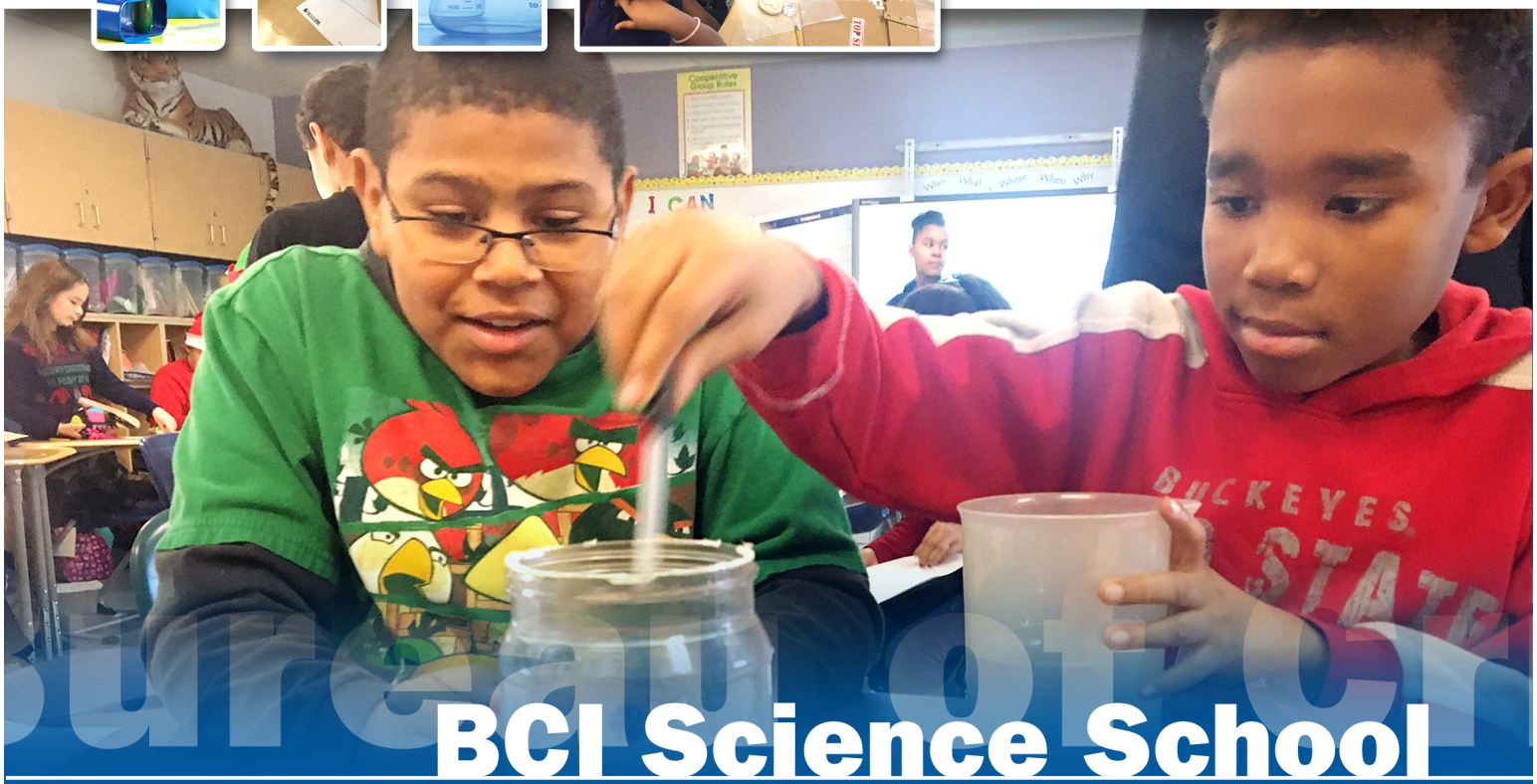
Protecting Ohio's Families

BCI Science School

A 4th grade STEAM curriculum using problem-based learning to explore the fields of investigations and forensics.



BCI Science School

Teacher Resource Guide

MIKE DEWINE
OHIO ATTORNEY GENERAL

OHIO ATTORNEY GENERAL'S
BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

MIKE DEWINE
OHIO ATTORNEY GENERAL

OHIO ATTORNEY GENERAL'S
BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Welcome to the Ohio Attorney General's Bureau of Criminal Investigation (BCI) Science School!

We are glad you are choosing to use the BCI Science School curriculum with your students. We created BCI Science School so students could learn about the fields of forensic science, criminal investigation, and related careers. As you know, these fields rely heavily on the STEAM (Science, Technology, Engineering, Arts, and Mathematics) disciplines, and our goal is to make these areas of learning exciting and engaging for students at an early age.

With a STEAM-based curriculum, BCI Science School includes 26 lesson plans for fourth graders, using hands-on experiments and inquiry-based learning to help solve fictional crimes. The interdisciplinary curriculum focuses specifically on the Ohio Department of Education (ODE) fourth grade standards. Most lesson plans include short videos of BCI forensic scientists and BCI special agents (investigators), which allow us to "take" students into the laboratory and into the field.

We strongly encourage you to preview the curriculum, crime scene overview, lesson plans, and videos before using BCI Science School in your classroom to understand what each lesson involves. The curriculum uses supplies and materials that should be readily accessible or easy to obtain at your school or home. Lessons that require supplies that may be more expensive or difficult to find are marked as optional.

Please feel free to modify your implementation of the curriculum, taking your classroom structure, resources, and student needs into account. For example, some teachers complete one lesson every day and some teachers opt for one lesson every week. While the curriculum was developed for the fourth grade classroom environment, BCI Science School could easily be adapted for after-school programs, summer camps, and homeschool settings.

Thank you for using BCI Science School in your classroom. We hope your students become excited about science, technology, engineering, arts, and mathematics with our curriculum and that they are exposed to potential careers and opportunities to pursue in the future!

Very respectfully yours,

Mike DeWine
Ohio Attorney General

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Table of Contents

BCI Science School Scenario Overview for Teacher's Knowledge

One morning, farmer Bob Agriculture is investigating erosion on one of his large farms. Suddenly the ground below him collapses into a sinkhole. Bob falls in and strikes his head on a large rock, knocking him unconscious. Farmer Bob's wife, Terra Agriculture, reports him missing to the police later that weekend, when she returns home from visiting their out-of-town grandchildren. Terra is concerned about her husband's disappearance for a number of reasons:

- Bob isn't home or responding to her calls/texts to his cellphone, which he always has on him.
- She notices someone broke into the barn.
- Some chemicals and fertilizer Bob uses on the farm are missing.
- Buckeye the dog is missing.
- There is a note taped to their barn window from a "concerned citizen" threatening Bob regarding the use of fertilizers and chemicals on the farm.

Students will first serve as investigators to try to locate Bob and then as forensic scientist analyzing evidence collected at the crime scenes. Was it an accident, or did someone strike Farmer Bob with a rock or some other item, causing him to fall into the sinkhole? What could be the motive behind this type of crime? Who could be suspects? Farmer Bob eventually wakes up, but he has lost his short-term memory and has trouble remembering how he ended up in the sinkhole. Students will use techniques similar to those used by BCI's special agents — such as thermal imaging, GPS coordinates, crime scene documentation, and cellphone record analysis — to locate Farmer Bob. Students will then use techniques similar to those used by BCI's forensic scientists to determine what happened to Farmer Bob and his barn, such as latent print comparison, footwear comparison, toolmark analysis, handwriting analysis, principles of chromatography, principles of the scientific method, and DNA analysis.

Potential Suspects:
"Ashe" Ball — She is a neighbor who hates Bob's noisy dog, Buckeye. The dog interrupts her concentration while she is working from home, and he has ruined her flowerbed a number of times. After repeated attempts to try and politely get Bob to quiet and contain his dog, she threatens via text messages to "take matters into her own hands."

Juanto Buy — He is a neighbor who really wants to buy some of Bob's farmland and has been pressuring Bob to sell it. However, Bob doesn't want to sell. This has caused tension between the two men. Juanto has also started dating Mya Agriculture.

Organic Joe — He is a neighbor who doesn't like that Bob uses chemicals and fertilizers on his crops, which he thinks are causing algal blooms in the lake adjacent to both of their properties. Organic Joe has held repeated peaceful protests outside Bob's farm.

Mya Agriculture — She is Bob's sister and strongly believes all the farmland from their deceased father should be hers. She is currently in a legal dispute with her brother, Bob. She has also started dating Juanto Buy.

Who committed the crime? All evidence will eventually lead to Juanto Buy!

Lesson Plan Overview for Teachers

	Lesson Overview/Content Introduced:	Activity Masters and Teacher Resources for Lesson:	Video Clips Corresponding to Lesson:	Materials Needed for Each Lesson:
Lesson One: Writing a Summative Paragraph	Students will be introduced to the Ohio Attorney General's Bureau of Criminal Investigation and the two potential crimes reflected in BCI Science School. Students will learn to identify and describe the components of a paragraph (e.g., main idea/topic sentence, supporting details, and concluding sentence). Students will also read a brief description about forensic scientists and criminal investigators. They will focus on one of these professions and write a paragraph summarizing the profession. Approximate time: 50 minutes Main Content Area focus: English Language Arts (see Lesson Plan for ODE standards)	Activity Masters 1, 2, 3, 4, and 5	Video Clip 1 — *Welcome to BCI* (1:29) Video Clip 2 — *The Case* (1:26)	□ Pencil □ Copies of Activity Masters 1, 2, 3, and 4 (one copy per student) □ Copy of Activity Master 5 to place in common area of the room (only one copy) □ Science notebook or journal (to store information about the case) □ Glue sticks (to add information to science notebook/journal) □ Equipment for projecting video clips
Lesson Two: Reading for a Purpose	Students should always figure out what their purpose for reading a text is beforehand, so that they can pay specific attention to those details in the text. Students will also learn to review comprehension questions and short-answer extended-response prompts, before they read text passages, as a good test-taking skill. By reading Chris	Activity Master 6		□ Materials Needed □ Pencil □ Markers or highlighters (two different colors) □ Copies of Activity Master 6 (one copy per student) □ Interactive white board, ELMO, or overhead projector (with transparency of Activity Master

	Tovani's excerpt, students will begin to understand reading for purpose. They will also use this skill as they comb through information and review evidence from these two potential crimes. Approximate time: 50 minutes Main Content Area focus: English Language Arts (see Lesson Plan for ODE standards)			6) and overhead pens of different colors
Lesson Three: Using a Map	Students will be introduced to the BCI Cyber Crimes Unit as they help determine where Bob is located through cellphone records. Students will use cardinal and intermediate directions to navigate and find locations and landforms on a map, as well as map legends and scales. Approximate time: 50 minutes Main Content Area focus: Social Studies and Mathematics (see Lesson Plan for ODE standards)	Activity Masters 7 and 8	Video Clip 3 — *Cell Phone Pinging* (1:42)	□ Pencil □ Internet connection to connect to National Geographic's interactive map at http://nationalgeographic.org/maps/ohio-tabletop-map/ □ Copies of Activity Masters 7 and 8 (one copy per student) □ Science and/or social studies notebook or journal (to store information about the case) □ Glue sticks (to add information to science/social studies journal notebook/journal) □ Ruler (one/student) □ Equipment to project video clip □ Interactive white board, ELMO, or overhead projector and overhead pens of different colors

Lesson Four: Heat Energy Science Experiment	Students will review the concept of insulation. Then, students will take part in an inquiry-based science experiment on thermal energy using an ice cube or popsicle (left to teacher discretion) and various materials to try to slow down the melting of one of those items. Approximate time: 50 minutes Main Content Area focus: Science (see Lesson Plan for ODE standards)	Activity Master 9	Video Clip 4 — *Thermal Energy* (5:15)	□ Foil □ Packing peanuts □ Newspaper □ Plastic wrap □ Bubble Wrap □ Paper towels □ Scraps of fabric □ Other useful "junk" for possible insulation □ Tape □ Two Popsicles or ice cubes (teachers discretion)/group of three □ Heat source (sun, heater, candle) □ Copies of Activity Master 9 (one copy per student) □ Glue stick □ Science journals □ Pencil □ Colored pencils □ Timers □ Equipment to project video clips
Lesson Five: Thermal (Heat) Energy	Students will read an informational text on thermal/heat energy. Then they will answer comprehension questions based on the text passage. Approximate time: 50 minutes Main Content Area focus: Language Arts and Science (see Lesson Plan for ODE standards)	Activity Master 10	Video Clip 5 — *Thermal Energy Detection* (1:30) Video Clip 6 — *Locating Bob* (0:43)	□ Pencil □ Equipment to project video clips □ Copies of Activity Master 10 (one copy per student)

Lesson Six: Erosion, Deposition, and Weathering	Students will gain a deeper understanding of how the processes of erosion, deposition, and weathering take place. Students will observe a demonstration of these concepts on Video Clip 7 — Erosion, Deposition, and Weathering and complete an experiment where they create a pre-glaciated topographic map of Ohio out of clay (which may be done in conjunction with the art teacher), and then have a melting glacier (ice cube with gravel) travel across the clay map, simulating how parts of Ohio's current landscape were formed. Next, they will classify landforms that were created and use linear measurement of the grooves to make scientific observations and conclusions based on their experiment, on Activity Master 11. Approximate time: 50 minutes Main Content Area focus: Science and Mathematics (see Lesson Plan for ODE standards)	Activity Masters 11, 12, and 13	Video Clip 7 — *Erosion, Deposition, and Weathering* (4:18)	□ Copies of Activity Master 11 (one copy per student) □ Copies of Activity Masters 12 and 13 (one copy per small group) □ One rectangular clay piece (Crayola works well if freshly unwrapped)/group of three students, about eight or nine clay sticks depending on class size □ One "glacier" ice cube/group of three students, about eight or nine per class □ One reusable plastic or aluminum container to use when creating clay topographic map of Ohio/group of three students, about eight or nine depending on class size □ Student science journals □ Pencil □ Colored pencils (if teacher prefers, for illustrating science journal) □ Ruler □ Scissors □ Glue stick □ Gravel, sediment, and sand □ Ice cube trays □ Water source □ Freezer □ One "Exit Ticket" per student □ Equipment for projecting videos

Lesson Seven: Erosion, Deposition, and Weathering Text	Students will review the concepts of erosion, deposition, and weathering. The students will then read informational texts about erosion, deposition, and weathering and answer extended response questions about these concepts. Approximate time: 50 minutes Main Content Area focus: English Language Arts and Science (see Lesson Plan for ODE standards)	Activity Master 14		□ Copies of Activity Master 14 (one copy per student) □ Student science journals □ Pencil □ Glue sticks
Lesson Eight: Sinkhole Simulation	Students will learn how erosion can lead to sinkhole formation. The students will conduct a sinkhole simulation to see if Farmer Bob could have fallen into the sinkhole accidentally. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Master 15	Video Clip 8 — *Sinkholes* (1:57)	□ Copies of Activity Master 15 (one copy per student) □ Graham crackers (about one box) □ Sugar cubes □ Eight or nine empty glass jars (spaghetti sauce-size), depending on class size □ Eight or nine Lego people, depending on class size □ Eight or nine turkey basters (graduated cylinders with spouts/measuring cups would also work for pouring the water slowly out of containers) □ Science journals □ Pencil □ Colored pencils □ Glue stick □ Equipment to project video clip

Lesson Nine: Sinkhole Informational Text	Students will read an informational text on sinkholes. Then they will create, below the text passage, a description of how sinkholes form. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Master 16		□ Copies of Activity Master 16 (one copy per student) □ Pencil
Lesson Ten: Suspect Introduction and Area Map Study	Students will be introduced to the four suspects of this case that police identified based on Bob's historical cellphone records and interviews with Bob's family and neighbors, and they will take part in a Google Earth lesson based on those records and interviews. Approximate time: 50 minutes Main Content Area Focus: Math, Social Studies, and English Language Arts (see Lesson Plan for ODE standards	Activity Masters 17, 18, and 19, and 22 Lesson 10 Teacher Resource (cell sector drawing instructions)	Video Clip 9 — *Historic Cell Records* (4:27)	□ Copies of Activity Masters 17, 18, and 19, and 22 (one copy per student) □ Glue stick □ Science journals □ Pencil □ Rulers □ Protractors □ Highlighters □ Equipment to Project video clip and Google Earth activity
Lesson Eleven: Timelines	Students will analyze the historic cellphone records of Bob Agriculture and Juanto Buy, and develop a timeline based on Juanto Buy's location during the timeframe of Bob's barn being broken into and having the chemicals and fertilizer stolen.	Activity Masters 20, 21, 22 (from Lesson 10), 23, and 24	Video Clip 10 – *Timeline* (1:59)	□ Copies of Activity Masters 20, 21, 22, 23, and 24 (one copy per student) □ Students' copies of Activity Master 17 from Lesson 10 (Suspect Sheets) □ Glue sticks □ Science journals □ Pencil

	Approximate time: 50 minutes Main Content Area Focus: Social Studies and English Language Arts (see Lesson Plan for ODE standards)			□ Rulers □ Equipment to project video clip
Lesson Twelve: Crime Scene	Students will take part in a few observation activities, look at pictures of the crime scene, and document their observations and questions. Approximate time: 50 minutes Main Content Area Focus: Science (see Lesson Plan for ODE standards)	Activity Master 25	Video Clip 11 — *Crime Scene* (1:13)	□ Copy of Activity Master 25 (one set per classroom, to be placed on bulletin board) □ Glue stick □ Science journals □ Paper for sketch and observation of crime and suspect □ Pencil □ Colored pencils □ Equipment to project video clip □ Interactive white board, ELMO, or overhead projector to display photos from Activity Master 25 □ One exit ticket per student □ Super glue □ One zip lock bag □ One plastic 8 oz. clear cup
Lesson Thirteen: Optional – Algae Blooms	(Optional Lesson) Students will take part in a scientific experiment involving the creation of an algae (or algal) bloom. This will be an ongoing experiment that they check every day for a few minutes to take measurements and observe changes. This is tied to the case because Organic Joe's possible	Activity Masters 26 and 27		□ Pencil □ Glue stick □ Science journals □ Copies of Activity Masters 26 and 27 (one copy per student) □ Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different

	motive to break into Bob's barn would be because he believes Bob's use of fertilizers on his farm causes algae blooms in the adjacent waterways.			colors □ Four glass jars, spaghetti sauce-sized (Possibly reuse the sinkhole experiment jars) Note: If you have enough supplies, the students could do this activity in small groups. □ OPTIONAL — One aquarium water- quality test kit — or a kit that tests for pH, phosphate level, dissolved oxygen (enough to test both sets of water for at least 10 days) Note: The kits can be expensive and have to be used only by the teacher and with care because the chemicals can be harmful. □ Thermometer to measure water temperature □ Microscope and slides and coverslips, if available □ Magnifying glasses □ One bottle of liquid plant food □ Source of heat (sunlight in windowsill works well) □ Algae from freshwater pond or lake □ Distilled or bottled water (at least 40 ounces/ 10 per jar) □ Pipette or eyedropper
Lesson Fourteen: Latent Prints	Students will learn more about how forensic scientists in the Latent Print Unit of BCI use fingerprints and palm prints found at crime scenes to help link suspects to the crime.	Activity Masters 28 and 29	Video Clip 12 — *Fingerprints* (1:59) Video Clip 13 — *Fingerprints Conclusion* (0:18)	□ Pencil □ Highlighter □ Glue stick □ Science journals □ Copies of Activity Masters 28

	Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)			and 29 (one copy per student) □ Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters 28, 29) and overhead pens of different colors □ Equipment to project Video Clip 12 — Fingerprints and Video Clip 13 — Results □ Magnifying glasses are optional, but recommended
Lesson Fifteen: Optional Lesson: Latent Prints - A Closer Look	Students will learn more about how forensic scientists in the Latent Print Unit of BCI use fingerprints and palm prints found at crime scenes to help link suspects to the crime. Approximate time: 50 minutes Main Content Area Focus: Science (see Lesson Plan for ODE standards)	Activity Master 30		□ Pencil □ Highlighter □ Glue stick □ Seven rolls of scotch tape □ Science journals □ Copies of Activity Master 30 (one copy per student) □ Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters 30) and overhead pens of different colors □ Plastic cup in bag that was "fumed" previously □ Paper towels □ Scrap paper (for creating graphite patch to make fingerprints) □ Magnifying glasses (optional, but recommended) □ One exit ticket per student
Lesson Sixteen: DNA Introduction	Students will learn more about how forensic scientists in the DNA Unit of BCI test DNA found at crime scenes to help link suspects to the crime.	Activity Masters 31 and 32	Video Clip 14 — *DNA Testing* (5:10)	□ Make copies of Activity Masters 31 and 32 (one copy per student) □ Pencil

	They will watch a segment of the movie Jurassic Park illustrating how DNA works. Then, they will compare the suspects' DNA to the DNA found on the envelope left at the crime scene. Finally, they will read an article together as a class from the HowStuffWorks website to determine whether they can find evidence to support the ability to clone dinosaurs using fossilized DNA, or that refutes or proves it is impossible to get/obtain dinosaur DNA. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)			□ Highlighter (optional) – students can underline instead □ Science journals and/or reading/writing journals □ Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters and overhead pens of different colors □ Equipment to project video clip
Lesson Seventeen: Fossil Molds and Casts	Students will learn how fossils can be compared to one another and to present-day organisms. Students will also make a fossil mold and a fossil cast. Approximate time: 60 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Masters 33 and 34		□ Copies of Activity Masters 33 and 34 (one copy per student) □ Pencil □ Science journals □ Magnifying glasses (optional) □ One seashell, twig, or other small object (plastic insect) per student or group □ About ¼ to ½ cup plaster of Paris/student or small group, about 3½ to 4 cups total □ Seven or eight small margarine dishes

				□ Seven or eight plastic forks □ About ¼ to ½ cup of water per student or small group □ Tub of petroleum jelly □ Seven or eight paper cups □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 33 and 34) and overhead pens
Lesson Eighteen: Handwriting Analysis	Students will learn more about how forensic scientists in the Questioned Documents Unit of BCI use handwriting analysis to help link suspects to the crime. Approximate time: 70 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Masters 34 Activity Masters 34 (from Lesson 17), 35 and 36	Video Clip 15 – "Handwriting" Video Clip 15 — *Handwriting* (1:34) Video Clip 16 — *Handwriting Results* (1:32) Activity Masters 34 (from Lesson 17), 35 and 36	□ Pencil □ Glue sticks □ Science journals □ Colored pencils or crayon, one/student □ Copies of Activity Masters 34, 35 and 36 (one copy per student) □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different colors □ Equipment to project video clips □ Magnifying glasses (optional)
Lesson Nineteen: Optional – Handwriting Identification	Students will learn more about how forensic scientists in the Questioned Documents Unit of BCI use handwriting analysis and the examination of imprints/indentations to link suspects to the crime. Approximate time: 50 minutes Main Content Area Focus: Science (see Lesson Plan for ODE standards)			□ One exit ticket per student □ Pencil □ Glue stick □ Science journals □ Colored pencils or crayon, one/student □ Magnifying glasses (optional)

Lesson Twenty: Chemistry	Students will learn more about how forensic scientists in the Chemistry Unit of BCI use chromatography to help them link the ink found on the threatening note to ink from one of the ink pens found at the suspects' homes. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Masters 37 and 38	Video Clip 17 — *Chromatography* (1:18) Video Clip 18 — *Chromatography Results* (0:28)	□ Pencil □ Glue Stick □ Science journal □ Pencils upon which to tape paper towel strips containing ink dots/group of four students, so about six to eight depending on class size □ Black pens for chromatography experiment (have paper towel strips cut, dotted, and labeled prior to the lesson) □ One Zebra fine-point gel pen (label as Pen #1) □ One Optiflow fine-point pen (label as Pen #2) Note: Students will eventually discover that this is Juanto Buy's pen, which was used to write the threatening note to Bob. □ One Bic Mark-it ultrafine-point pen (label as Pen #3) □ One Sharpie fine-point pen (label as Pen #4) Note: These are the pens used in the video. You can do this as a demonstration to save on materials, but it would be more powerful to have students do this in small groups. Regardless, you only need one set of pens for this experiment. □ One pair of scissors for teacher to cut paper towel strips □ Plastic cups for chromatography experiment (clear 8 oz. ones

				work well) one cup/group (so about six to eight if you have a class you are dividing into groups of four) □ Water source □ Scotch tape □ Quality paper towels (Bounty) □ □ Copies of Activity Masters 37 and 38 (one copy per student) □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 37 and 38) and overhead pens of different colors □ Equipment to project video clips
Lesson Twenty-one: Trace Evidence	Students will learn more about how forensic scientists in the Trace Evidence Unit of BCI analyze and examine evidence found at crime scenes. In the Trace Evidence section, forensic scientists examine microscopic evidence, in the effort to discover how a suspect, victim, and crime scene were in contact with one another. The scientists in this unit examine glass, fibers, paint, shoe prints, tire tracks, fracture matches, and other miscellaneous items that may be found in relation to a crime. Today, students will learn specifically about fracture matches and how they are used to link suspects to crime scenes.	Activity Masters 39 and 40	Video Clip 19 — *Fracture Match* (5:24) Video Clip 20 — *Fracture Match Results* (0:27)	□ Copies of Activity Masters 39 and 40 (one copy per student) □ Pencil □ Highlighter (optional) — students can underline instead □ Science journals □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 39 and 40) and overhead pens □ Equipment to project video clip

	Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)			
Lesson Twenty-two: Trace Evidence	Students will learn more about how forensic scientists in the Trace Unit of BCI test shoeprints found at crime scenes to help link suspects to the crime. First, they will watch Video Clip 21 — Shoeprint. Then, the students will use the "top possible matches" on Activity Master 41 that Suzanne received from her computer search to see if there is a match to the shoeprint found at the barn crime scene. Next, students will watch Video Clip 22 — Shoeprint Results and conclude that shoeprint No. 3 was a match. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)	Activity Master 41	Video Clip 21 — *Shoeprint* (2:04) Video Clip 22 — *Shoeprint Results* (0:57)	□ Copies of Activity Master 41 (one copy per student) □ Piece of scrap paper large enough for each student's shoeprint □ Science journals □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different colors □ Equipment to project video clips
Lesson Twenty-three: Toolmarks	Students will learn more about how forensic scientists in the Firearms and Toolmarks Unit of BCI study clues left at crime scenes. In this unit, the scientists examine all types	Activity Master 42	Video Clip 23 — *Toolmarks* (1:18)	□ Copies of Activity Master 42 (one copy per student) □ Pencil □ Science journals and/or

	of guns, knives, and other tools used in crimes. The scientists examine fired cartridge cases and fired bullets to look for small markings on bullets and cartridge cases through a microscope. These forensic scientists also study tools that are used in crimes, such as crowbars, to look for marks that match the tool and the markings left at the crime scene. First, students will watch Video Clip 23 — Toolmarks. Then, students will take part in an activity where they work in small groups comparing marks made by different screwdrivers to see how each tool leaves a unique set of marks or imprints. Approximate time: 50 minutes Main Content Area Focus: Science and Mathematics (see Lesson Plan for ODE standards)			reading/writing journals □ Silly Putty (the type used in occupational and physical therapy), about 1 oz./small group of students (about 8-10 oz. total, depending on class size) □ Ruler (with metric system) □ Seven regular screwdrivers (each labeled with tape and a number to keep students' records accurate) □ Magnifying glasses (optional) □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Master 42) and overhead pens □ Equipment to project video clip
Lesson Twenty-four: Fossil Imprints and Clues	Students will read "How Fossils Work, an article projected on the interactive whiteboard or overhead from the HowStuffWorks website. This article explains how fossils tell a story, just like the clues at the scene of the crime. Then students can make their own fossil imprints, comparing that to both the use of impressions in the Firearms and Toolmarks Unit of BCI and to the	Activity Master 43		□ Copies of Activity Master 43 (one copy per student) □ Pencil □ Science journals □ Waxed paper (one container) □ Metric ruler □ Rolling pins (optional — students can use a book or their hand to make indentations) □ White Sculpey clay, enough for

	shoeprint casts that crime scene investigators made of the shoeprint in this case. Approximate time: 50 minutes Main Content Area Focus: Science and English Language Arts (see Lesson Plan for ODE standards)			each student group to have about 4 ounces □ Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters for Day 14) and overhead pens of different colors □ Have students collect (or the teacher can supply) a variety of leaves, seashells, bones, plastic dinosaurs, stems, etc. □ Magnifying glasses (optional)
Lesson Twenty-five: Case Conclusion	Students will watch Video Clip 24 — Conclusion and will verify that all the evidence from the investigation leads to Juanto Buy. Students will learn that Juanto Buy was arrested for breaking into Bob and Terra Agriculture's barn and stealing farm fertilizer and chemicals, as well as placing a threatening note on the barn window. Thankfully, Bob falling into the sinkhole was just an accident and nobody wished to hurt him. Students will then be given directions for an optional small group performance assessment project they will work on, part of which will be used to "help" the prosecuting attorneys prepare their case against Juanto Buy. Students will be asked to make visual aids and charts to help share the results of their investigation and testing of evidence.	Activity Master 44 and 45	Video Clip 24 — *Conclusion* (1:31)	□ Copies of Activity Master 44 and 45 (one copy per student) – OPTIONAL Project □ Pencil □ Science journal □ interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Master 44) and overhead pens □ Equipment to project video clips

	Approximate time: 50 minutes Main Content Area Focus: All (see Lesson Plan for ODE standards)			
Lesson Twenty-six: Thank You	Students will watch Video Clip 25 — Thank You and complete the content area-based assessment. If they have time after they finish taking their assessment, and you've opted to have the students participate in the small group performance assessment project, then students will work on the product they had approved by you for the remainder of the class period. Approximate time: 60 minutes Main Content Area Focus: All (see Lesson Plan for ODE standards)	Activity Master 45 (Content Area Assessment)	Video Clip 25 — *Thank You* (0:38)	□ Copies of Activity Master 45 Content Area Assessment (one copy per student) □ Pencil □ Materials needed if you are doing the final small group performance assessment project (optional) □ Equipment to project video clips

BCI Science School Master Supply List

- □ Pencil
- □ Copies of Activity Masters
- □ Science notebook or journal (to store information about the case)
- □ Glue stick (one per student)
- □ Equipment to project video clips
- □ Interactive Whiteboard, ELMO, or overhead projector
- □ Markers
- □ Highlighters
- □ Colored Pencils
- □ Internet connection
- □ Ruler (one per student)
- □ Aluminum foil
- □ Packing peanuts
- □ Newspaper
- □ Plastic wrap
- □ Bubble wrap
- □ Paper towels
- □ Scraps of fabric
- □ Other useful "junk" for possible insulation
- □ Tape (various types – duct, masking, etc.)
- □ Popsicles or ice cubes
- □ Heat source (sun, heater, candle)
- □ Eight to nine pieces of rectangular prism clay piece (Crayola works well if freshly unwrapped)
- □ "Glacier" ice cubes (to be made by the teachers – instructions in lesson plan)
- □ Eight to nine reusable plastic or aluminum container to use when creating clay topographic map
- □ Scissors
- □ Gravel, sediment, and sand (to make glacier ice cubes)
- □ Ice cube trays
- □ Water source
- □ Freezer
- □ Graham crackers (approximately one box)
- □ Sugar cubes
- □ Eight or nine empty glass jars (spaghetti sauce size work well), depending on class size
- □ Eight or nine Lego people, depending on class size
- □ Eight or nine turkey basters ideally (graduated cylinders with spouts/measuring cups would also work when pouring the water slowly out of those types of containers)
- □ OPTIONAL: liquid metric measurement instruments (i.e. graduated cylinder, eye dropper, etc. to measure melted liquid of control and ice cube.
- □ Protractors
- □ Super glue
- □ One zip lock bag
- □ One plastic 8 oz. clear cup (works best, but you could try a water bottle)
- □ Rubber gloves (school nurse/clinic might have extra set)
- □ OPTIONAL – one Aquarium/Water Quality Test Kit – or a kit that tests for pH, phosphate level, dissolved oxygen, enough to test both sets of water for at least 10 days) **NOTE:** These kits can be very pricey and have to be used with care because the chemicals are harmful. Read the labels carefully and use according to package directions. Children and pregnant individuals should not use the kit. You can use these kits again for a few years, but they should only be used by the teacher, carefully following the specific directions.
- □ Thermometer to measure water temperature

- □ Microscope and slides and coverslips, if available (for optional algae bloom experiment)
- □ Magnifying glasses
- □ One bottle of liquid plant food (for optional algae bloom experiment)
- □ Algae source from freshwater pond or lake (for optional algae bloom experiment)
- □ Distilled or bottled water (at least 40 ounces total – 10 oz. per jar) - (for optional algae bloom experiment)
- □ Pipette or eye dropper - (for optional algae bloom experiment)
- □ paper towels (high quality)
- □ Seven rolls of scotch tape
- □ Scrap paper
- □ One sea shell, twig, or other small object (plastic insect) per student or small group
- □ ¼ to ½ cup Plaster of Paris/student or small group, approximately 3 ½ - 4 cups total
- □ Seven or eight small, disposable plastic dishes or cups (margarine tubs work well)
- □ Seven or eight plastic forks
- □ ¼ to ½ cup of water/student or small group
- □ Tub of petroleum jelly
- □ Seven or eight paper cups, depending on how many groups you will have
- □ Pencils to tape paper towel strips onto (which contain ink dots) – one pencil per group of four
- □ Pens for chromatography experiment – all black in color (have paper towel strips cut and doted, and labeled prior to the lesson)
    - One, Zebra fine point gel pen (label as Pen #1)
    - One, Optiflow fine point pen (label as Pen #2)
    - One, BIC Mark-it ultra fine (label as Pen #3)
    - One, Sharpie fine point (label as Pen #4) – (These are the pens we use in the video. You can do this as a demonstration to save on materials, but it would be more powerful to have students do this in small groups. Regardless, you only need one set of pens for this experiment.)
- □ Silly Puddy (the type used in occupational and physical therapy), around 1 oz./small group of students (approximately 8-10 oz. total, depending on class size
- □ Ruler (with metric system)
- □ Seven regular screw drivers (each labeled with tape and a number to keep students records accurate, and organized properly).
- □ Rolling pins (optional – students can use a book or their hand to make indentations if needed)
- □ White Sculpy clay, enough for each student group to have about 4 oz.
- □ A variety of leaves, sea shells, bones, plastic dinosaurs, stems, etc.

Science School Teacher's Cell Sector Drawing Instructions

Google Earth Pro Download:

- Download Google Earth Pro (https://www.google.com/earth/download/gep/agree.html).
- License are free. The username is your email address and the license code is GEPFREE.
- School use and public display are all permitted as long as the copyright is visible on the bottom of the screen.

Interpreting Cell Records:

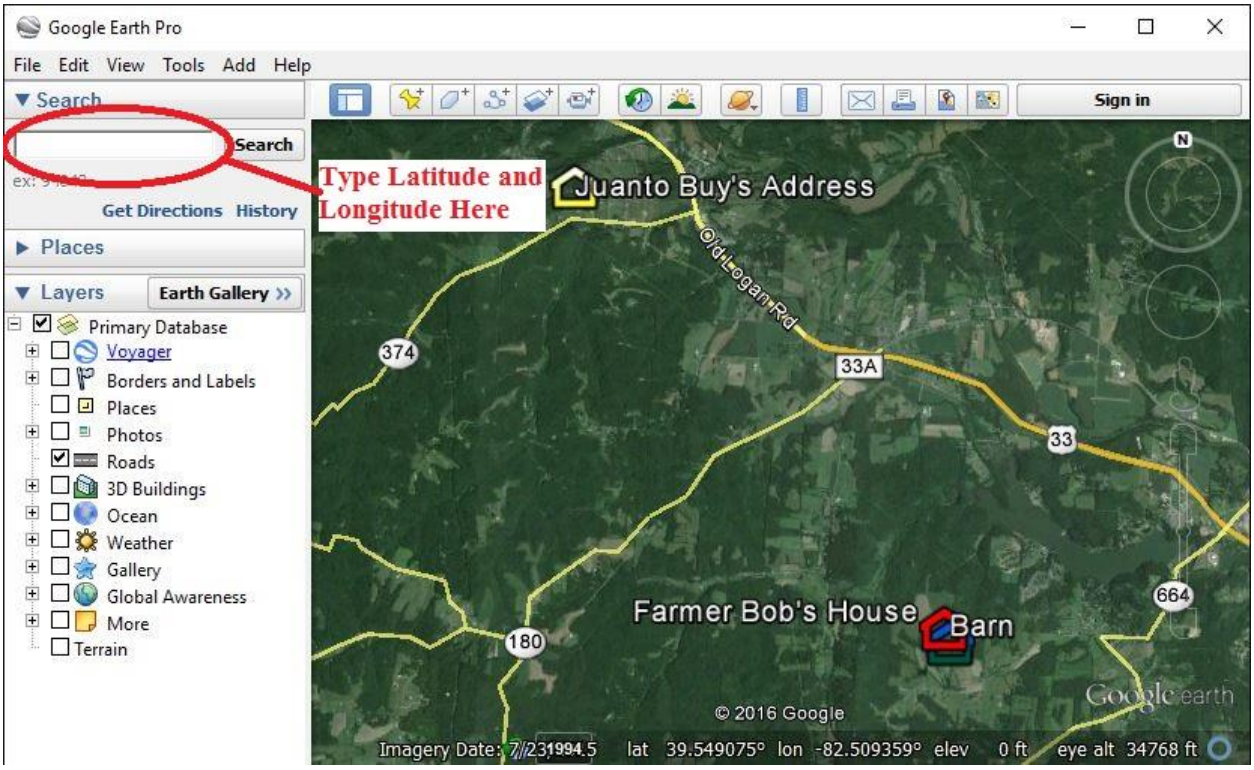
	A	B	C	D	E	F	G	H	I	J
1	Date	Time (EST)	Calling Number	Called Number	Incoming/ Outgoing	Duration of Call (seconds)	Type	Tower Location	Sector Azimuth	Content
2	10/23	2217	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Hey! Hope you had a good day. I'm so tired. I
3	10/23	2218	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	I'll hav
4	10/23	2219	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	It got r Bob to
5	10/23	2220	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Anywa
6	10/23	2221	740-555-2757	513-555-9874	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Did yo
7	10/23	2222	513-555-9874	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Missed it!
8	10/23	2223	740-555-2757	513-555-9874	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	The refs are pathetic!
9	10/23	2224	513-555-9874	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Doesn't surprise me! They've been making bad
10	10/23	2230	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Hey there! I did have a good day, but it would have been better if I saw your pretty face.
11	10/23	2231	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Call me tomorrow. I'm curious what you are going to chat with Bob about, and btw I can go
12	10/23	2232	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Ok, goodnight
13	10/23	2330	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.526547, -8249895	90 Degrees	Night!
14	10/24	930	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Morning! If you are home, I'm going to head
15	10/24	932	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Yes, I'm home. Come on over. Already at Bob's
16	10/24	935	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	I want you to look at my car tire. I think I ran over a nail or something on the way to Bob's
17	10/24	938	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Oh no! I'll see you soon and can't wait to hear
18	10/24	2140	614-555-9314	740-555-2757	Incoming	240	Call	39.578745, -82.521130	270 Degrees	

Latitude and Longitude of Cell Tower

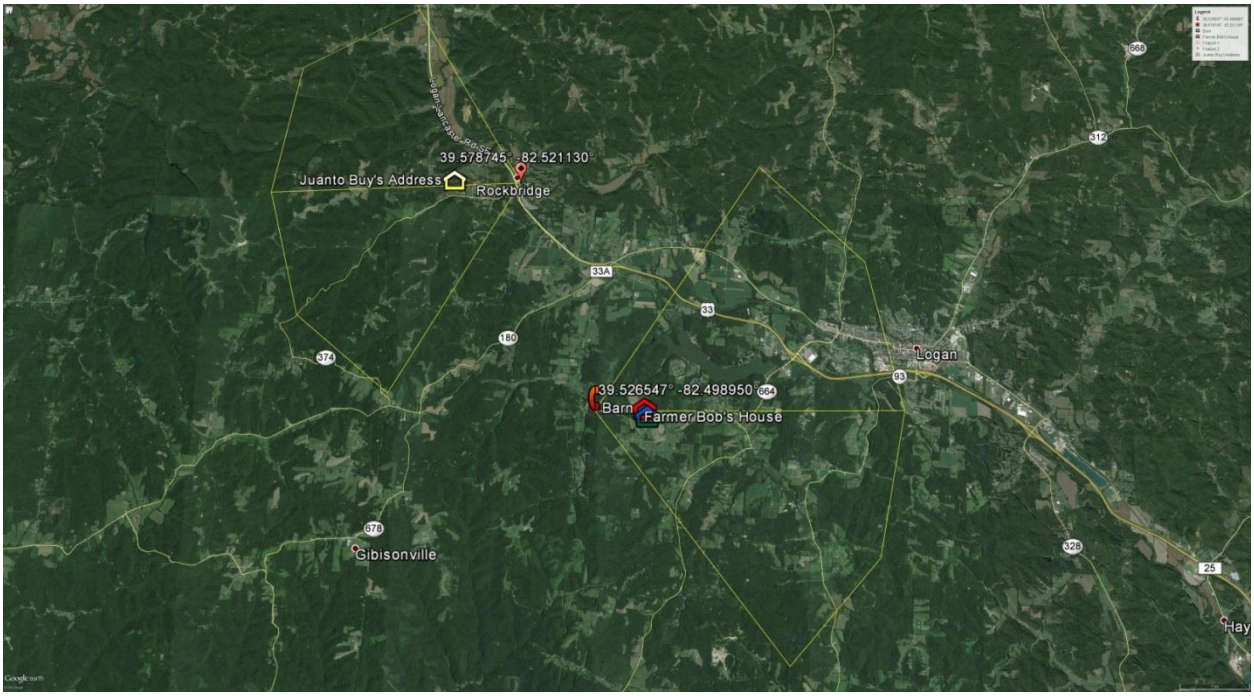
Compass bearing of center line of 120 degree cell sector which denotes direction from Cell Tower where cell phone was used.

Drawing Cell Sectors to Determine Cell Phone Usage Location:

- Open the file "**Science School Cell Map.kmz**" with Google Earth Pro. You will see the location of Juanto Buy's and Farmer Bob's Houses already plotted on the map. Project onto whiteboard.
- Refer to Juanto's Cell Record and take notice that there are only two different cell sectors in the record. One has a cell tower location of 39.578745 Latitude and -82.521130 Longitude and a sector azimuth of 270 degrees (due west). The other has a cell tower location of 39.526547 Latitude and -82.49895 Longitude and a sector azimuth of 90 degrees (due east). **Only Two Cell Tower Sectors Need to be Drawn to Represent All Record Entries.**
- Type the Latitude and Longitude for a specific record entry into the search bar at the top left of the Google Earth Pro window as designated below



- Next, zoom out the map so both Juanto Buy's and Farmer Bob's Houses are visible with plenty of room to draw the Cell Sectors on the board. Use a dry erase marker to draw a line to represent the Cell Sector Azimuth that is listed next to the Latitude and Longitude. The Azimuth will be either 90 degrees (due east) or 270 degrees (due west). The Azimuth denotes the centerline of the 120 degree cell sector. To draw the upper and lower boundaries of the cell sector, use a protractor to draw lines 60 degrees on either side of the Azimuth.
- Repeat procedure for the other Latitude, Longitude, and Azimuth. Finished product will resemble the map below with the exception that these sector lines were drawn on the map in yellow while yours will be drawn in marker on the white board the map is projected on:



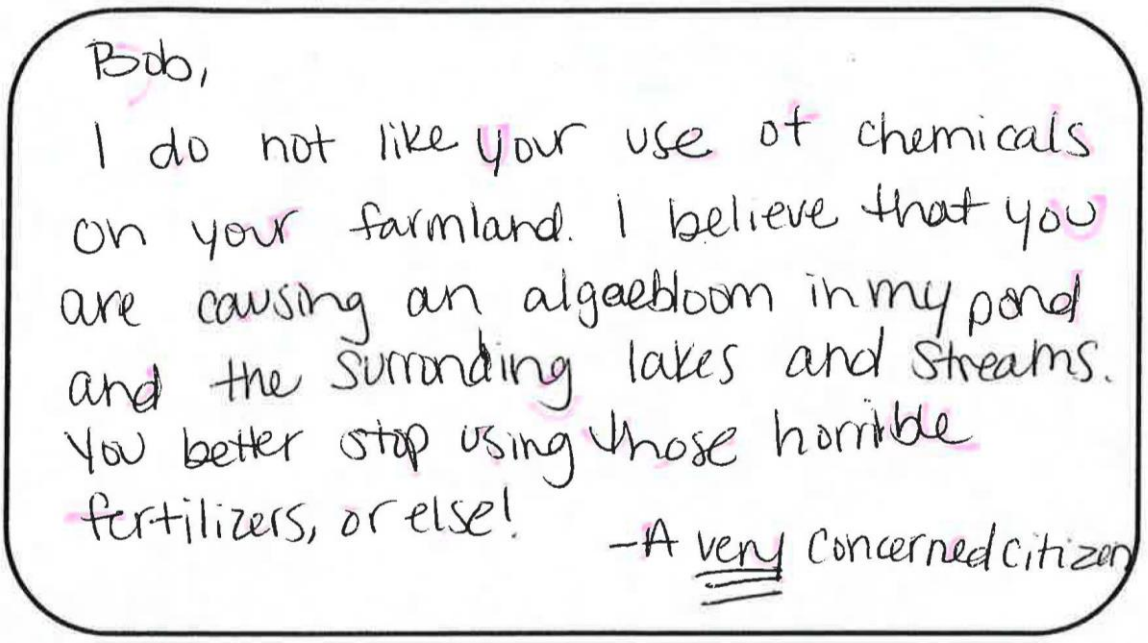
Alternate Methods of Demonstrating:

- Advanced classes may choose to allow students to read the Cell Records, plot the Tower Locations, and draw the Sectors.
- If technical difficulties or other circumstances make this demonstration too difficult, the grid map provided on the CD may be used to plot the location of the cell phone by advising the students the Cell Records provided grid coordinates corresponding to Juanto Buy's and Farmer Bob's residences respectively.

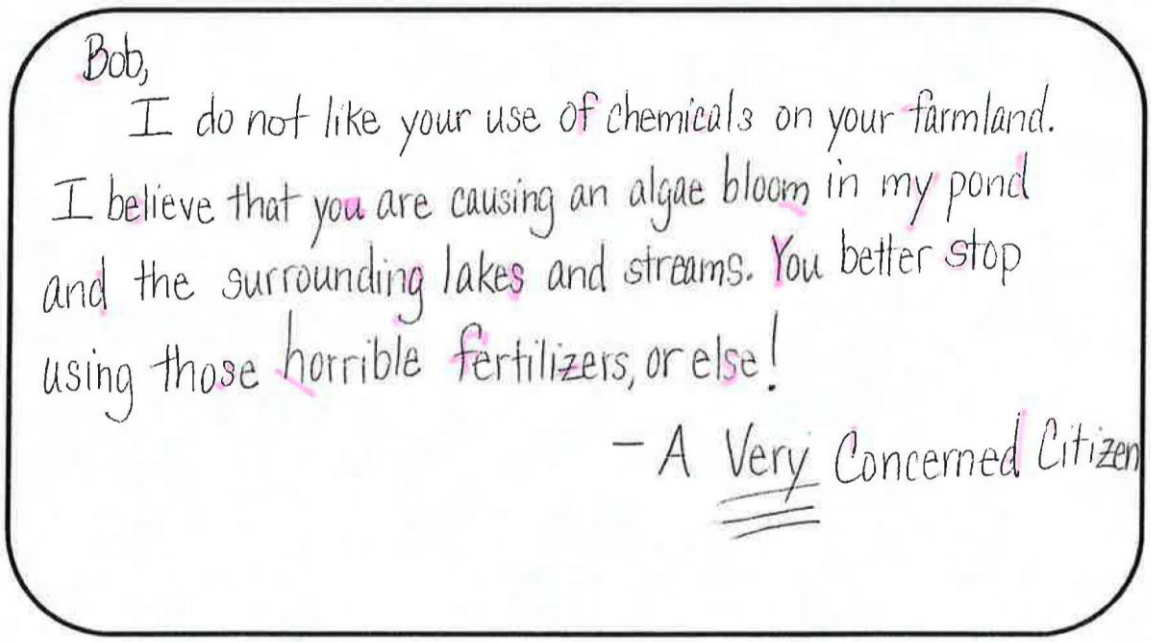
Teachers: The below handwriting samples have been highlighted by a BCI forensic scientist to show the elements of the suspects' handwriting that she found of note. You may find this helpful to guide you as you assist the students in comparing the handwriting samples.

Handwriting Samples

Mya Agriculture



Ashe Ball



Handwriting Samples

Robert (Bob) Agriculture

Bob,
I dont like your use of chemicals on your farmland, I Believe that you are causing an algaebloom in my Pond and the surrounding lakes and streams, you better Stop using those horrible fertilizers, or else!

- a Very Concerned Citizen

Juanto Buy

Bob,
I do not like your use of chemicals on your farmland. I believe that you are causing an algaebloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

—A Very Concerned Citizen

Handwriting Samples

Terra Agriculture

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

- A very concerned citizen

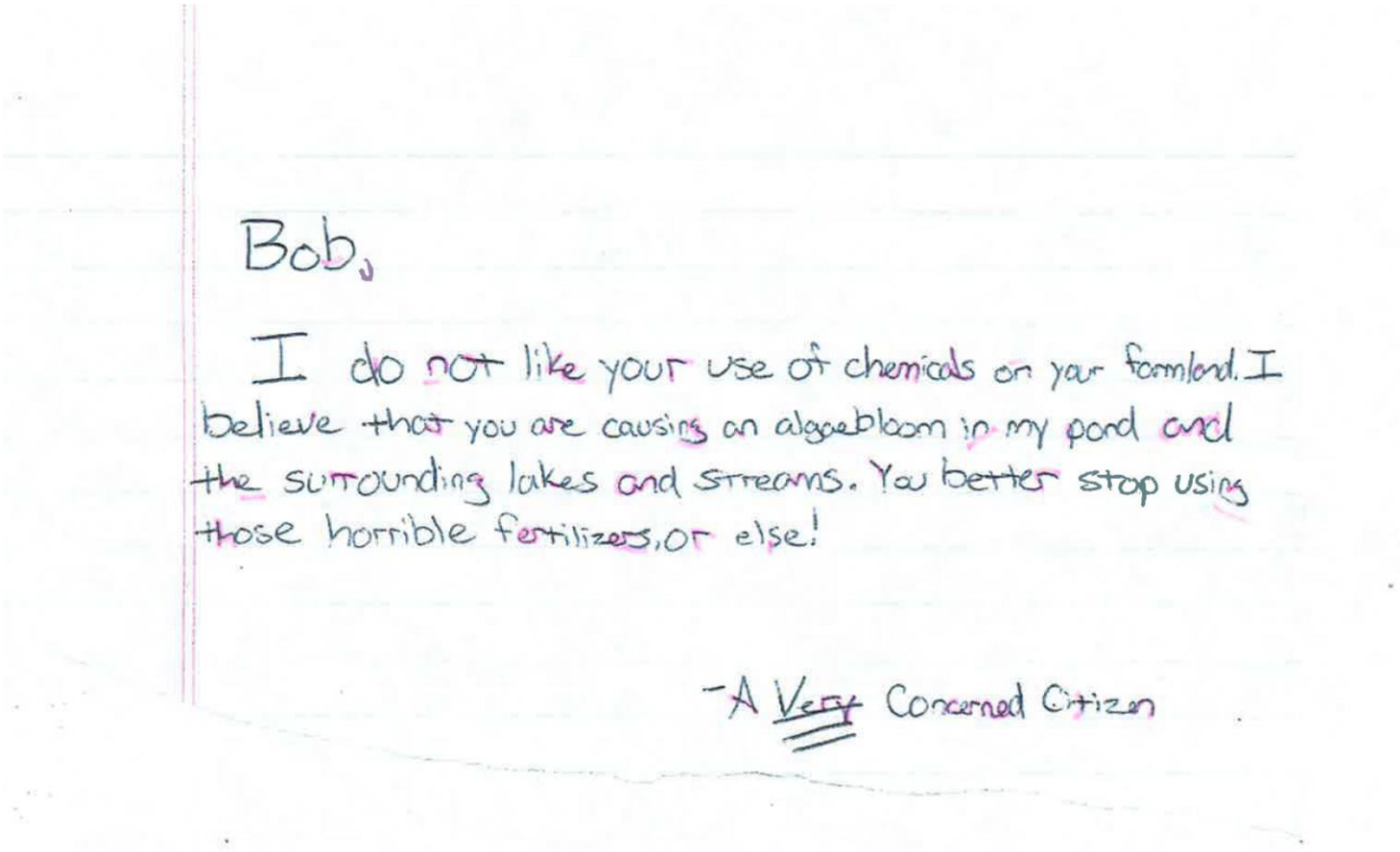
Organic Joe

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using these horrible fertilizers, or else!

- A very concerned citizen

Teachers: The below note has been highlighted by a BCI forensic scientist to show the elements of the handwriting that she found of note. You may find this helpful to guide you as you assist the students in comparing the handwriting samples.



Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

-A Very Concerned Citizen

Student Name:_____ Date:_____

Assessment Rubric for Activity Masters 2, 3, and 16 (Paragraph Writing)

Category:	4	3	2	1	No Score/0
Topic Sentence – Main Idea	Topic Sentence/Main Idea of paragraph is well-written and clearly stated.	Topic Sentence/Main Idea of paragraph is generally clear.	Topic Sentence/Main Idea of paragraph may be vague.	Topic Sentence/Main Idea of paragraph is unclear or confusing.	This code may be used for compositions that are entirely illegible or otherwise unable to be scored: blank responses, responses that are off-topic or incoherent, etc.
Supporting/Key Details	Supporting/key details of paragraph are related to and support the main idea/topic sentence.	Support information (supporting/key details) has minor weaknesses in relatedness to and/or support of the topic/subject.	Support information (supporting/key details) has major weaknesses in relatedness to and/or support of the topic/subject.	An attempt has been made to add support information, but it was unrelated or confusing.	This code may be used for compositions that are entirely illegible or otherwise unable to be scored: blank responses, responses that are off-topic or incoherent, etc.
Closing Sentence	Closing sentence of the paragraph is clear and seals the paragraph by restating the main idea/topic sentence in a different way.	Closing sentence of the paragraph is generally clear and somewhat seals the paragraph by restating the main idea/topic sentence in a different way.	Closing sentence of paragraph is vague and does not seal paragraph well.	Closing sentence of the paragraph is unclear or confusing.	This code may be used for compositions that are entirely illegible or otherwise unable to be scored: blank responses, responses that are off-topic or incoherent, etc.

Writing Conventions	Exhibits proper usage of grammatical conventions appropriate to the writing task: sentence formation; standard usage including agreement, tense, and case; and mechanics including use of capitalization, punctuation, and spelling.	Exhibits minor weaknesses in proper usage of grammatical conventions appropriate to the writing task: sentence formation; standard usage including agreement, tense, and case; and mechanics including use of capitalization, punctuation, and spelling.	Exhibits major weaknesses in proper usage of grammatical conventions appropriate to the writing task: sentence formation; standard usage including agreement, tense, and case; and mechanics including use of capitalization, punctuation, and spelling.	Lacks proper understanding and usage of grammatical conventions appropriate to the writing task: sentence formation; standard usage including agreement, tense, and case; and mechanics including use of capitalization, punctuation, and spelling.	This code may be used for compositions that are entirely illegible or otherwise unable to be scored: blank responses, responses that are off-topic or incoherent, etc.
Column Total:					

Total Points Earned:	**Total Points Possible:**	**Final Grade:**

Name: _____ Date: _____

Exit Ticket

Concept:_____**Lesson:**_____

Name: _____ Date: _____

Exit Ticket

Concept:_____**Lesson:**_____

Name: _____ Date: _____

Exit Ticket

Concept:_____**Lesson:**_____

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 1

Writing a Summative Paragraph

Materials Needed

- Pencil
- Copies of Activity Masters 1, 2, 3, and 4 (one copy per student)
- Copy of Activity Master 5 to place in common area of the room (only one copy)
- Science notebook or journal (to store information about the case)
- Glue sticks (to add information to science notebook/journal)
- Equipment for projecting video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 1 — *Welcome to BCI* (1:29)
- Video Clip 2 — *The Case* (1:26)
- Activity Masters 1, 2, 3, 4, and 5

Lesson Objectives

- Students will be able to identify the two potential crimes.
- Students will learn about forensic scientists and criminal investigators.
- Students will be able to identify and describe the components of a paragraph.
- Students will engage effectively in groups through discussions.

Lesson Overview:

Students will be introduced to the Ohio Attorney General's Bureau of Criminal Investigation and the two potential crimes reflected in BCI Science School. Students will learn to identify and describe the components of a paragraph (e.g., main idea/topic sentence, supporting details, and concluding sentence). Students will also read a brief description about forensic scientists and criminal investigators. They will focus on one of these professions and write a paragraph summarizing the profession.

Student Prerequisites:

- At least some prior knowledge of how to write a paragraph and understanding of the necessary parts of a paragraph (e.g., main idea/topic sentence, supporting details, and concluding sentence)
- At least some prior knowledge of transition words (e.g., *first*, *then*, *next*, *in addition*, and *in conclusion*).

Word Study

Forensic Scientist
Criminal Investigator
Criminal
Fertilizer
Main idea/Topic Sentence
Closing/Concluding Sentence
Transition Words
Analyze
Examine
Threatening
Crime
Clues
Chemical
Purpose
Paragraph
Evidence
Fingerprints
Concerned
Suspect
Summary
Supporting Details
Shoeprint
Process

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading — Informational Text	Key Ideas and Details
Standard Statements	
1. Determine the main idea of a text and explain how it is supported by key details; summarize the text. (ODE Standard Statement No. 2)	

Content Area: English Language Arts	
Strand	**Topic**
Reading — Informational Text	Key Ideas and Details
Standard Statements	
1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on others' ideas, and expressing their own clearly. a. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and explain their own ideas and understanding.	

Activity: Writing a Summary Paragraph

Instructional Strategies:

1. Play Video Clip 1 — *Welcome to BCI* and briefly discuss.
2. Play Video Clip 2 — *The Case* and hand out Activity Master 1.
3. Briefly discuss information shared in video clips and on Activity Master 1 handout. Clarify any misconceptions on the case.

4. Have students choose between the informational text on a forensic scientist (Activity Master 2) or criminal investigator (Activity Master 3). They can circle the description of which type of profession they want to read more about on Activity Master 1. Students can read the text individually or in pairs, depending on teacher discretion.

5. Students can then turn and talk to another student who read the same text to discuss what they thought the main idea and supporting details were in their particular text.

6. Pass out the graphic organizer hamburger visual aid (Activity Master 4). Explain how a paragraph is like a hamburger. The top bun symbolizes the main idea or topic sentence of the paragraph. The hamburger and toppings represent the supporting details of the paragraph, and the bottom bun represents the concluding sentence of the paragraph (sealing the paragraph or hamburger together), simply restating the main idea in a different way.

7. Have students write a one-paragraph summary of the informational text they read on the bottom of Activity Master 4.

8. Call the entire class together to discuss the two different types of categories of professions studied and review the basic known facts of the case of Bob Agriculture. Please reiterate that the questions on Activity Master 1 will be their guide or give them a purpose when learning about the case. Keep a record or chart of all known facts about this case, and add to it as students investigate and collect new evidence and test results. (This information could be placed on a bulletin board for students to refer to throughout the case.) Place the "Missing Persons" poster of Bob (Activity Master 5) on the bulletin board or in the area where you are keeping the case information.

9. Answer any questions and collect paragraphs.

Optional Extension Activities

1. Have students write a newspaper article about this case. (Make sure they use the five W's, and one H: Who, What, When, Where, Why, and How.)

2. Create a "Missing Persons" poster by hand, or on the computer.

3. Using Movie Maker, iMovie, or similar program, make a video of a newscast about the crime scene scenarios.

4. Research different forensic science careers and investigative careers and create a written or typed report and/or a Keynote or PowerPoint presentation.

Name: _____ Date: _____

BCI Science School Facts for Students

Terra Agriculture reports to the police that her husband, Bob, was missing when she returned home from visiting their out-of-town grandchildren. Terra is concerned about her husband's disappearance for a number of reasons:

- Bob isn't home or responding to her calls or texts to his cellphone, which he always has on him.
- She notices that someone broke into the barn.
- Some chemicals and fertilizer that Bob uses on the farm are missing.
- Buckeye the dog is missing.
- There is a note taped to their barn window from a "concerned citizen" threatening Bob about the use of fertilizers and chemicals on the farm.

Students, you will first have to serve as detectives and try to locate Bob. Then, you will serve as forensic scientists and analyze evidence collected at the crime scenes. You will use techniques similar to those used by BCI's Investigations to locate Farmer Bob, such as thermal imaging, GPS coordinates, crime scene documentation, and cellphone record analysis. You will then use techniques similar to those used by BCI's Laboratory to determine what happened to Farmer Bob and his barn, such as latent print comparison, footwear comparison, toolmark analysis, handwriting analysis, principles of chromatography, principles of the scientific process, and DNA analysis.

Forensic Scientist – A type of scientist (biologist, chemist, anthropologist, etc.) who applies his or her scientific knowledge to solve criminal investigations.

Criminal Investigator – A type of investigator (a street detective, crime scene investigator, cybercrimes agent, etc.) who studies facts used to identify, locate, and prove the guilt of an accused criminal.

What You Need to Figure Out:

Where is Bob?
Is he alive?
Where is his dog, Buckeye?
Who broke in to the barn?
Who stole the chemicals and fertilizer?
Who left the shoeprint outside of the barn?
Who placed the threatening note on the barn window?
Has someone hurt Bob, or did he have an accident?
If someone hurt Bob, why would they do that? What was their motive?
Who might have done it — in other words, who is our "suspect"?

Name: _____ Date: _____

Directions: Please read the text selection below. Then, summarize, in paragraph form, what you learned from this passage about forensic scientists. Include a topic sentence, supporting details, and a closing sentence.

Forensic Scientists

A forensic scientist is a type of scientist who uses their knowledge of science and training to help solve criminal investigations. The word *forensic* comes from a Latin word meaning having to do with a court of law. Therefore, when you describe something as forensic, you usually mean that is has to do with finding evidence to solve a crime. Evidence means anything (for example, a note, fingerprint, email, blood, or paint chip) that can be used to prove something.

Forensic scientists help solve crimes. They collect, preserve, and analyze physical evidence and other facts found at the scene of a crime. Some forensic scientists travel to the crime scene to collect the evidence themselves. Some work in a lab testing and analyzing the evidence. The evidence found at crime scenes can include fingerprints, shoeprints, blood, tools or firearms, saliva, drugs, notes with handwriting, and other items.

At the Ohio Attorney General's Bureau of Criminal Investigation (BCI), the Laboratory Division includes many different units. In order to become a forensic scientist in one of these units, you must go to college and earn at least a bachelor's degree. Studying specific areas of science, such as biology, chemistry, or biochemistry, will help you prepare for a career in the crime laboratory. Also, in order to work in a specific unit, each scientist has to receive further training to properly analyze crime scene evidence.

Once crime scene evidence has been examined, forensic scientists usually have to provide testimony on their findings in court. Forensic scientists help law enforcement agents and prosecuting attorneys bring criminals to justice. Forensic scientists play an important role in helping keep our country safe.

Name: _____ Date: _____

Directions: Please read the text selection below. Then, summarize, in paragraph form, what you learned from this passage about criminal investigators. Include a topic sentence, supporting details, and a closing sentence.

Criminal Investigators

A criminal investigator is a type of investigator who studies facts used to identify, locate, and prove the guilt of an accused person, or criminal. A criminal is someone who breaks the law. The job of a criminal investigator is to attempt to solve each case that comes his or her way, using many methods.

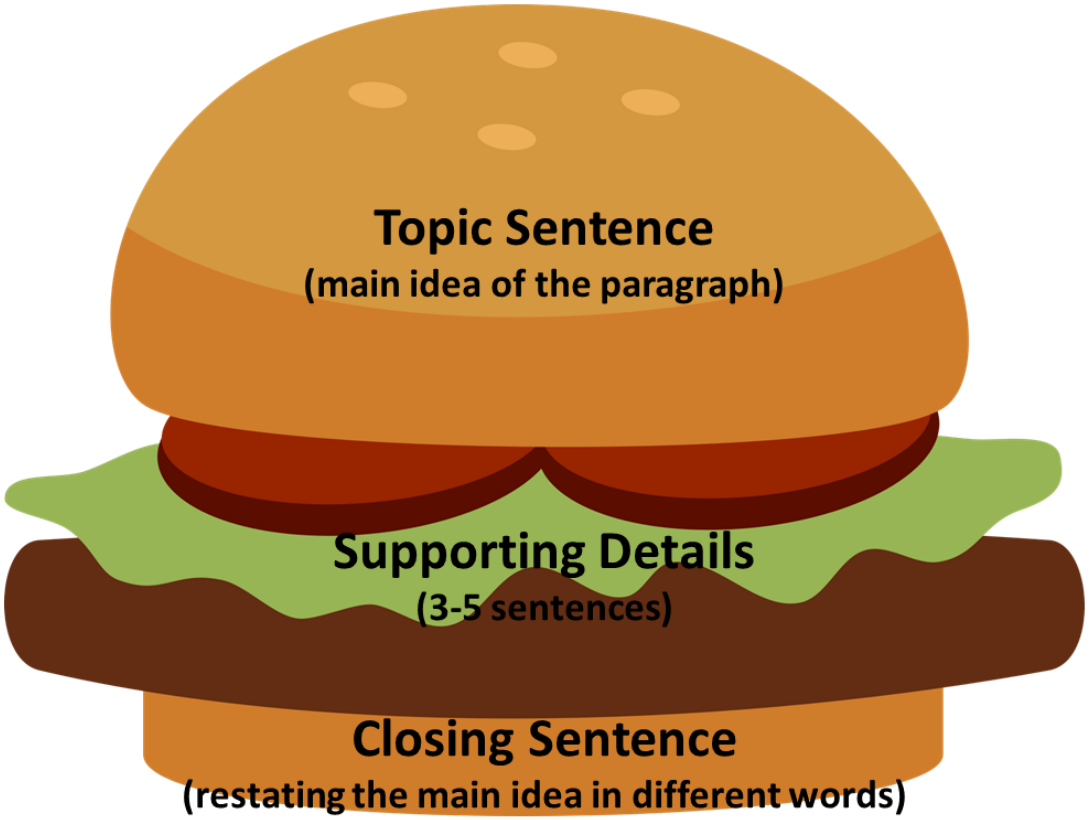
A criminal investigator often interviews people who are related to the case to gain more information. Criminal investigators study records, observe suspicious activities or suspects, and help with searches and arrests.

The work of police detectives and criminal investigators can be dangerous. They have to be observant and prepared to act in a quick and calm way. Criminal investigators often have to work long hours.

The professional investigators at the Ohio Attorney General's Bureau of Criminal Investigation (BCI) are called "special agents." They work in many different specialized units. Some of the units they work in are the Crime Scene Unit, Cyber Crimes Unit, Environmental Enforcement Unit, and many more. They assist local, state, federal (national), and international law enforcement agencies. BCI special agents work closely with federal and local authorities, as well as lawyers from the Ohio Attorney General's Office. These investigators want to make sure that each investigation is done well and according to the law.

Name: _____ Date: _____

Writing a Paragraph – Hamburger Example



MIKE DEWINE
OHIO ATTORNEY GENERAL

Ohio Attorney General's Office

Missing

Bob Agriculture Missing adult

- **Nickname or alias:** Bobby
- **Missing from:** Logan, Ohio
- **Missing since:** 10/24/2016
- **Missing age:** 43
- **Current age:** 43
- **Date of birth:** 12/1/1972
- **Gender:** Male
- **Race/Ethnicity:** White
- **Height:** 6'0"
- **Weight:** 220 lbs
- **Hair color:** Brown
- **Eye color:** Hazel

Details

Bob was last seen at his residence on 10/24/16 at 9:30 a.m. in Logan, Ohio. He was last seen wearing blue jeans, a flannel shirt, a green hat, and work boots. He had his Labradoodle, Buckeye, with him.

Contact

If you have information contact **Logan Police Department** at **(740) 123-5555**.

OHIO ATTORNEY GENERAL BCI

855-BCI-OHIO

OHIO ATTORNEY GENERAL'S
BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 2

Reading for Purpose

Materials Needed

- Pencil
- Markers or highlighters (two different colors)
- Copies of Activity Master 6 (one copy per student)
- Interactive white board, ELMO, or overhead projector (with transparency of Activity Master 6) and overhead pens of different colors

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Master 6

Lesson Objectives

- Students will be able to identify the purpose of reading a text.
- Students will learn good test-taking skills by reading over the comprehensive and short/extended response questions before they read.
- Students will learn how to pay attention to detail within the text they are required to read.
- Students will be able to determine a theme of a story, drama, or poem from details within the text and summarize the text.

Lesson Overview:

Students should always figure out what their purpose for reading a text is beforehand, so that they can pay specific attention to those details in the text. Students will also learn to review comprehension questions and short-answer extended-response prompts, before they read text passages, as a good test-taking skill. By reading Chris Tovani's excerpt, students will begin to understand reading for purpose. They will also use this skill as they comb through information and review evidence from these two potential crimes.

Student Prerequisites:

- Students should have some knowledge of what it means to read for purpose. (If students do not have a strong prior knowledge or understanding of this concept, then these activities may be done as demonstrations to introduce students to it, or you could spend more time on the concept before returning to the BCISS lessons.)

Review of Lesson 1:

- What is BCI? (The Bureau of Criminal Investigation)
- What are criminal investigators and what do they do?
- What are forensic scientists and what do they do?
- What facts do we know about Bob Agriculture and his barn break-in?

Word Study

Purpose	Robber
Paragraph	Analyze
Evidence	Examine
	Clues

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine a theme of a story, drama, or poem from details in the text; summarize the text.	

Content Area: English Language Arts	
Strand	**Topic**
Speaking and Listening	Comprehension and Collaboration
Standard Statements	
1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on other's ideas and expressing their own clearly. a. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and have students explain their own ideas and understanding.	

Activity: Reading for Purpose

Instructional Strategies:

1. Hand out a copy of the text excerpt, from Chris Tovani's book, *I Read It, But I Don't Get It* (Activity Master 6). Depending on the reading abilities of the students in your class, you can have the students read this text on their own or in pairs. You could also read the text together as a class using an ELMO, Interactive Whiteboard, or overhead projector to give students a visual of the text to follow along with at their seats.

2. If you are doing this as a whole-class instruction, have the students use a pencil to circle whatever they think is important as you read the text excerpt for the first time. Usually students will not question what the purpose is for reading, they just start circling. (If you have students do this solo or with buddies, bring the class back together after the task is completed to discuss what students thought was important to circle.)

3. Next, tell the students that the purpose for reading through the text excerpt this time is to highlight (using a colored pencil or marker) any parts of the text that a **robber** would think to be important information.

4. Finally, have the students read the text again, using a different colored highlighter or marker. Inform them that the purpose for reading the text this time is to highlight places in the story that an **interested home buyer** might think to be important.

5. It should be obvious at this point how much easier it is to determine what information is important in a text when the reader has a purpose. If the students do not recognize this on their own, make sure that you explain and address this concept before going further with the lesson.

    a. **Question to ask students:** What did you notice about the three times you read through the text and circled or highlighted the different information? (Point out that the first time was probably the most difficult because they did not have a specific purpose for reading the text the first time.)

6. On the board or chart paper, have students help you generate points they think are important for the robber and for the home buyer to pay attention to when reading the excerpt. (Students can also record the brainstormed lists and/or Venn diagram of the two different purposes for reading, on the back of Activity Master Lesson 6.)

    a. Compare and contrast the two lists and discuss why each item is important, and then discuss why some items might be on both lists.
    b. Emphasize to students that they should always figure out what their purpose for reading a text is before they read so that they can pay specific attention to those details in the text.
    c. Explain how reading the comprehension questions, and short and extended response questions first before reading the text passage, is a good test-taking strategy that provides students with a purpose when reading tests.

Optional Extension Activities

1. Have students write a newspaper article about this case. (Make sure they use the five W's, and one H: Who, What, When, Where, Why, and How.)

2. Create a "Missing Persons" poster by hand, or on the computer.

3. Using Movie Maker, iMovie, or similar program, make a video of a newscast about the crime scene scenarios.

4. Research different forensic science careers and investigative careers and create a written or typed report and/or a Keynote or PowerPoint presentation.

Name: _____ Date: _____

I Read It, But I Don't Get It

By Chris Tovani

The two boys ran until they came to the driveway. "See, I told you today was good for skipping school," said Mark. "Mom is never home on Thursday," he added. Tall hedges hid the house from the road so the pair strolled across the finely landscaped yard. "I never knew your place was so big," said Pete. "Yeah, but it's nicer now than it used to be since Dad had the new stone siding put on and added the fireplace."

There were front and back doors and a side door which led to the garage which was empty except for three parked 10-speed bikes. They went in the side door, Mark explaining that it was always open in case his younger sister got home earlier than their mother. Pete wanted to see the house so Mark started with the living room. It, like the rest of the downstairs, was newly painted. Mark turned on the stereo, the noise of which worried Pete. "Don't worry, the nearest house is a quarter mile away," Mark shouted. Pete felt more comfortable observing that no houses could be seen in any direction beyond the huge yard. The dining room, with all the china, silver, and cut glass, was no place to play so the boys moved into the kitchen where they made sandwiches. Mark said they wouldn't go to the basement because it had been damp and musty ever since the new plumbing had been installed.

"This is where my Dad keeps his famous paintings and his coin collection," Mark said as they peered into the den. Mark bragged that he could get spending money whenever he needed it since he'd discovered that his Dad kept a lot in the desk drawer.

There were three upstairs bedrooms. Mark showed Pete his mother's closet which was filled with furs and the locked box which held her jewels. His sister's room was uninteresting except for the color TV which Mark carried to his room. Mark bragged that the bathroom in the hall was his since one had been added to his sisters' room for their use. The big highlight in his room, though, was a leak in the ceiling where the old roof had finally rotted.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 3
Using a Map

Materials Needed

- Pencil
- Internet connection to connect to National Geographic's interactive map at http://nationalgeographic.org/maps/ohio-tabletop-map/
- Copies of Activity Masters 7 and 8 (one copy per student)
- Science and/or social studies notebook or journal (to store information about the case)
- Glue sticks (to add information to science/social studies journal notebook/journal)
- Ruler (one/student)
- Equipment to project video clip
- Interactive white board, ELMO, or overhead projector and overhead pens of different colors

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 3 — *Cell Phone Pinging* (1:42)
- Activity Masters 7 and 8

Lesson Overview:

Students will be introduced to the BCI Cyber Crimes Unit as they help determine where Bob is located through cellphone records. Students will use cardinal and intermediate directions to navigate and find locations and landforms on a map, as well as map legends and scales.

Student Prerequisites:

- Students should have an understanding of cardinal and intermediate directions and how to use a compass rose on a map or coordinate grid. (If students do not have a strong prior knowledge or understanding of these concepts, then these activities may be done as demonstrations to introduce students to the concepts, or you could spend more time on these concepts before returning to the BCISS lessons.)
- Students should be able to do basic linear measurement with a ruler and understand how to convert a map scale.

Review of Lesson 2:

- Discuss with students why it is important to have a purpose in mind when reading a text passage. Also, remind students that reading over comprehension questions first and then reading the text selection is a good test-taking skill.

Word Study

Human Characteristics
Physical Characteristics
Intermediate Directions
Linear Measurement
Perpendicular Lines
Metric System
Angles
Coordinates
Acute Angle
Map Scale
Map Key
Cardinal Directions
Pinging
Obtuse Angle
Degrees
Azimuth
Compass Rose
Right Angle
Parallel Lines

Lesson Objectives

- Students will learn how to use a map.
- Students will review intermediate and cardinal directions.
- Students will review map scales and legends.
- Students will be introduced to coordinate grids.
- Students will learn about cellphone pinging.

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Mathematics	
Domain	**Cluster**
Geometry	Draw and identify lines and angels, and classify shapes by properties of their lines and angles
Standard Statements	
1. Draw points, lines, segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.	

Content Area: Social Studies	
Theme	**Strand**
Ohio in the United States	Geography
Topic: Spatial Thinking and Skills — Spatial thinking examines the relationships among people, places, and environments by mapping and graphing geographic data. Geographic data are compiled, organized, stored, and made visible using traditional geospatial technologies. Students need to be able to access, read, interpret, and create maps and other geographic representations as tools of analysis.	
Content Statement	
1. A map scale and cardinal and intermediate directions can be used to describe the relative location of physical and human characteristics of Ohio and the United States. (ODE Content Statement No. 9)	

Activity: Using a Map

Instructional Strategies:

1. Play Video Clip 3 — *Cell Phone Pinging* for the students and discuss.

2. Provide a visual of Activity Master 7 (flat map of Ohio courtesy of the National Geographic Society — http://nationalgeographic.org/maps/ohio-tabletop-map/) for students on an interactive white board, ELMO, overhead, or other projector.

3. Explain that you are going to review map skills in this lesson, but first have the students share what they already know about the map that you are projecting (Activity Master 7). Note: Please make sure that the students talk about the map title (in this case at the bottom of the map), map key, or legend (map is missing one), map scale, compass rose (map is missing one) (review cardinal and intermediate directions), and how you could label a specific area or location according to its coordinates and/or latitude and longitude lines.

4. Ask the students to try to complete the following activities and questions together as a class. (Do this as a whole class demonstration.)

    a. Create a compass rose on the map of Ohio, making sure you include cardinal and intermediate directions. (Check for understanding.)
    b. Create a legend on the map of Ohio, including why certain cities are in bold print and some are not/why the bullet sizes are smaller and larger, why Columbus has a circle around its dot, and how lakes and rivers are marked on the map. (Check for understanding.)
    c. Have students practice measuring distances between locations on the map and answer the questions on the Activity Master. (Check for understanding.)

5. Provide many examples of how to find the coordinates (in this case in latitude and longitude) of the different cities/landmarks, and how to describe the directions from one place to another using cardinal and intermediate directions.

6. Point out that the latitude and longitude lines run perpendicular to each other, creating a grid system. Also, that latitude lines run parallel to other latitude lines, and longitude lines run parallel to other longitude lines. Have students decipher which lines are which.

7. Pass out Activity Master 8 to all students and project a copy on the board. Explain that instead of degrees of latitude and longitude, this map uses a coordinate grid system. Explain how it works.

8. Go over the directions of how to play this game with the students. Show several examples on the board to the class with the students' participation.

9. Have the students find a partner (or assign them one based on your discretion) and have the students play a few more rounds while you walk around the room checking for understanding.

10. Finally, have the students glue Activity Master 8 into their science or social studies journals/notebooks.

Optional Extension Activities

1. Continue to play more rounds of "Find Bob's Missing Hat"— you can laminate copies and use wet-erase markers.

2. Students can write their own story about a missing person and create their own map, complete with a compass rose, map scale, landforms (lakes, rivers, mountains, etc.), and coordinate grid.

Name: _____ Date: _____

Map of Ohio

Use the below map to answer the following questions:

1. What is the distance on the map between Columbus and Marietta?
   In miles: _____ In kilometers: _____
2. What is the distance on the map between Toledo and Cleveland?
   In miles: _____ In kilometers: _____
3. What is the distance on the map between Dayton and Cincinnati?
   In miles: _____ In kilometers: _____
4. What is the distance on the map between Urbana and Youngstown?
   In miles: _____ In kilometers: _____
5. What is the distance on the map between Marion and Jackson?
   In miles: _____ In kilometers: _____

NATIONAL GEOGRAPHIC education

Name: _____ Date: _____

Map of Ohio

Note: Depending on the mathematical ability of your students, you can have them estimate this distance.

Use the below map to answer the following questions:

1. What is the distance on the map between Columbus and Marietta?
   In miles: ~87.5 miles In kilometers: ~156.25 km
2. What is the distance on the map between Toledo and Cleveland?
   In miles: ~100 miles In kilometers: ~162.5 km
3. What is the distance on the map between Dayton and Cincinnati?
   In miles: ~37.5 miles In kilometers: ~75 km
4. What is the distance on the map between Urbana and Youngstown?
   In miles: ~200 miles In kilometers: ~300km
5. What is the distance on the map between Marion and Jackson?
   In miles: ~106.25 miles In kilometers: ~171 km

NATIONAL GEOGRAPHIC education

Name: _____ Date: _____

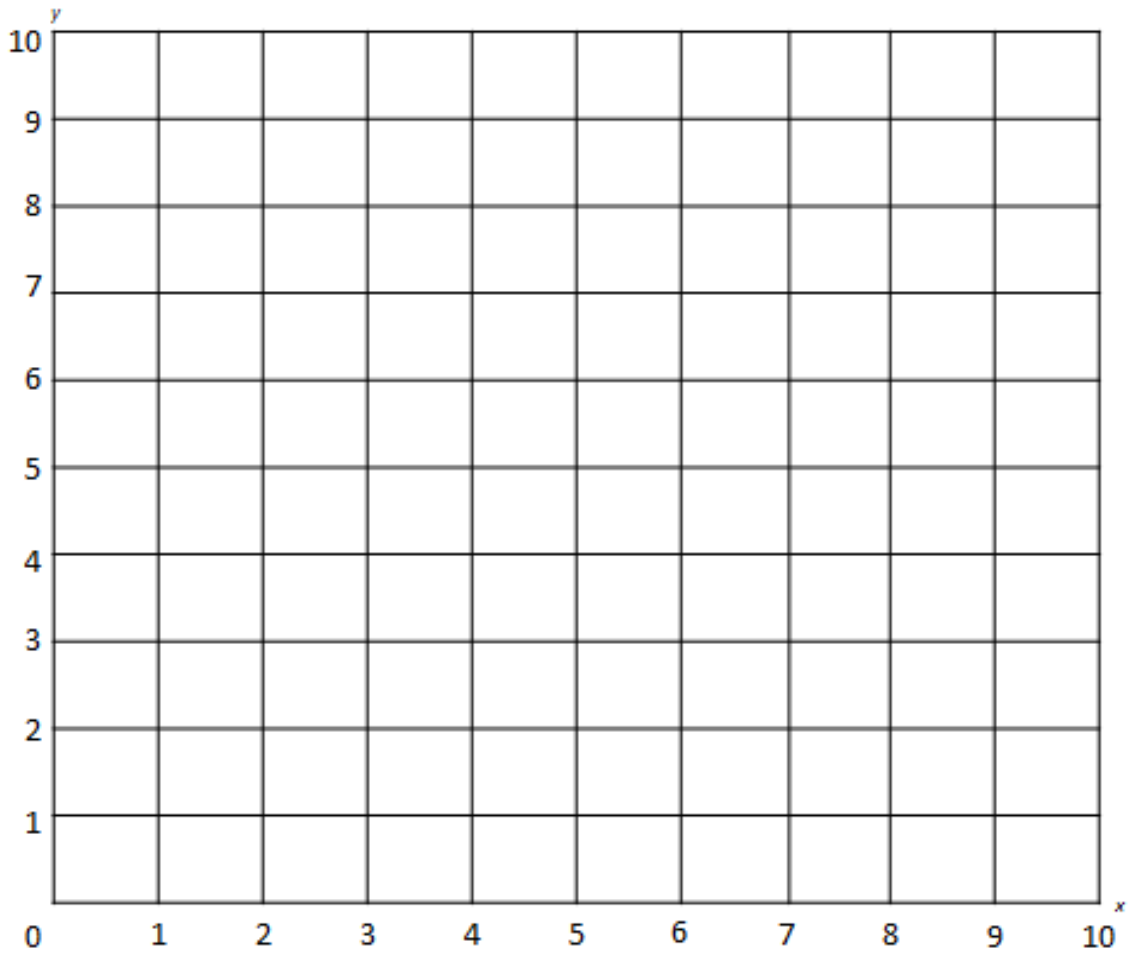
Find Bob's Missing Hat

Bob's favorite hat is missing somewhere in his field. Use the grid below to help Bob find his hat.

1. Make a compass rose on this paper with intermediate and cardinal directions.
2. Choose a leader for the first game, and then rotate this role in future games.
3. The leader chooses the location of Bob's missing hat, but does not reveal that location to the other players.
4. The other players need to figure out the coordinates of the location of Bob's missing hat by guessing a pair and having the leader state whether the person is correct, or if the location is a different direction from the point that they guessed.

   Example: If a player guesses that Bob's hat is located at (5, 4) but the leader has really chosen (9, 7) for the location, then the leader would respond, "No, it is northeast of there."

5. The game will continue until a player guesses the correct location of Bob's hat. Then, the group can decide who will be the leader of the game in the next round.



OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 4

Heat Energy Science Experiment

Materials Needed

- Foil
- Packing peanuts
- Newspaper
- Plastic wrap
- Bubble Wrap
- Paper towels
- Scraps of fabric
- Other useful "junk" for possible insulation
- Tape
- Two Popsicles or ice cubes (teachers discretion)/group of three
- Heat source (sun, heater, candle)
- Copies of Activity Master 9 (one copy per student)
- Glue stick
- Science journals
- Pencil
- Colored pencils
- Timers
- Equipment to project video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 4 — *Thermal Energy* (5:15)
- Activity Master 9

Lesson Overview:

Students will review the concept of insulation. Then, students will take part in an inquiry-based science experiment on thermal energy using an ice cube or popsicle (left to teacher discretion) and various materials to try to slow down the melting of one of those items.

Student Prerequisites:

- At least some prior knowledge of what heat/thermal energy is and a basic understanding of how insulation (the material or technique used to reduce the rate at which heat is transferred) works.

Review of Lesson 3:

- What are cardinal and intermediate directions?
- What is a compass rose?
- How are lines of latitude and longitude or coordinates used on maps?
- What is a map scale and how does it work?
- What is a map legend or key?

Word Study

Heat Energy (Thermal Energy)	Detector
Radiation	Instrument
Conclusion	Insulators
Inquiry	Prototype
Conduction	Convection
Prediction	Hypothesis
Molecules	Vibrate
Variable	Control

Lesson Objectives

- Students will be able to explain what heat (thermal) energy is and how it is transferred.
- Students will be able to explain what insulation is and what types of materials are best used for insulation.
- Students will be able to record and graph results of heat energy experiment.

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Electricity, Heat and Matter — This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they apply to heat and electrical energy.
Content Statement
Energy can be transformed from one form to another or can be transferred from one location to another. Energy transfers from hot objects to cold objects as heat, resulting in a temperature change. The addition of heat may increase the temperature of an object. The removal of heat may decrease the temperature of an object. There are materials in which the entire object becomes hot when one part of the object is heated (e.g., in a Styrofoam cup, very little of the warmth from hot liquid inside the cup is transferred to the hand holding the cup.)

Activity: Thermal Energy Experiment

Instructional Strategies:

1. Begin the lesson by asking students:
    a. What is insulation?
    b. How does insulation work?
    c. Can you design an insulator prototype to keep an ice cube or Popsicle from melting when exposed to a source of heat?
2. Explain to students that they need to create some type of insulator for their frozen object (ice cube or Popsicle) to see if they can prevent the object from melting, or melting as quickly as it would if it did not have any insulation.
3. Give each student a copy of Activity Master 9. Then, go over the science inquiry lesson with the students, step-by-step, making sure they understand the task at hand. Note: Make sure you explain to the class

that the variables will be what type of materials are used to insulate the cold object, and the control will be the same exact type/size, etc. of cold object without any insulation around it.

4. Make sure the students understand that they are to work in teams using any combination of the supplies provided to them (aluminum foil, packing peanuts, paper towels, etc.) to create their team's insulator prototype.

5. Explain to students that they will have the teams put their insulated cold object (Popsicle or ice cube), along with the same exact size cold object without insulation (the control) either outside (weather permitting), in the windowsill, or by the heating unit. (If you need to use a lit candle, make sure you are providing the proper adult supervision (yourself or parent volunteers) and that you have permission from the principal to use the candles.)

6. Have students use timers and their copy of Activity Master 9 to record their observations and conclusions as they conduct this experiment.

7. When all groups' prototypes have been tested, make sure students have recorded their findings and their conclusions on their lab report (Activity Master 9) and cleaned up their experiment area.

8. Once the clean-up process has taken place, call the students to the carpet area with their Activity Master 9 to discuss their findings about the concept of heat energy and insulation and insulators. Make sure you clarify any misconceptions of these concepts. Discuss how students might alter/improve their insulator prototypes if they were to conduct this experiment again. Collect/record the students' thoughts on a class chart.

9. Have the students turn in Activity Master 9 for you to assess and/or to guide your future instruction on these concepts.

10. View Video Clip 4 — *Thermal Energy* and discuss how students might change or alter their insulator prototype after reviewing or learning more about heat/thermal energy and heat/thermal energy transfer.

Optional Extension Activities

1. Students can create an elapsed-time video of this experiment.

2. Students can create a song or rap about these science concepts.

3. Students can design and create a new and improved prototype to insulate cold objects better than their initial attempts.

Name: _____ Date: _____

Heat Energy Inquiry – Science Lab

Question: Can you design a way to keep an ice cube or popsicle from melting, or slow down the melting process when exposed to a source of heat?

Make a Prediction/Form a Hypothesis:

Materials Needed:

Draw a picture of your design:

Observations:

_____

_____

Conclusion:

_____

_____

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 5

Thermal (Heat) Energy

Materials Needed

- Pencil
- Equipment to project video clips
- Copies of Activity Master 10 (one copy per student)

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 5 — *Thermal Energy Detection* (1:30)
- Video Clip 6 — *Locating Bob* (0:43)
- Activity Master 10

Lesson Objectives

- Students will answer comprehensive questions based on the heat energy text passage.
- Students will be able to make inferences from the text and will refer back to examples that they found in the text.
- Students will determine the main idea of a text, explain how it is supported by key details, and summarize the text.
- Students will describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

Lesson Overview:

Students will read an informational text on thermal/heat energy. Then they will answer comprehension questions based on the text passage.

Student Prerequisites:

- At least some prior knowledge of how to write a paragraph, and an understanding of the necessary parts of a paragraph (e.g., main idea/topic sentence, supporting details, and concluding sentence)
- At least some prior knowledge of transition words (e.g., *first*, *then*, *next*, *in addition, in conclusion*)

Review of Lesson 4:

- What is heat energy?
- What is insulation?
- How does insulation work?
- What are good examples of insulation?

Word Study

Thermal Energy	Conduction
Radiation	Insulator
Detector	Convection
Instrument	Transfer

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Electricity, Heat, and Matter — This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they apply to heat and electrical energy.
Content Statement
Energy can be transformed from one form to another or can be transferred from one location to another. Energy transfers from hot objects to cold objects as heat, resulting in a temperature change. The addition of heat may increase the temperature of an object. The removal of heat may decrease the temperature of an object. There are materials in which the entire object becomes hot when one part of the object is heated (e.g., in a Styrofoam cup, very little of the warmth from hot liquid inside the cup is transferred to the hand holding the cup.)

Content Area: English Language Arts	
Strand	**Topic**
Reading Standards for Informational Text K-5	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a fourth grade topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text. 6. By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades four-five text complexity band proficiently, with scaffolding as needed at the high end of the range. (ODE Standard No.10)	

Activity: Using Heat/Thermal Energy to Find Bob

Instructional Strategies:

1. Have students watch Video Clip 5 — *Thermal Energy Detection* and then briefly review concepts of heat/thermal energy, insulators, and how thermal energy is transferred.

2. Have students read over the informational text from Activity Master 10 and answer the comprehension questions. Remind students to read the questions first to use as their purpose for reading, before reading the text excerpt. Note: If you think your students need to read this in pairs, or as a class, feel free to adapt this lesson to meet the individual needs of your students.

3. Once the students have completed Activity Master 10, call the class together to go over the answers before collecting them for a grade.

4. Have students watch Video Clip 6 — *Locating Bob*. Discuss how the criminal investigators can use these scientific concepts to locate missing people.

Optional Extension Activities

1. Students can create a visual graphic organizer explaining science concepts of heat/thermal energy, conduction, convection, radiation, and insulation.

2. Students can create a webpage based on these scientific concepts.

3. Students can design and test a melting prototype to see if they can increase the acceleration of an ice cube or popsicle melting.

Name: _____ Date: _____

Thermal (Heat) Energy

Directions: Please read the comprehension questions below first, and then read the informational text passage. The questions will serve as your purpose or guide for reading. Once you have completed the reading of this text selection, please answer the questions below. Remember, it is always a good idea to look back at the text to find the correct answer or double-check your response.

Heat Energy

Heat energy, which is also referred to as thermal energy, is the energy an object has because of the movement of its molecules. These molecules vibrate constantly. A rise in temperature of matter makes the particles vibrate faster. The addition of heat may increase the temperature of an object. The removal of heat may decrease the temperature of an object.

Heat can be transferred from object to object in three different ways. The three ways are called conduction, convection, and radiation. If two things or objects are touching each other, heat will flow from the hotter one to the colder one, unless they are the same temperature. The molecules of the hotter one will slow down, and the molecules of the colder one will speed up, until they are all moving at the same speed, and the two things have the same temperature.

Explain what happens to ice when it is added to a hot drink. What happens to the hot drink? Why?

_____

_____

_____

_____

_____

_____

_____

_____

(Please see reverse side)

You have been hired as a packaging design engineer at a chocolate factory. Using your knowledge of heat energy, and the way different materials can be used for insulation, design a way to keep chocolate from melting in a car on a hot summer day. Describe your idea and draw a diagram of your idea below:

Name: _____ Date: _____

Thermal (Heat) Energy

Directions: Please read the comprehension questions below first, and then read the informational text passage. The questions will serve as your purpose or guide for reading. Once you have completed the reading of this text selection, please answer the questions below. Remember, it is always a good idea to look back at the text to find the correct answer or double-check your response.

Heat Energy

Heat energy, which is also referred to as thermal energy, is the energy an object has because of the movement of its molecules. These molecules vibrate constantly. A rise in temperature of matter makes the particles vibrate faster. The addition of heat may increase the temperature of an object. The removal of heat may decrease the temperature of an object.

Heat can be transferred from object to object in three different ways. The three ways are called conduction, convection, and radiation. If two things or objects are touching each other, heat will flow from the hotter one to the colder one, unless they are the same temperature. The molecules of the hotter one will slow down, and the molecules of the colder one will speed up, until they are all moving at the same speed, and the two things have the same temperature.

Explain what happens to ice when it is added to a hot drink. What happens to the hot drink? Why?

Answers will vary but should include something like the following: When you add ice to a hot drink, the ice melts and the hot drink cools. This is based on the exchange of heat energy from the hot drink to the ice. The exchange of energy causes the ice to melt.

You have been hired as a packaging design engineer at a chocolate factory. Using your knowledge of heat energy, and the way different materials can be used for insulation, design a way to keep chocolate from melting in a car on a hot summer day. Describe your idea and draw a diagram of your idea below:

Answers will vary but should include information describing a way to use materials like ice and styrofoam to insulate the chocolate bar, rather than aluminum foil which would accelerate the process of melting the chocolate.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 6

Erosion, Deposition, and Weathering

Materials Needed

- Copies of Activity Master 11 (one copy per student)
- Copies of Activity Masters 12 and 13 (one copy per small group)
- One rectangular clay piece (Crayola works well if freshly unwrapped)/group of three students, about eight or nine clay sticks depending on class size
- One "glacier" ice cube/group of three students, about eight or nine per class
- One reusable plastic or aluminum container to use when creating clay topographic map of Ohio/group of three students, about eight or nine depending on class size
- Student science journals
- Pencil
- Colored pencils (if teacher prefers, for illustrating science journal)
- Ruler
- Scissors
- Glue stick
- Gravel, sediment, and sand
- Ice cube trays
- Water source
- Freezer
- One "Exit Ticket" per student
- Equipment for projecting videos

Approximate Time

- 50 minutes

Note: *This lesson was placed first so that students could enhance their knowledge of the scientific concepts of erosion, deposition, and weathering through inquiry exploration, before reading more about it in the informational texts. If you as the teacher feel that your students would benefit from first reading more about these concepts and then conducting the experiment, feel free to switch the order of these lessons.*

Lesson Overview:

Students will gain a deeper understanding of how the processes of erosion, deposition, and weathering take place. Students will observe a demonstration of these concepts on Video Clip 7 — *Erosion, Deposition, and Weathering* and complete an experiment where they create a pre-glaciated topographic map of Ohio out of clay (which may be done in conjunction with the art teacher), and then have a melting glacier (ice cube with gravel) travel across the clay map, simulating how parts of Ohio's current landscape were formed. Next, they will classify landforms that were created and use linear measurement of the grooves to make scientific observations and conclusions based on their experiment, on Activity Master 11.

Student Prerequisites:

- Have some prior knowledge of the concepts of erosion, deposition, and weathering

Review of Lesson 5:

- What is heat energy?
- What would happen if you put an ice cube in a cup of hot chocolate? Why?

Corresponding Required Resources

- Video Clip 7 — *Erosion, Deposition, and Weathering* (4:18)
- Activity Masters 11, 12, and 13

Lesson Objectives

- Students will learn about the processes of erosion, deposition, and weathering.
- Students will create a pre-glaciated topographic map of Ohio out of clay.
- Students will classify landforms that were created.
- Students will use linear measurement of the grooves to make scientific observations and conclusions based on the experiment.

Tip

- Remember, students will need to have their Ohio pre-glaciated topographical clay maps already created before beginning this part of the lesson, and have the ice cube glaciers thawing while you discuss the science activity with the class.

Word Study

Erosion
Landscape
Glacier
Sand
Supporting Details
Experiment
Conclusion
Result
Topography
Mountains
Deposition
Weathering
Hypothesis
Hills
Gravel
Compare
Wind
Informational Text
Contrast
Regions
Terrain
Valleys
Lakes
Sediment
Summary
Analyze
Conduct
Observation
Rivers
Paragraph
Landforms

Preparation:

1. The teacher or volunteer will need to fill the bottom of each section of an ice cube tray with a thin layer of sand, followed by a thin layer of bits of gravel/ sediment, and fill the remaining space in each section with water. Put in freezer to freeze until about 25 to 30 minutes before the experiment. Tip: This experiment works best when the "glacier" ice cubes have a chance to start to melt, becoming somewhat transparent and wet.

2. The teacher will have students in groups of three create their pre-glaciated topographic maps of Ohio out of clay in their waterproof containers, trying to simulate what Ohio looked like before the glaciers came through (use Ohio Department of Natural Resources maps provided, Activity Master 13). Tip: This is best done within a few hours of creating a clay representation of Ohio (or this can be done by the art teacher with clay deemed appropriate for the activity).

3. Make hard copies of the attached lesson material for use when completing class activities.

4. Optional: Create a model of a student response in your sample science journal to share with students

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Earth Science — This topic focuses on the variety of processes that shape and reshape Earth's surface.
Content Statement
1. Earth's surface has specific characteristics and landforms that can be identified. Earth's surface can change due to erosion and deposition of soil, rock, or sediment. Catastrophic events, such as flooding, volcanoes and earthquakes, can create landforms. 2. The surface of Earth changes due to weathering. Rocks change shape, size and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases in the air, pollution, and catastrophic events such as earthquakes, mass wasting, flooding, and volcanic activity. 3. The surface of Earth changes due to erosion and deposition. Water, wind, and ice remove and carry (erosion) rock, soil, and sediment and deposit the material in a new location.

Content Area: Mathematics	
Domain	Cluster
Measurement and Data	Solve problems involving measurement and conversion of measurement from a larger unit to a smaller unit
Standard Statements	
1. Know relative sizes of measurement from a larger units within one system of units including: km, m, cm; etc.	

Activity: Learning About Erosion, Deposition, and Weathering

Instructional Strategies:

1. Play Video Clip 7 — *Erosion, Deposition, and Weathering* and briefly discuss.

2. Hand out Activity Master 11 and present this question that the students are being asked to investigate in this lab: **How do glaciers change the landscape of an area of land, in this case Ohio's terrain?** Instruct students to answer the following question in their science journals.) Students can cut and paste Activity Master 11 into their journals.

3. Go over the remaining sections on Activity Master 11, making sure that students know what they are being asked to do. Go over Activity Master 12 to show students what Ohio's landscape looks like today. They will need to record their observations, make a visual diagram of the experiment, and take measurements (using the metric system) of any valleys, hills, mountains, rivers, or lakes created.

4. Place students in groups of three. Before releasing the students to do the activity, explain to students that their group will receive their glacier when they go to their lab station, where their clay map is located. Then, have them set up their experiment area with their science journals, scissors, glue stick, pencil, colored pencils, rulers, and clay map of Ohio.

5. Explain that the students will work in their groups of three taking their glacier and re-creating what happened to Ohio's topography after the glacier came through (deposition, erosion, etc.), making sure to fill out Activity Master 11 as they complete the experiment.

6. Have students discuss with their small group what they discovered about the concepts of deposition, erosion, and weathering; how it affected Ohio's landscape; and how it pertains to the case of Bob Agriculture.

7. Invite the students back to the carpet area to discuss as a class their findings and the results of their experiments. **Ask students how evidence they have observed now can help explain or conclude what happened in the past in Ohio?** Collect responses on chart paper and keep on display throughout the duration of BCI Science School. Clarify any questions or misconceptions about erosion, deposition, and weathering.

8. Explain that this connects to our case with Bob Agriculture because erosion on Bob's property lead to a sinkhole developing, and that students will learn about sinkholes in more detail in the next day's lesson.

9. Reiterate that they reviewed these concepts because Bob Agriculture was out inspecting erosion on his farm when he went missing.

10. Pass out "exit tickets" to each student to write down what they learned or reviewed today and how that information connects to the case of Bob Agriculture.

Note: An "exit ticket" is written feedback from the student to the teacher about the lesson that the student just completed. The exit ticket is a good way to provide feedback to the teacher about the student's understanding of the material that was presented. It also requires the student to do some synthesis of the lesson content and challenges the student to apply what he or she just learned in the lesson.

Optional Extension Activities

1. Have students research the ways people can prevent erosion, and have students share their findings with their classmates through:

    a. A multimedia presentation.
    b. An informative website.
    c. An experiment showing how people can impact our environment in a positive way by reducing erosion.
    d. A graph or chart illustrating what erosion-prevention techniques are best.

2. Have students create an iMovie, or other type of video, demonstrating how erosion, deposition, and weathering affect Earth's landscape.
3. Create, using Comic Life, or an original paper comic format, a visual representation with captions about how a landscape can change over time through the process of erosion, weathering, and deposition.
4. Have students create a rap or song explaining the concepts of erosion, deposition, and weathering to their classmates.
5. Write a report hypothesizing what Ohio would be like now had the glaciers not come through.
6. Draw a map of Ohio before and after the glacier came through and changed the landscape
7. Write a historical fiction and/or fantasy story of what it would have been like to live in Ohio at the time of glaciation.
8. Create a poem, song, or rap on the concepts of erosion, deposition, and weathering.
9. Create a movie about the concepts of erosion, deposition, and weathering.

Name: _____ Date: _____

Erosion and Deposition Inquiry – Science Lab

Question: How do/did glaciers change the landscape of an area of land, in this case Ohio's terrain?

Make a Prediction/Form a Hypothesis:

Before Glacier Moved Through Ohio

Use Activity Master 13 to try and help you form the type of landforms Ohio had before the glacier moved through Ohio.

After Glacier Moved Through Ohio

Please label landforms created by the glacier and measure the length and depth of the grooves.

Conclusion:

_____

_____

_____

Name: _____ Date: _____

Erosion and Deposition Inquiry – Science Lab

Question: How do/did glaciers change the landscape of an area of land, in this case Ohio's terrain?

Make a Prediction/Form a Hypothesis:

Before Glacier Moved Through Ohio

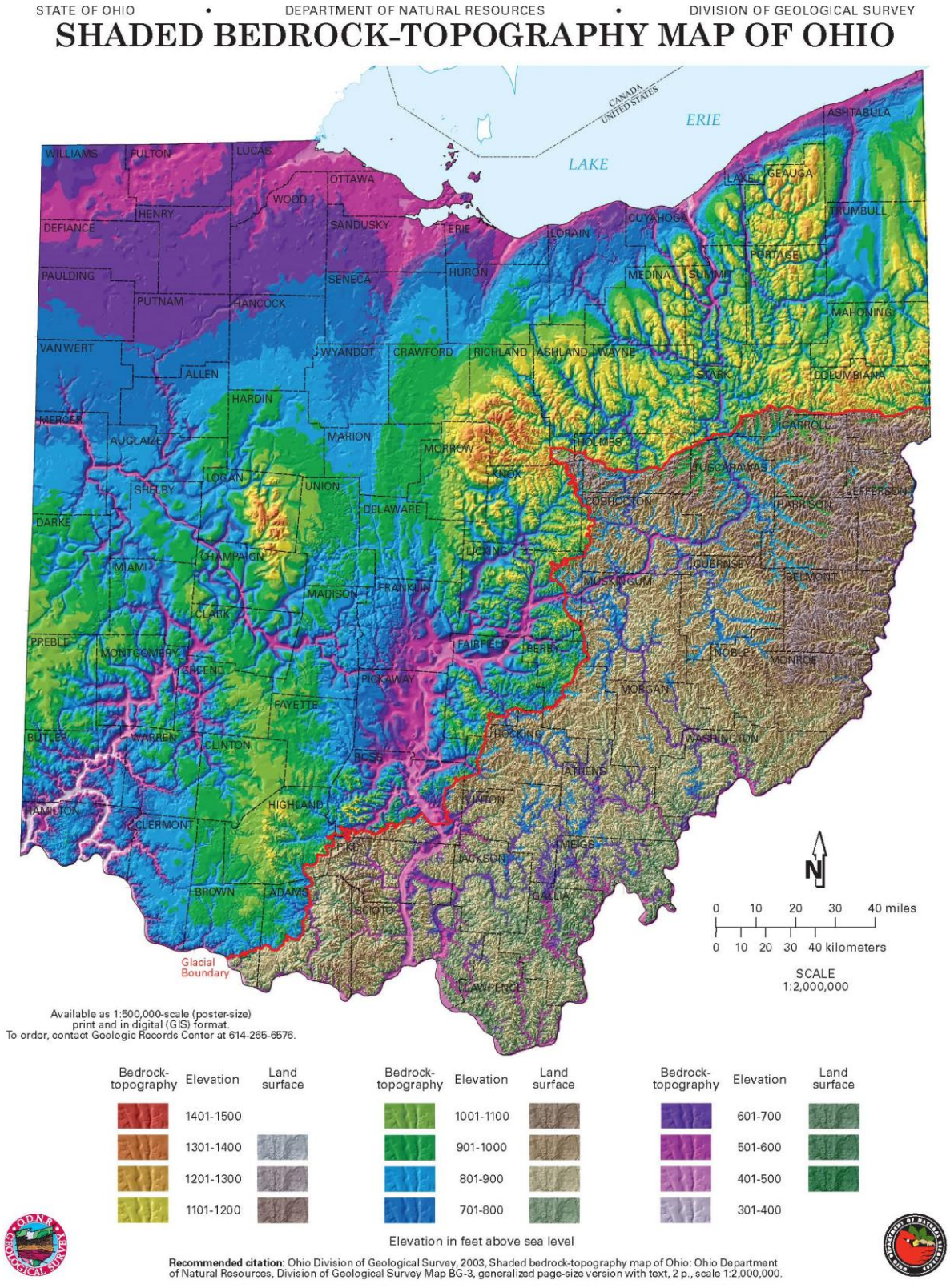
Use Activity Master 13 to try and help you form the type of landforms Ohio had before the glacier moved through Ohio.

After Glacier Moved Through Ohio

Please label landforms created by the glacier and measure the length and depth of the grooves.

Conclusion: Glaciers create a different looking topography by creating new landforms (i.e. creating mountains, hills, valleys, lakes, etc.), through deposition, weathering, and erosion.

Name: _____ Date: _____


STATE OF OHIO • DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY
SHADED BEDROCK-TOPOGRAPHY MAP OF OHIO
CANADA
UNITED STATES
LAKE ERIE
ASHTABULA
GEAUGA
TRUMBULL
PORTAGE
MAHONING
COLUMBIANA
CARROLL
JEFFERSON
HARRISON
BELMONT
GUERNSEY
MUSKINGUM
NOBLE
MONROE
MORGAN
WASHINGTON
ATHENS
MEIGS
GALLIA
LAWRENCE
JACKSON
PIKE
SCIOTO
ADAMS
BROWN
HIGHLAND
CLERMONT
HAMILTON
BUTLER
WARREN
CLINTON
FAYETTE
PICKAWAY
ROSS
HOCKING
VINTON
FAIRFIELD
PERRY
LICKING
MUSKINGUM
MADISON
FRANKLIN
CLARK
GREENE
MONTGOMERY
PREBLE
MIAMI
CHAMPAIGN
DARKE
SHELBY
LOGAN
UNION
DELAWARE
MORROW
KNOX
HOLMES
COSHOCTON
MARION
AUGLAIZE
MERCER
HARDIN
ALLEN
VAN WERT
PAULDING
PUTNAM
HANCOCK
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
SUMMIT
MEDINA
CUYAHOGA
LORAIN
ERIE
SANDUSKY
SENECA
HURON
WOOD
OTTAWA
LUCAS
FULTON
WILLIAMS
DEFIANCE
HENRY
Glacial Boundary
N
0 10 20 30 40 miles
0 10 20 30 40 kilometers
SCALE 1:2,000,000
Available as 1:500,000-scale (poster-size) print and in digital (GIS) format. To order, contact Geologic Records Center at 614-265-6576.
Bedrock-topography
Elevation
Land surface
1401-1500
1301-1400
1201-1300
1101-1200
1001-1100
901-1000
801-900
701-800
601-700
501-600
401-500
301-400
Elevation in feet above sea level
Recommended citation: Ohio Division of Geological Survey, 2003, Shaded bedrock-topography map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-3, generalized page-size version with text, 2 p., scale 1:2,000,000.

SHADED BEDROCK-TOPOGRAPHY MAP OF OHIO

The shaded bedrock-topography map of Ohio depicts the configuration and elevation of the bedrock surface. In southeastern Ohio, the bedrock surface coincides with present-day land-surface topography and is depicted by earth-tone hues to represent elevation intervals. In glaciated western and northern Ohio, the bedrock surface is buried under mainly glacial sediments that can be several-hundred-feet thick. The land surface in this region was smoothed by glaciation (figure 1) and masks a complexly dissected, underlying bedrock surface. This dissected bedrock surface is the result of erosion before, during, and after glaciation. Spectral hues depict elevation intervals on the buried-bedrock surface and show the bedrock surface as if the overlying glacial sediment were removed.

Prior to and during glaciation, the north-flowing Teays River system dominated surface-water drainage patterns in western and southern Ohio (figure 2). Water flow direction in the main Teays valley was north from Wheelersburg (Scioto County) to Circleville (Pickaway County) and then northwest to Mercer County where the Teays Valley exited the state. Remnants of the Teays Valley are distinct on the present land surface in southern Ohio and form a continuous valley on the buried-bedrock surface across western Ohio. Modern rivers and streams still occupy portions of this valley system. Water flow in the Teays River system was disrupted by early glaciations as southward-advancing glaciers blocked outlets of the north-flowing river system. Drainageways, both large and small, were abandoned or filled with sediment as ice advanced and retreated.

In northwestern Ohio, the generally smooth buried-bedrock surface is the result of repeated scouring by glacial ice advancing westward out of the Lake Erie basin. Another distinctly scoured bedrock surface is in the Grand River Lobe (figure 2) in northeastern Ohio where smooth north-south trending valleys mirror ice-flow direction. South of the scour-dominated surface of northern Ohio, the bedrock surface has been sculpted by water to create a distinct drainage pattern (figure 2). Large volumes of glacial meltwater eroded the bedrock surface, widening and deepening existing valleys of the Teays system and creating new valleys. Some modern rivers and creeks flow in unusually wide valleys; evidence that far greater volumes of water generated from melting glaciers once flowed in these valleys. Flow direction in other valleys has been reversed as glacial ice or glacial sediments blocked formerly northward and westward flowing streams.

Southeastern Ohio is unglaciated and devoid of ice-deposited sediment (glacial till). However, many river valleys in southeast Ohio did carry glacial meltwater away from the ice front and toward the Ohio River. In the process, many of these valleys were at times made deeper by the erosive force of fast-flowing meltwater streams, and at other times partially filled with sediment. Some valleys in unglaciated Ohio contain thick deposits of clay and silt that accumulated on the bottoms of lakes that formed when glacial ice blocked the flow of rivers or when rapidly accumulating meltwater sediments blocked the mouths of rivers.

This map is one of the results of a 7-year effort by the ODNR, Division of Geological Survey to map the bedrock geology of Ohio. Bedrock-topography maps are essential to producing accurate bedrock-geology maps of glaciated Ohio and of partially buried valleys beyond the glacial limit. Bedrock-topography maps were created for all 788 7.5-minute topographic quadrangles in the state and are available from the Division's Geologic Records Center. Some pre-existing county bedrock-topography maps (1:62,500 scale) and data were photographically enlarged to 1:24,000 scale, revised, and utilized in the compilation of 1:24,000-scale, bedrock-topography maps. Data concentration and contour intervals on the original maps vary widely across the state in response to changing geologic and topographic conditions. Data consists mainly of water-well logs on file at the ODNR, Division of Water, supplemented by outcrop data, Ohio Department of Transportation bridge-boring data, and oil-and-gas-well data.

Elevation contours and over 158,000 data points from the 788 bedrock-topography maps were digitized and compiled for the glaciated portions of the state and for the major valleys beyond the glacial boundary containing significant accumulations of sediment deposited during and after glaciation. The bedrock-topography contours were digitally converted in the ARC GIS environment into a continuous grid model (60 meter grid spacing). This surface was shaded from the northwest slightly above the horizon to produce the appearance of a three-dimensional surface.

The land surface represents the topography of the bedrock surface in southeastern Ohio (excluding valleys beyond the glacial boundary) and in some glaciated areas near the glacial limit where meltwater sediments are thin or absent. Land-surface topography is based largely on data derived from the U.S. Geological Survey's National Elevation Dataset (30 meter grid spacing).

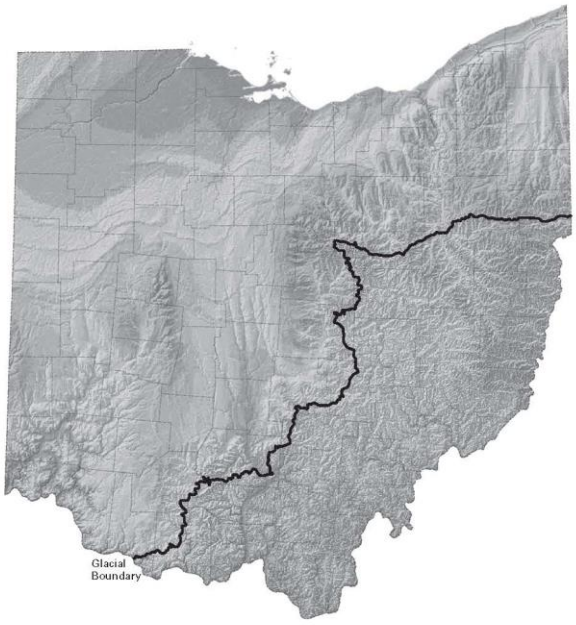


FIGURE 1.—Shaded elevation map of Ohio with the glacial boundary. Note the smooth landscape of glaciated northern and western Ohio compared to the high-relief landscape of unglaciated southeastern Ohio.

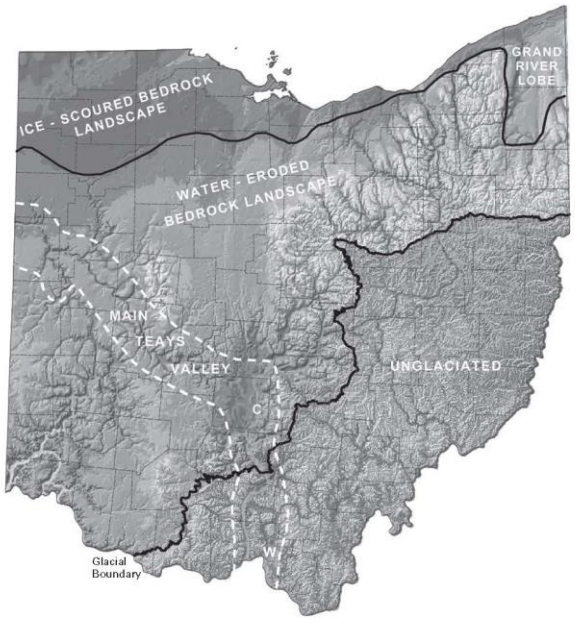
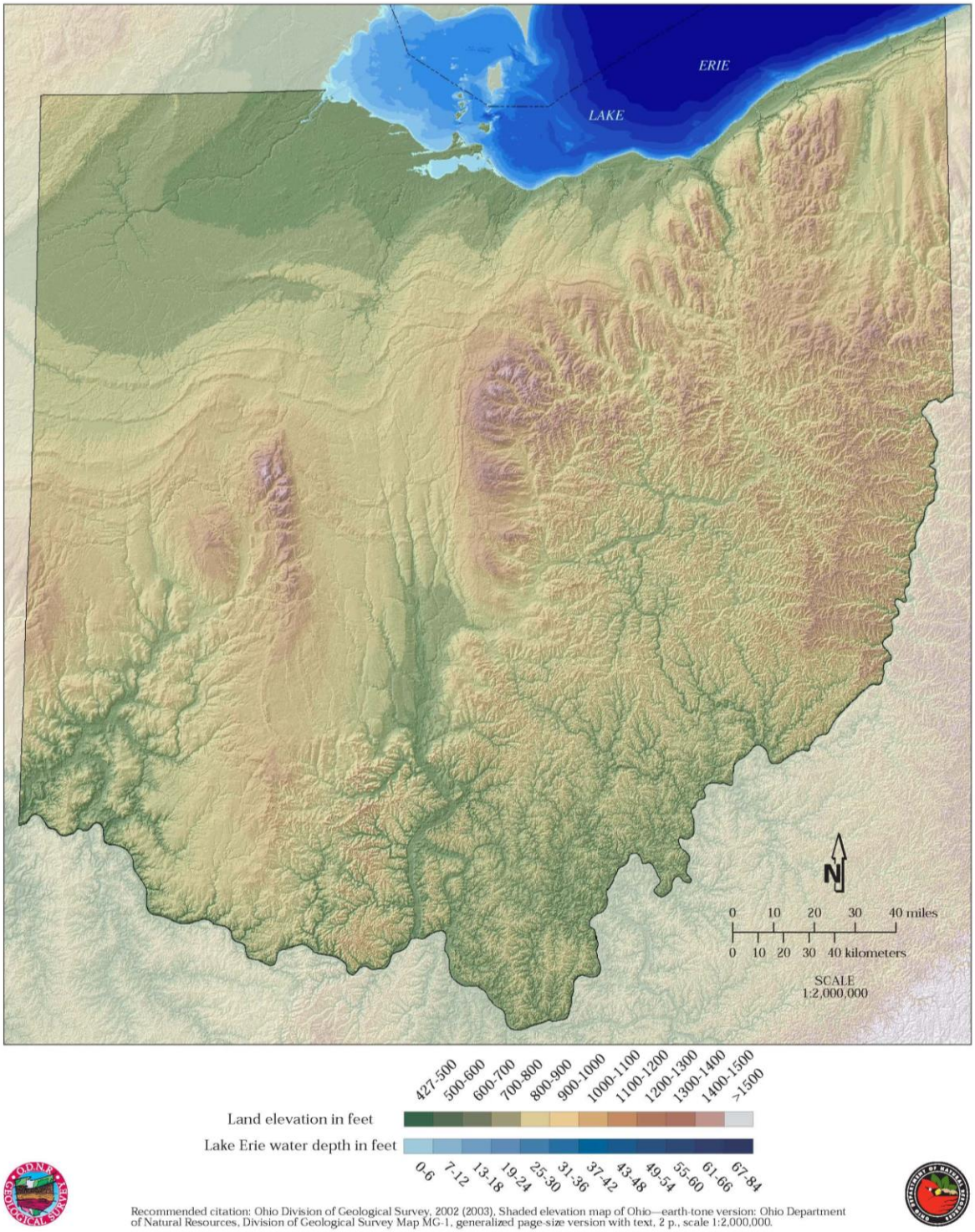


FIGURE 2.—Bedrock-topography map of Ohio showing the extent of the main Teays valley, the unglaciated portion of the state, and the ice-scoured and water-eroded portions of glaciated Ohio (C = Circleville, W = Wheelersburg).

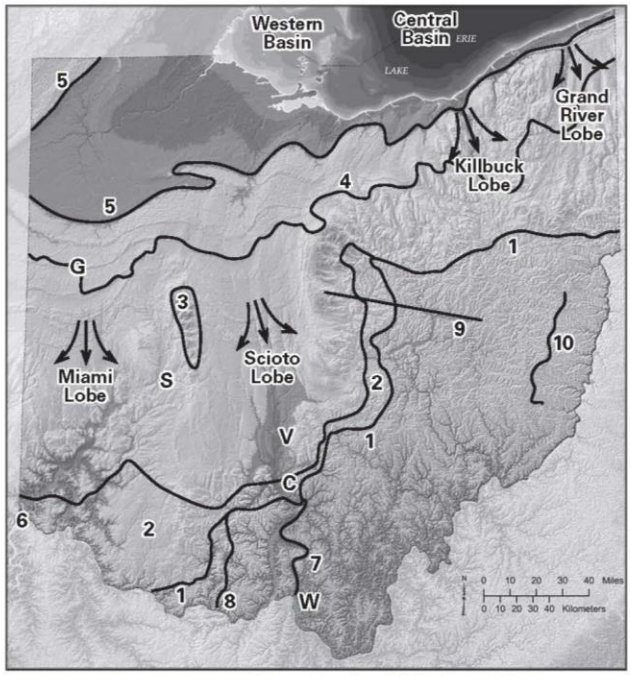
Name: _____ Date: _____

Ohio Pre-Glacier



SHADED ELEVATION MAP

This map depicts the topographic relief of Ohio's landscape using color to represent elevation intervals. The colorized topography has been digitally shaded from the northwest slightly above the horizon to give the appearance of a three-dimensional surface. The map is based on elevation data from the U.S. Geological Survey's National Elevation Dataset; the grid spacing for the data is 30 meters. Lake Erie water depths are derived from National Oceanic and Atmospheric Administration data. This digitally derived map shows details of Ohio's topography unlike any map of the past. Some of Ohio's more striking topographic features are outlined on the inset map below and described in the following paragraphs.



Direction of ice flow in glacial lobes

C = Chillicothe
G = Grand Lake St. Marys
S = Springfield
V = Circleville
W = Wheelersburg

1 *Glacial boundary*—Continental ice sheets several thousand feet thick sculpted about two-thirds of Ohio's landscape and, upon melting, deposited material formerly incorporated in or beneath the ice. This boundary marks the southernmost known extent of glacial ice in Ohio. Topography in the glaciated portion of Ohio is smooth compared to the highly dissected, unglaciated part of Ohio. The glacial boundary in eastern Ohio is farther north than the boundary in western Ohio because the erosion-resistant bedrock hills in eastern Ohio impeded southward glacial advances. The glacial boundary in central and southwestern Ohio typically represents the maximum advance of Illinoian-age (130,000-300,000 years ago) glaciers. The east-west-oriented boundary in northeastern Ohio represents the maximum advance of Wisconsinan-age (14,000-24,000 years ago) glaciers.

2 *Illinoian till areas*—Thin till (an unsorted mixture of glacially deposited clay, silt, sand, and cobbles) of Illinoian age is at the surface in a 10- to 40-mile-wide belt between the Illinoian and Wisconsinan maximum advances. Terrain in this belt is typically transitional between the generally flat Wisconsinan till plains to the north and west and the dissected, unglaciated bedrock to the southeast. The surface deposits in this belt are characterized by loess (wind-blown silt) over thin till on ridge tops and thick colluvium (weathered bedrock) on slopes.

3 *Ohio's highest elevation*—An upland area known as the Bellefontaine Outlier covers portions of Champaign, Logan, and Union Counties in west-central Ohio. The outlier is an erosional remnant of Devonian-age limestone, dolomite, and shale that lies 25 miles west of the main outcrop belt of Devonian-age rock in Franklin and Delaware Counties in central Ohio. The outlier is mantled by up to 160 feet of till, which adds to the outlier's height. Campbell Hill, the highest elevation in Ohio at 1,549 feet above sea level, is on the outlier. The higher, more resistant bedrock of the outlier impeded the southward-advancing glaciers, causing them to split into two lobes, the Miami Lobe on the west and the Scioto Lobe on the east. Ridges of thick accumulations of glacial material, called moraines, drape around the outlier and are distinct features on the map. Some moraines in Ohio are more than 200 miles long. Two other glacial lobes, the Killbuck and the Grand River Lobes, are present in the northern and northeastern portions of the state.

4 *Eastern Continental Divide*—A continental drainage divide extends east-west across northern Ohio. Surface water north of this divide flows northward to Lake Erie, eventually over Niagara Falls into Lake Ontario, and into the Atlantic Ocean. Surface water south of the divide flows south to the Ohio River, the Mississippi River, and eventually into the Gulf of Mexico. The divide follows the crests of glacial moraines in western Ohio. In north-central and northeastern Ohio, the divide follows bedrock-controlled hills and glacial valleys containing thick glacial-lake deposits.

5 *Ancient Lake Maumee shoreline*—About 14,000 years ago, the last continental ice sheet retreated northward across Ohio. The St. Lawrence Seaway was blocked by glacial ice, and glacial meltwater created lakes in front of the ice. A large lake, called Lake Maumee, formed in the general position of Lake Erie but extended over a much larger portion of northwestern Ohio. Ancient Lake Maumee water levels were about 230 feet higher than modern Lake Erie, and drained westward into the Wabash River system. The shoreline of ancient Lake Maumee had a series of sandy beaches and beach scarps, much like portions of Lake Erie today. The ancient sandy beaches are visible on the map as long, thin ridges on the surrounding flat lake terrain. Other beach ridges formed as the water level receded in stages before rising to its current level of approximately 572 feet above sea level. Lake Erie is the shallowest of the Great Lakes and has three basins: the western (averages 30 feet in depth), central (averages 60 feet in depth), and eastern (not shown on map; averages 80 feet in depth; maximum depth is about 212 feet).

6 *Ohio's lowest elevation*—The lowest surface elevation in Ohio is about 455 feet above sea level and is located where the Ohio River exits the state at the extreme southwestern corner of Ohio.

7 *Teays River valley*—The ancient Teays River flowed across Ohio before and during the earliest Ice Age. A north-south-trending remnant of the Teays River valley in south-central Ohio is distinctly visible on this map. From its headwaters in North Carolina, the Teays River flowed northwest across Virginia and West Virginia and entered Ohio in the area of present-day Wheelersburg. The Teays River cut a wide, curving valley as it flowed northward through southern Ohio. This valley, partially filled with clay, silt and sand, contains only a small stream today and remains clearly visible on the map as far as Chillicothe. North of Chillicothe, the valley is buried beneath hundreds of feet of glacial sediment but can be traced using well data to Circleville; the buried valley then turns northwestward, passing beneath Springfield and Grand Lake St. Marys and into eastern Indiana. In parts of western Ohio, the valley lies beneath 700 feet of glacially derived material. The valley commonly is about 200 to 300 feet deep and has steep to near-vertical walls.

8 *Allegheny Escarpment*—Beyond the glacial boundary, the Allegheny Escarpment of southern Ohio marks a distinct change in topography. The land surface changes abruptly from the flatter, lower terrain in the west, which is underlain by soft carbonate rocks, to the higher, steeper terrain in the east, which is underlain by shale and sandstone. To the north, the escarpment was affected by glaciation, making it a less distinct topographic feature. The Allegheny Escarpment corresponds to a slight increase in the dip (tilt) of the rock layers as they descend eastward into the Appalachian Basin.

9 *Surface lineament*—A west-northwest-trending lineament (a linear topographic feature on the Earth's surface) across east-central Ohio is distinctly visible on the map. The Walhonding River and a portion of the Muskingum River flow in portions of this linear topographic depression. Although poorly understood, this feature, which is referred to as the Coshocton Fracture Zone, has been attributed to fractures in the surface bedrock that are possibly related to faults present deeper in the subsurface.

10 *Flushing Divide*—A sharp, north-northeast-trending, ridgelike feature in eastern Ohio is the Flushing Drainage Divide, named after the Belmont County village of Flushing, where it is well developed. Surface water west of the divide flows westward into a series of low-gradient creeks, such as the Sandy, Conotton, and Stillwater, and then to the Tuscarawas River. Surface water east of the divide flows eastward into a series of high-gradient, rapidly down-cutting creeks that flow into the Ohio River. The ridge is at an elevation of about 1,260 to 1,280 feet above sea level and separates two old Teays-era drainage basins.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 7

Erosion, Deposition, and Weathering Text

Materials Needed

- Copies of Activity Master 14 (one copy per student)
- Student science journals
- Pencil
- Glue sticks

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Master 14

Lesson Objectives

- Students will review the processes of erosion, deposition, and weathering.
- Students will engage effectively in groups through discussions.
- Students will read information texts about erosion, deposition, and weathering.
- Students will be able to answer extended response questions about the concepts.

Lesson Overview:

Students will review the concepts of erosion, deposition, and weathering. The students will then read informational texts about erosion, deposition, and weathering and answer extended response questions about these concepts.

Student Prerequisites:

- Have some prior knowledge of the concepts of erosion, deposition, and weathering

Review of Lesson 6:

1. What is erosion?
2. What is deposition?
3. What is weathering?
4. How do all those processes change the way our Earth looks?

Word Study

Erosion
Landscape
Glacier
Sand
Supporting Details
Experiment
Conclusion
Result
Topography
Mountains
Deposition
Weathering
Hypothesis
Hills
Gravel
Compare
Wind
Informational Text
Contrast
Regions
Terrain
Valleys
Lakes
Sediment
Summary
Analyze
Conduct
Observation
Rivers
Paragraph
Landforms

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Earth Science — This topic focuses on the variety of processes that shape and reshape Earth's surface.
Content Statement
1. Earth's surface has specific characteristics and landforms that can be identified. Earth's surface can change due to erosion and deposition of soil, rock, or sediment. Catastrophic events such as flooding, volcanoes, and earthquakes can create landforms. 2. The surface of Earth changes due to weathering. Rocks change shape, size, and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases, pollution, and catastrophic events such as earthquakes, mass wasting, flooding, and volcanic activity. 3. The surface of Earth changes due to erosion and deposition. Water, wind, and ice physically remove and carry (erosion) rock, soil, and sediment and deposit the material in a new location.

Content Area: English Language Arts	
Strand	**Topic**
Speaking and Listening	Comprehension and Collaboration
Standard Statements	
1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on others' ideas and expressing their own clearly. a. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and have them explain their own ideas and understanding.	

Content Area: English Language Arts	
Strand	Topic
Speaking and Listening	Comprehension and Collaboration
Standard Statements	
1. Determine the main idea of a text and explain how it is supported by key details; summarize the text. (ODE Standard Statement No. 2)	

Activity: Reading and Answering Comprehension Questions on Erosion, Deposition, and Weathering

Instructional Strategies:

1. Pass out Activity Master 14 to students. Ask students to read over the comprehension questions that they will be asked to answer upon completion of reading the informational text. Remind them, that similar to their earlier BCI lesson on Chris Tovani's "reading for a purpose," they need to use these questions to guide their reading. Release students to read and complete comprehension questions independently, or as buddies, depending on teacher preference. If individual students or buddy readers complete this work before their classmates they can:

    a. Generate questions that they still have about erosion, deposition, and weathering in their science journals.
    b. Research visual examples in books or online of examples of these concepts.
    c. Develop a plan in their science journals to create an experiment or demonstration on these concepts to share with classmates.
    d. Study topographical maps of the United States or the world trying to identify areas where erosion, deposition, or weathering has most likely occurred.

2. Invite students back to the carpet area to discuss as a class their reading, making sure you clarify any concept misconceptions. Have them turn and talk to a partner that they had not been previously working with for about two minutes, discussing these concepts. Then have students share as a class, while you write their thoughts on chart paper, what new information or important information they learned or reviewed.

3. Have students turn in their work when they are finished.

Optional Extension Activities

1. Research ways people can prevent erosion and share their findings with their classmates through:

    a. A multimedia presentation.
    b. An informative website.
    c. An experiment showing how people can impact our environment in a positive way by reducing erosion.
    d. Making a graph or chart illustrating what erosion preventative techniques are the best.

2. Create an iMovie, or other type of video, demonstrating how erosion, deposition, and weathering affect Earth's landscape.
3. Create, using Comic Life, or an original paper comic format, a visual representation with captions about how a landscape can change over time through the process of erosion, weathering, and deposition.
4. Have students create a rap or song, explaining the concepts of erosion, deposition, and weathering to their classmates.
5. Write a report hypothesizing what Ohio would be like today had the glaciers not come through when they did.
6. Draw a map of Ohio before and after the glacier came through to show how it changed the landscape.
7. Write a historical fiction and/or fantasy story of what it would have been like to live in Ohio at the time of glaciation.
8. Create a poem, song, or rap on the concepts of erosion, deposition, and weathering.
9. Create a movie about the concepts of erosion, deposition, and weathering.

Name: _____ Date: _____

Directions: Please read the text selection below on erosion, deposition and weathering. Then, answer the extended response questions below for each passage.

Erosion

Erosion is the process of moving sediment by wearing it away, with forces such as water, wind, and ice. Water is actually the main force of erosion at work on the Earth. Water in the form of rainfall, rivers, waves, and floods can erode the Earth.

Erosion can also be caused by wind, especially in dry areas. Wind causes erosion by picking up and carrying loose particles and dust away causing flying pieces of sediment to crash into the land and break off more particles of the Earth.

Erosion can also occur from ice. Glaciers are like giant rivers of ice that slowly move around as they melt. This slow movement of glaciers can carve out valleys and even create mountains.

Erosion can occur from animals, insects, and worms, as well. These animals and insects break up the soil as they go about their day building homes and rummaging for food. Gravity also is a cause of erosion. It is a force that pulls rocks and other particles down the side of a mountain or cliff. Gravity can even cause landslides which erode the Earth.

Another way erosion can occur is from temperature changes. When the temperature becomes warmer, the sun heats up rock and the rock can actually expand and crack into pieces.

Lastly, people can cause erosion. Through poor farming practices, ranching, cutting down forests without replanting, and building roads and cities.

Erosion can be slowed down and prevented in some cases. We can plant more trees, we can move grazing herds of animals in a rotation so that grass can grow back, add mulch to flowerbeds, and we can add barriers or retaining walls in areas that need extra support. The daily choices we make can prevent erosion.

1. What is erosion? (Please answer in complete sentences.)

2. What are the causes of erosion? (Please answer in complete sentences.)

3. How can we prevent erosion? (Please answer in complete sentences.)

Deposition

Deposition is the transfer of collected sediment being dropped or dumped from one location to another. Deposition is tied to the processes of weathering and erosion. First, rocks are broken down into small pieces. This is weathering. Then, the small pieces of dirt and sand are picked up by forces of nature which is erosion. When those pieces of sediment are moved to a new place, that is deposition.

Sediment can be transported as rocks, pebbles, sand, and mud. There are four primary causes of deposition. The first cause is glacier movement. Glaciers pick up rocks and deposit them as they move. Another cause is gravity. Gravity acts upon the earth and rocks tumble or fall downhill. Wind can cause deposition. Wind picks up lighter forms of sediment, such as dust, and sand, and deposits them as it dies down. Finally, water also is a cause of deposition. Ocean waves, runoff from rainwater (that does not become absorbed by the ground), and the movement of streams all cause deposition.

All of the rocks and tiny pieces of sediment that have been moved, have to be deposited somewhere. Sometimes the deposition of the sediment can mean the creation of a new landform such as deltas, mountains, and even new islands!

1. In the experiment you conducted using the "glacier" and the map of Ohio, how did deposition change the topography of Ohio? Did it create any new landforms?

Weathering

Weathering is the slow breakdown of rock and sediment. Over time, sun, wind, rain, and ice wear down Earth's surface. They break the Earth into small pieces called sediment.

During an intense storm, winds can be very strong. The wind can lose small bits of dirt and dust. Water can run into cracks in rocks. If the water freezes inside the rocks, it will expand, which can widen the cracks and sometimes even split the rocks. A glacier, which is a very large sheet of ice and snow, can cut into rock as it moves slowly down the land. As the glacier melts, the water carves out large valleys.

The heat from the sun can change the Earth's surface as well. When the sun heats up rock, it makes the rock expand. When the rocks cool they shrink. As this process repeats, the rocks begin to crack and eventually break apart into tiny pieces. Plants and animals can also cause weathering. When a seed finds its way into soil between rocks and grows, the plant's roots crack and break apart the rock. Rocks can also break apart when animals move underground through the dirt or as they run or walk on the rocks.

Finally, when the oxygen in our air and soil mix with water it can create a chemical called acid. Acid can dissolve rocks turning them into liquid. Limestone is a common rock that can

be dissolved quickly. Acid can cause rocks to crack and create caves and even sinkholes. Weathering, with its many causes, can really change the way the surface of our Earth looks, creating new landforms.

1. How are the concepts of weathering, deposition, and erosion related to one another?

2. How does weathering change the surface of the Earth?

Name: _____ Date: _____

Directions: Please read the text selection below on erosion, deposition and weathering. Then, answer the extended response questions below for each passage.

Erosion

Erosion is the process of moving sediment by wearing it away, with forces such as water, wind, and ice. Water is actually the main force of erosion at work on the Earth. Water in the form of rainfall, rivers, waves, and floods can erode the Earth.

Erosion can also be caused by wind, especially in dry areas. Wind causes erosion by picking up and carrying loose particles and dust away causing flying pieces of sediment to crash into the land and break off more particles of the Earth.

Erosion can also occur from ice. Glaciers are like giant rivers of ice that slowly move around as they melt. This slow movement of glaciers can carve out valleys and even create mountains.

Erosion can occur from animals, insects, and worms, as well. These animals and insects break up the soil as they go about their day building homes and rummaging for food. Gravity also is a cause of erosion. It is a force that pulls rocks and other particles down the side of a mountain or cliff. Gravity can even cause landslides which erode the Earth.

Another way erosion can occur is from temperature changes. When the temperature becomes warmer, the sun heats up rock and the rock can actually expand and crack into pieces.

Lastly, people can cause erosion. Through poor farming practices, ranching, cutting down forests without replanting, and building roads and cities.

Erosion can be slowed down and prevented in some cases. We can plant more trees, we can move grazing herds of animals in a rotation so that grass can grow back, add mulch to flowerbeds, and we can add barriers or retaining walls in areas that need extra support. The daily choices we make can prevent erosion.

1. What is erosion? (Please answer in complete sentences.)

   Answer should include something like - Erosion is the process of moving sediment by wearing it away, with forces such as water, wind, and ice.

2. What are the causes of erosion? (Please answer in complete sentences.)

   Answer should include something like – The causes of erosion are water, wind, ice, animals, gravity, and people.

3. How can we prevent erosion? (Please answer in complete sentences.)

Answer should include something like – We can prevent erosion by planting more trees, rotating location of grazing animals, adding mulch to flowerbeds, and adding barriers or retaining walls in areas that might need extra support.

Deposition

Deposition is the transfer of collected sediment being dropped or dumped from one location to another. Deposition is tied to the processes of weathering and erosion. First, rocks are broken down into small pieces. This is weathering. Then, the small pieces of dirt and sand are picked up by forces of nature which is erosion. When those pieces of sediment are moved to a new place, that is deposition.

Sediment can be transported as rocks, pebbles, sand, and mud. There are four primary causes of deposition. The first cause is glacier movement. Glaciers pick up rocks and deposit them as they move. Another cause is gravity. Gravity acts upon the earth and rocks tumble or fall downhill. Wind can cause deposition. Wind picks up lighter forms of sediment, such as dust, and sand, and deposits them as it dies down. Finally, water also is a cause of deposition. Ocean waves, runoff from rainwater (that does not become absorbed by the ground), and the movement of streams all cause deposition.

All of the rocks and tiny pieces of sediment that have been moved, have to be deposited somewhere. Sometimes the deposition of the sediment can mean the creation of a new landform such as deltas, mountains, and even new islands!

1. In the experiment you conducted using the "glacier" and the map of Ohio, how did deposition change the topography of Ohio? Did it create any new landforms?

   Answers will vary. Answers should include information about how the glacier deposited rocks/gravel, smoothed or flattened hills and mountains, created lakes or valleys, etc.

Weathering

Weathering is the slow breakdown of rock and sediment. Over time, sun, wind, rain, and ice wear down Earth's surface. They break the Earth into small pieces called sediment.

During an intense storm, winds can be very strong. The wind can lose small bits of dirt and dust. Water can run into cracks in rocks. If the water freezes inside the rocks, it will expand, which can widen the cracks and sometimes even split the rocks. A glacier, which is a very large sheet of ice and snow, can cut into rock as it moves slowly down the land. As the glacier melts, the water carves out large valleys.

The heat from the sun can change the Earth's surface as well. When the sun heats up rock, it makes the rock expand. When the rocks cool they shrink. As this process repeats, the

rocks begin to crack and eventually break apart into tiny pieces. Plants and animals can also cause weathering. When a seed finds its way into soil between rocks and grows, the plant's roots crack and break apart the rock. Rocks can also break apart when animals move underground through the dirt or as they run or walk on the rocks.

Finally, when the oxygen in our air and soil mix with water it can create a chemical called acid. Acid can dissolve rocks turning them into liquid. Limestone is a common rock that can be dissolved quickly. Acid can cause rocks to crack and create caves and even sinkholes. Weathering, with its many causes, can really change the way the surface of our Earth looks, creating new landforms.

1. How are the concepts of weathering, deposition, and erosion related to one another?

Answers will vary. Answers should include something like the following: Deposition is tied to the processes of weathering and erosion. First, rocks are broken down into small pieces. This is weathering. Then, the small pieces of dirt and sand are picked up by forces of nature which is erosion. When those pieces of sediment are moved to a new place, that is deposition.

2. How does weathering change the surface of the Earth?

Answers will vary. Answers should include something like the following: Weathering, with its many causes, can really change the way the surface of our Earth looks, creating new landforms and therefore changing the topography of an area of land.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 8

Sinkhole Simulation

Materials Needed

- Copies of Activity Master 15 (one copy per student)
- Graham crackers (about one box)
- Sugar cubes
- Eight or nine empty glass jars (spaghetti sauce-size), depending on class size
- Eight or nine Lego people, depending on class size
- Eight or nine turkey basters (graduated cylinders with spouts/measuring cups would also work for pouring the water slowly out of containers)
- Science journals
- Pencil
- Colored pencils
- Glue stick
- Equipment to project video clip

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 8 — *Sinkholes* (1:57)
- Activity Master 15

Lesson Objectives

- Students will learn how erosion can cause sinkholes.
- Students will discuss topics in groups and effectively express their ideas.

Lesson Overview:

Students will learn how erosion can lead to sinkhole formation. The students will conduct a sinkhole simulation to see if Farmer Bob could have fallen into the sinkhole accidentally.

Student Prerequisites:

- Have some prior knowledge of sinkholes and how they form

Review of Lesson 7:

- What are erosion, deposition, and weathering?

Word Study

Erosion
Landscape
Glacier
Sand
Supporting Details
Experiment
Conclusion
Topography
Deposition
Weathering
Hypothesis
Wind
Informational Text
Contrast
Gypsum
Rock Salt
Lakes
Sediment
Summary
Analyze
Conduct
Terrain
Rivers
Cavity
Soluble
Limestone Bedrock
Compare
Paragraph
Landmarks

Preparation:

1. Have a source of warm water around to use as “rainwater” to make the dissolving process of the sugar cubes go more quickly.

2. Have necessary lab materials divided into different lab stations around the room, or in an area where group members can collect what they need for their group to complete this experiment.




Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Earth Science — This topic focuses on the variety of processes that shape and reshape Earth’s surface.
Content Statement
1. Earth’s surface has specific characteristics and landforms that can be identified. Earth’s surface can change due to erosion and deposition of soil, rock or sediment. Catastrophic events such as flooding, volcanoes and earthquakes can create landforms. 2. The surface of Earth changes due to weathering. Rocks change shape, size, and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases, pollution, and catastrophic events such as earthquakes, mass wasting, flooding, and volcanic activity. 3. The surface of Earth changes due to erosion and deposition. Water, wind, and ice physically remove and carry (erosion) rock, soil, and sediment and deposit the material in a new location.

Content Area: Science
Grand Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes with appropriate laboratory safety techniques, to construct their knowledge and understanding of all science content area.
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations, and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: English Language Arts	
Strand	**Topic**
Speaking and Listening	Comprehension and Collaboration
Standard Statements	
1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on others' ideas and expressing their own clearly. a. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and explain their own ideas and understanding.	

Activity: Sinkhole Simulation

Instructional Strategies:

1. Play Video Clip 8 — *Sinkhole*s and briefly discuss.

2. Pass out a copy of Activity Master 15 to each student. Explain that in small groups, students will be trying to re-create what might have happened to Farmer Bob.

3. Go over each step of the lab activity, making sure students understand what to do. They will be given a set of instructions on their Activity Master that they will have to complete as they conduct their sinkhole experiment.) Explain to students that they will:

    a. Place two to three graham cracker squares in the bottom of the glass jar to represent sediment.
    b. Then cover the crackers with about three layers of sugar cubes to represent soluble rock, such as limestone, gypsum, or rock salt.
    c. Next, cover the stack with crushed graham cracker crumbs to represent soil. Pack the crumbs together firmly, by pressing them down.
    d. Slowly add water (ideally with a turkey baster filled with hot water) to simulate rain and weathering.
    e. Observe how the sugar cubes slowly dissolve, simulating soluble rock dissolving through the process of weathering and erosion.

4. Break students into small groups making sure that they have all the materials for the experiment. (If you do not have enough supplies, do the activity as one group in an area where all of the students can see the experiment.)

5. Have students complete the experiment in their small groups, making sure they fill in Activity Master 15 as they conduct the experiment.

6. Once the experiment is completed, have students discuss in their small groups what they observed, and what they can conclude about Bob's situation with the sinkhole collapsing. Make sure students document their observations, findings, and conclusions.

7. Have students clean up after the experiment and turn in their Activity Master for assessment.

Optional Extension Activities

1. Create a video or Keynote/PowerPoint on the concept of sinkholes.

2. Create a graphic organizer storyboard of how sinkholes form.

3. Research and write an informational report on sinkholes in Ohio.

4. Design a plan to potentially prevent sinkholes from happening.

5. Have students read this article about a Toledo elementary principal who fell into a sinkhole while driving her car. Available at www.toledoblade.com/Police-Fire/2013/07/03/Sinkhole-on-road-in-central-Toledo-traps-1.html. (Last accessed 27 February, 2017).

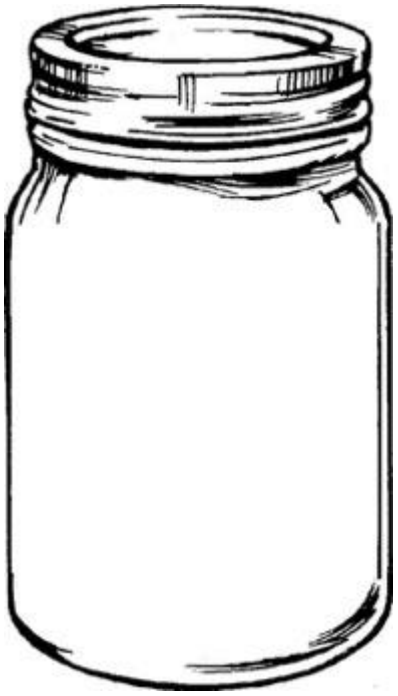
Name: _____ Date: _____

Sinkhole Simulation Activity

Directions: Please follow the instructions below, making sure you complete each step in order.

1. Place two or three graham cracker squares in the bottom of the glass jar. (Represents sediment)
2. Then cover the crackers with about three layers of sugar cubes. (Represents soluble rock, such as limestone, gypsum, or rock-salt)
3. Cover the stack with crushed graham cracker crumbs. Pack the crumbs together firmly, by pressing them down. (Represents soil)
4. Then, place the "Farmer Bob" Lego or figurine in a standing position on top of the ground.
5. Draw a diagram of this experiment ***before*** we add the "rain."

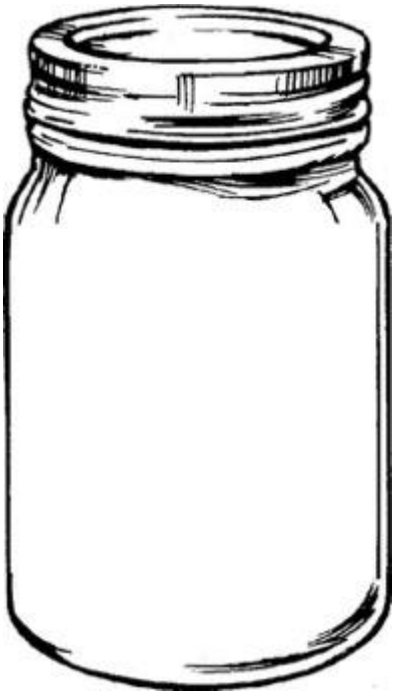
Predict what you think will happen when we add the rain water:



6. Slowly add water (ideally with a turkey baster filled with hot water) to simulate weathering (rain).

Draw a picture of what happened after it rained on the area where Farmer Bob was standing. Describe beside the image of the jar, what happened to the “rock, sediment, and soil.”

Diagram and describe what happened to “Farmer Bob” and the land he was standing on after it rained during this simulation:



Describe how the rain affected the rock, soil, and sediment:

After conducting this experiment, what can you conclude might have happened to the real Farmer Bob?

-OPTIONAL EXTENSION ACTIVITY-

Read the article available at http://www.toledoblade.com/Police-Fire/2013/07/03//Sinkhole-on-road-in-central-Toledo-traps-1.html
and watch the video clip of a sinkhole. Discuss with your classmates what seemed to cause this sinkhole in the middle of the city and compare it with what caused the sinkhole on Bob's property.

In the area below, try to design a way that geologists and engineers could prevent sinkholes like these from happening in the future, before potential injury and harm are caused to people and animals. Please describe your design in detail.

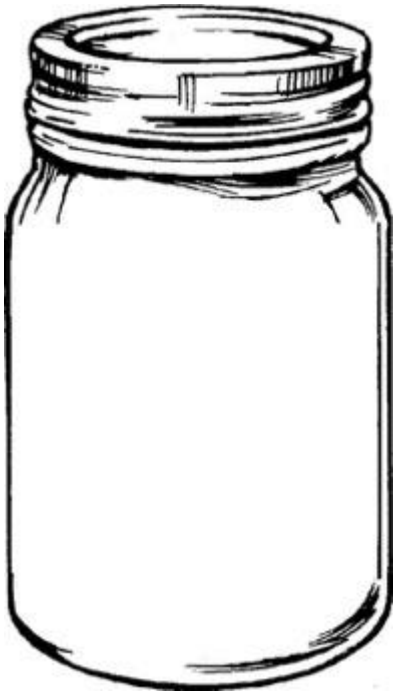
Name: _____ Date: _____

Sinkhole Simulation Activity

Directions: Please follow the instructions below, making sure you complete each step in order.

1. Place 2 – 3 graham cracker squares in the bottom of the glass jar. (Represents sediment)
2. Then cover the crackers with approximately three layers of sugar cubes. (Represents soluble rock like limestone (or gypsum or rock-salt).
3. Next cover the stack with crushed graham cracker crumbs. Pack the crumbs together firmly, by pressing them down. (Represents soil)
4. Then, place the "Farmer Bob" lego or figurine standing on top of the ground.
5. Draw a diagram of this experiment ***before*** we add the "rain".

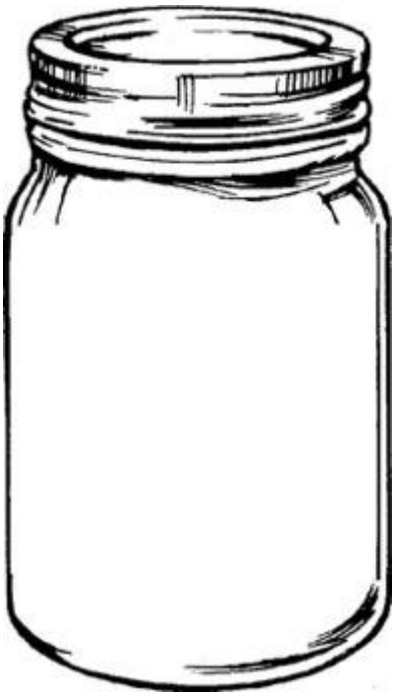
Predict what you think will happen when we add the rain water:
Answers will vary.



6. Slowly add water (ideally with a turkey baster filled with hot water) to simulate weathering (rain).

Draw a picture of what happened after it rained on the area where Farmer Bob was standing. Describe beside the image of the jar, what happened to the "rock, sediment, and soil."

Diagram and description of what happened to "Farmer Bob" and the land he was standing on during this simulation, after it rained:
Answers will vary, but should include the fact that the ground collapsed underneath Farmer Bob and he fell into some type of sinkhole.



Describe how the rain affected the rock, soil, and sediment:
Answers will vary, but should include the following: The rain dissolved the underground rock through weathering. The rain water broke down the (soluble) rock. As the rock eroded, the surface found above the sinkhole began to weaken. Over time, the hole in the rock grew larger allowing more soil to fall into it, leaving an empty cave-like space in the earth. When the roof of the hole could no longer hold up the weight above it, a sinkhole formed.

After conducting this experiment, what can you conclude might have happened to the real Farmer Bob?

Answers will vary, but should include some information about the possibility of Farmer Bob accidentally falling into a sinkhole while walking on his property with his dog.

-OPTIONAL EXTENSION ACTIVITY-

Read the article available at http://www.toledoblade.com/Police-Fire/2013/07/03//Sinkhole-on-road-in-central-Toledo-traps-1.html and watch the video clip of sinkhole. Discuss with your classmates what seemed to cause this sinkhole in the middle of the city and compare it with what caused the sinkhole on Bob's property.

Now, in the area below, try to design a way that geologists and engineers could prevent sinkholes like these from happening in the future, before potential injury and harm are caused to people and animals. Please describe your design in detail.

Answers will vary.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 9

Sinkhole Informational Text

Materials Needed

- Copies of Activity Master 16 (one copy per student)
- Pencil

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Master 16

Lesson Objectives

- Students will read the informational text regarding the formation of sinkholes.
- Students will create a description of how sinkholes form.

Lesson Overview:

Students will read an informational text on sinkholes. Then they will create, below the text passage, a description of how sinkholes form.

Student Prerequisites:

- At least some prior knowledge of how sinkholes are formed

Review of Lesson 8:

- What is a sinkhole and how is it formed?

Word Study

Erosion
Landscape
Glacier
Sand
Supporting Details
Experiment
Conclusion
Topography
Deposition
Weathering
Hypothesis
Wind
Informational Text
Contrast
Gypsum
Rock Salt
Lakes
Sediment
Summary
Analyze
Conduct
Terrain
Rivers
Cavity
Soluble
Limestone Bedrock
Compare
Paragraph

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Physical Science
Topic: Earth Science — This topic focuses on the variety of processes that shape and reshape Earth's surface.
Content Statement
1. Earth's surface has specific characteristics and landforms that can be identified. Earth's surface can change due to erosion and deposition of soil, rock, or sediment. Catastrophic events such as flooding, volcanoes, and earthquakes can create landforms. 2. The surface of Earth changes due to weathering. Rocks change shape, size, and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases, pollution, and catastrophic events such as earthquakes, mass wasting, flooding, and volcanic activity. 3. The surface of Earth changes due to erosion and deposition. Water, wind, and ice physically remove and carry (erosion) rock, soil and sediment and deposit the material in a new location.

Content Area: English Language Arts	
Strand	**Topic**
Reading — Informational Text K-5	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says and when drawing inferences from the text 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text. 6. By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades four to five text complexity band proficiently, with scaffolding as needed at the high end of the range. (ODE Standard No. 10)	

Activity: Reading and Answering Comprehension Questions on Sinkholes

Instructional Strategies:

1. Have students read the informational text from Activity Master 16 and answer the extended-response question. Remind students to read the question first to use as their purpose for reading, before reading the text excerpt. Note: If you feel your students need to read this in pairs, or as a class, feel free to adapt this lesson to meet the individual needs of your students.

2. Once the students have completed Activity Master 16, call the class together to go over the answers before collecting them for a grade.

Optional Extension Activities

1. Create a video, Keynote, or PowerPoint on the concept of sinkholes.
2. Create a graphic organizer storyboard about how sinkholes form.
3. Research and write an informational report on sinkholes in Ohio.
4. Design a plan to potentially prevent sinkholes from happening.

Name: _____ Date: _____

Directions: Please read the text selection below on sinkholes. Then, summarize, in paragraph form, what you learned from this passage about why and how sinkholes form over time. Include a topic sentence, supporting details, and a closing sentence.

Sinkholes

Sinkholes happen all around the world (even in Ohio) and vary greatly in size. Sinkholes begin underground. They can be as minor as a small slump in the ground, usually in the shape of a bowl. Some are much larger though and can collapse completely without any warning.

Sinkholes form when water dissolves underground rock. Rain water (weathering) or other water runoff mixes with carbon dioxide in the air and soil making it acidic. As the acidic water seeps into the ground, it slowly wears away the soluble rock. Soluble rocks are rocks that dissolve easily, such as limestone, dolomite, and gypsum.

As the rock erodes and the sinkhole grows larger, the surface ground above the sinkhole begins to weaken. Over time, the hole in the rock grows even larger and more soil falls into it, leaving an empty cave-like space in the earth above. Finally, the roof of the hole can no longer hold up the weight above it. This is how a sinkhole forms.

Sinkholes can be shallow or huge underground pockets. Regardless of their size, they are all caused because there is nothing underneath them to support the land's weight. Geologists (scientists who study Earth and its composition, structure, and history) work very hard researching areas where sinkholes might form and try to use their expertise to protect the people and animals that live in that area.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 10

Suspect Introduction and Area Map Study

Materials Needed

- Copies of Activity Masters 17, 18, and 19, and 22 (one copy per student) *Activity Master 22 located with Lesson 11 materials
- Glue stick
- Science journals
- Pencil
- Rulers
- Protractors
- Highlighters
- Equipment to Project video clip and Google Earth activity

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 9 — *Historic Cell Records* (4:27)
- Activity Masters 17, 18, and 19, and 22
- Lesson 10 Teacher Resource (cell sector drawing instructions)

Lesson Objectives

- Students will look over Farmer Bob's cellphone records and determine four suspects.
- Students will be familiarized with Google Earth.

Lesson Overview:

Students will be introduced to the four suspects of this case that police identified based on Bob's historical cellphone records and interviews with Bob's family and neighbors, and they will take part in a Google Earth lesson based on those records and interviews.

Student Prerequisites:

- At least some prior knowledge of how to interpret tables, charts, and timelines
- Angle measurement and classification
- Knowledge of map skills

Review of Lesson 9:

- What are sinkholes? Do you think it is possible that Farmer Bob could have fallen into the sinkhole accidentally?

Word Study

Timeline	Statement
Historic Cellphone Records	Examine
Events	Azimuth
Suspects	Link Chart
Analyze	Alibi
Court Order	Angle

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from it.	

Content Area: English Language Arts	
Strand	**Topic**
Speaking and Listening	Comprehension and Collaboration: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on others' ideas, and expressing their own clearly.
Standard Statements	
1. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. 2. Follow agreed-upon rules for discussions and carry out assigned roles. 3. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. 4. Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.	

Content Area: Social Studies	
Theme	**Strand**
Ohio in the United States	Geography
Topic: Spatial Thinking and Skills — Spatial thinking examines the relationships among people, places, and environments by mapping and graphing geographic data. Geographic data are compiled, organized, stored, and made visible using traditional geospatial technologies. Students need to be able to access, read, interpret, and create maps and other geographic representations as tools of analysis.	
Content Statement	
1. A map scale and cardinal and intermediate directions can be used to describe the relative location of physical and human characteristics of Ohio and the United States. (ODE Statement No. 9)	

Content Area: Mathematics	
Domain	**Cluster**
Geometry	Draw and identify lines and angles, and classify shapes by properties of their lines and angles
Standard Statements	
1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.	

Content Area: Mathematics	
Domain	**Cluster**
Measurement	Solve problems involving measurement and conversion of measurement from a larger unit to a smaller unit
Standard Statements	
1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.	

Activity: Suspect Introduction and Area Map Study

Instructional Strategies:

1. Watch Video Clip 9 — *Historic Cell Records* and hand out Activity Master 17.

2. Discuss historical cell records video clip and read over suspect statement sheets. Note: For the remainder of the lesson, you can either do the more advanced demonstration, which is labeled Option 1, or you can do a more basic version, which is labeled Option 2.

Option 1:

1. Project Google Earth on an interactive whiteboard and follow the teacher instructions on the Lesson 10 Teacher Resource until completion.

2. Then, hand out Activity Masters 18 and explain the directions. Have the students work in pairs to complete. Then, go over Activity Master 18 and discuss correct answers for the questions, or collect for a grade if students have had enough previous practice with these map skills concepts.

OR

Option 2:

1. Hand out Activity Master 19 and project it onto the interactive white board.

2. Show students how to measure 60 degrees above horizontal line (azimuth) and 60 degrees below the line. (Review angle labels — obtuse, acute, and right angles — and how many degrees there are in a circle.)

3. Explain that this is what BCI agents and analysts do to determine in what location cellphones were used.

4. Then, hand out Activity Master 18 and explain the directions. Have the students work in pairs to complete. Then, go over Activity Master 18 and discuss correct answers for the questions, or collect for a grade if students have had enough previous practice with these map skills concepts.

Optional Extension Activities

1. Create a TV news report about the case of Bob Agriculture, using movie-making software.

2. Create sketches of the suspects.

3. Students can take the information on the different suspects and create a realistic fiction story about the lives of each suspect.

Ashe Ball – Suspect #1

What We Know:

- Bob and Terra Agriculture's Neighbor
- Hates Bob's noisy dog Buckeye
- Buckeye interrupts her concentration while working from home
- Buckeye has ruined her flower bed many times
- After repeated attempts to try to get farmer Bob to quiet and contain his dog, she threatens through text messaging to "take matters into her own hands"

Physical Description:

Height: 5' 4"
Weight: 150 lbs.
Eye color: blue
Shoe: running shoe
Shoe Size: 8

Suspect's Statement: *"On the day that Bob and Buckeye went missing, I was at home working on my children's book manuscript. I drove into town around lunchtime and I saw E.P. Aye pulling into Bob and Terra's drive as I went past. I did not see Bob or Buckeye though. When I came back from town, I don't remember seeing anything out of the ordinary at the Agriculture home.*

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Juanto Buy – Suspect #2

What We Know:

- Bob's acquaintance
- Really wants to buy some of Bob's farmland, but Bob doesn't want to sell Juanto the land
- This has caused tension between the two acquaintances
- Juanto has also started dating Mya Agriculture, Bob's sister

Physical Description:

Height: 6' 1"
Weight: 170 lbs.
Eye color: hazel
Shoe: boot
Shoe Size: 13

Suspect's Statement: *"On the day that Bob and Buckeye went missing, I was at home working in my barn. I did not see or talk to Bob all day. Mya did bring her car over for me to look at her tire, and Mya borrowed my truck so she could go work on cleaning out her parent's farm house."*

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Mya Agriculture – Suspect #3

What We Know:

- Bob Agriculture's younger sister
- Strongly believes all the farmland is hers from their deceased parents
- Currently in a legal dispute with her brother Bob, arguing over who should be the rightful owner of the land
- Dating Juanto Buy

Physical Description:

Height: 5' 7"
Weight: 125 lbs.
Eye color: blue
Shoe: hiking boot
Shoe Size: 9 1/2

Suspect's Statement: *"I saw Bobby and Buckeye on the day they went missing. When I was cleaning up my parent's old farmhouse earlier in the week, I came across some old photos of Bobby and me on my parent's farm. It made me have a change of heart about the lawsuit I filed against Bobby in regard to my parent's farmland. I texted him to see if he would be willing to meet with me. I saw him in the morning, at his house, around 8:45 for about 45 minutes. I decided to drop the lawsuit against him, and we agreed to come to a better solution to my inheritance. I then went to Juanto's house so he could look at my car tire I thought was flat. He let me borrow his truck so he could look at the tire. I drove Juanto's truck over to my parent's farm house to continue cleaning out some of the rooms. I noticed that Juanto's truck had a strange smell to it."*

Organic Joe – Suspect #4

What We Know:

- Bob Agriculture's next door neighbor
- Doesn't like that Bob uses fertilizers and other chemicals on his crops which Joe believes causes algal blooms in the pond adjacent to both of their properties.
- Joe has held repeated peaceful protests outside Bob's farm against Bob's use of fertilizer and chemicals.

Physical Description:

Height: 6'1"
Weight: 180 lbs.
Eye color: blue
Shoe: boot
Shoe Size: 12

Suspect's Statement: *"It's no big secret that I disagree with the way Bob farms his land. I did not see him the day he disappeared, but I did turn around in his driveway a little before 12:00 p.m. I had just started on my way to get groceries in town and I remembered I left my wallet back at the house."*

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Name: _____ Date: _____

Area Map Study

Please complete the questions and activities below the coordinate grid.

1. Complete the compass rose by adding the intermediate directions.
2. Create a map title.
3. Create a map legend.
4. What is the grid location for Bob and Terra's house?_____
5. What is the grid location for Ashe Ball's house?_____
6. What is the grid location for Mya Agriculture's house? _____
7. What is the grid location for Organic Joe's house?_____
8. What is the grid location for Juanto Buy's house?_____
9. What direction is Ashe Ball's house from Bob's?_____
10. What direction is Juanto Buy's house from Bob's?_____
11. What direction is Bob's house from Organic Joe's?_____
12. What direction is Bob's house from Mya Agriculture's?_____

(Please see reverse side)

13. What is the distance between Organic Joe's and Bob Agriculture's houses?_____

14. What is the distance between Ashe Ball's and Juanto Buy's houses?_____

15. What is the distance between Mya's and Juanto's houses?_____

Name: _____ Date: _____

Area Map Study

Please complete the questions and activities below the coordinate grid.

1. Complete the Compass Rose by adding the intermediate directions.
2. Create a map title.
3. Create a map legend. Should include a house icon, road symbol, water symbol, etc.
4. What is the grid location for Bob and Terra's house? 7F
5. What is the grid location for Ashe Ball's house? 8F
6. What is the grid location for Mya Agriculture's house? 5F
7. What is the grid location for Organic Joe's house? 7D
8. What is the grid location for Juanto Buy's house? 4A
9. What direction is Ashe Ball's house from Bob's? 4A
10. What direction is Juanto Buy's house from Bob's? Northwest
11. What direction is Bob's house from Organic Joe's? South
12. What direction is Bob's house from Mya Agriculture's? Northeast or East

(Please see reverse side)

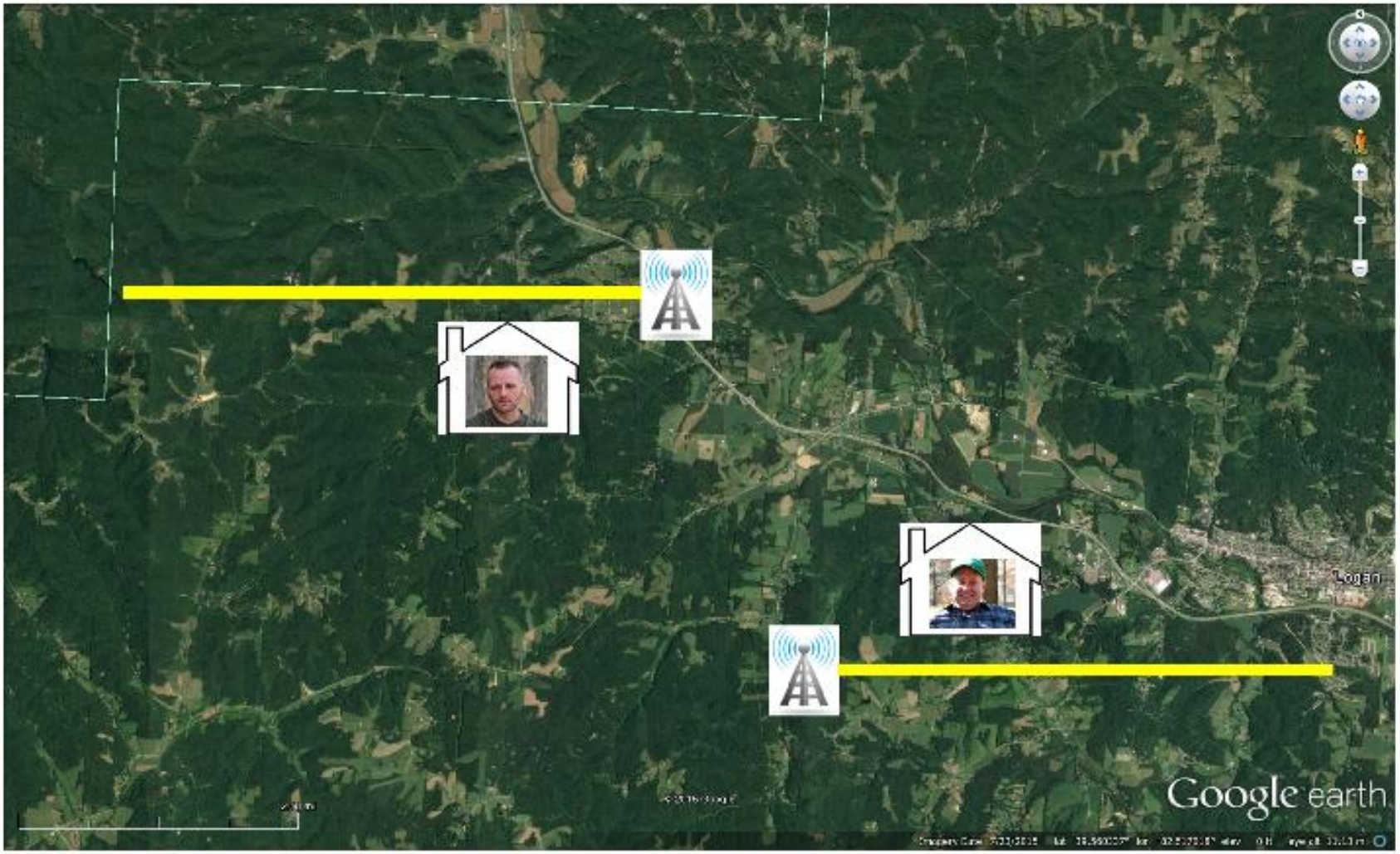
13. What is the distance between Organic Joe and Bob Agriculture's house? ~4,312.5 feet

14. What is the distance between Ashe Ball and Juanto Buy's house? ~12,750 feet

15. What is the distance between Mya and Juanto's house? ~9, 937.5 feet

Name: _____ Date: _____

Cell Tower Map Activity



OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 11
Timelines

Materials Needed
- Copies of Activity Masters 20, 21, 22, 23, and 24 (one copy per student)
- Students' copies of Activity Master 17 from Lesson 10 (Suspect Sheets)
- Glue sticks
- Science journals
- Pencil
- Rulers
- Equipment to project video clip

Approximate Time
- 50 minutes

Corresponding Required Resources
- Video Clip 10 – *Timeline* (1:59)
- Activity Masters 20, 21, 22 (from Lesson 10), 23, and 24

Lesson Objectives
- Students will successfully work in groups and participate in discussions.
- Students will come to class prepared and ready for discussions.
- Students will develop a timeline of Farmer Bob's disappearance.
- Students will be able to ask and respond to specific questions to clarify or follow up on information.

Lesson Overview:

Students will analyze the historic cellphone records of Bob Agriculture and Juanto Buy, and develop a timeline based on Juanto Buy's location during the timeframe of Bob's barn being broken into and having the chemicals and fertilizer stolen.

Student Prerequisites:

- At least some prior knowledge of how to interpret and create tables, charts, and timelines

Review of Lesson 10:

- Who are the four suspects in this case?

Word Study

Timeline	Forensic Scientist
Statement	Process
Analyze	Crime
Alibi	Robber
Suspects	Criminal Investigator
Examine	Criminal
Evidence	Clues

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading: Literature	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from it.	

Content Area: English Language Arts	
Strand	**Topic**
Speaking and Listening	Comprehension and Collaboration: Engage effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on grade four topics and texts, building on others' ideas and expressing their own clearly.
Standard Statements	
1. Come to discussions prepared after having read or studied required material; explicitly draw on that preparation, and other information known about the topic, to explore ideas under discussion. 2. Follow agreed-upon rules for discussions and carry out assigned roles. 3. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. 4. Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.	

Content Area: English Language Arts	
Theme	**Strand**
Ohio in the United States	History
Topic: Historical Thinking and Skills — Historical thinking begins with a clear sense of time — past, present and future — and becomes more precise as students' progress. Historical thinking includes skills such as locating, researching, analyzing, and interpreting primary and secondary sources so that students can begin to understand the relationships among events and draw conclusions.	
Content Statement	
1. The order of significant events in Ohio and the United States can be shown on a timeline. 2. Primary and secondary sources can be used to create historical narratives.	

Activity: Creating a Timeline

Instructional Strategies:

1. Pass out copies of Activity Masters 20, 21, 22, 23, and 24 to students. Explain that this information is going to be presented in the video clip.

2. Then, show Video Clip 10 and have the students briefly look over the historic cellphone records of Bob and Juanto Buy, and the suspect statements.

3. Have students come to the carpet area with their science journals, pencils, glue sticks, and Activity Masters 20, 21, 22, 23, 24, and 17 from Lesson 10.

4. Go over Activity Masters 21, 22, 23, and 24 with the students on the interactive whiteboard or projector clarifying any misconceptions and answering questions about the documents. As you explain each one, have the students glue them into their science journals.

5. Explain that the students are going to assemble in pairs and find a spot to take Juanto Buy's historic cellphone records and create a timeline of his actions and whereabouts from Friday, Oct. 23, to Saturday, Oct. 24, on Activity Master 20. Go over the directions and answer any questions. Release students to work.

6. Walk around the room to each pair, making sure students understand what they are doing and are on-task.

7. Call students back to the carpet area to share their timelines and discuss with their classmates if they decided to put the same events on their timelines. Ask the students if they made any interesting observations that might help with solving the case. Collect timelines at the end of the lesson.

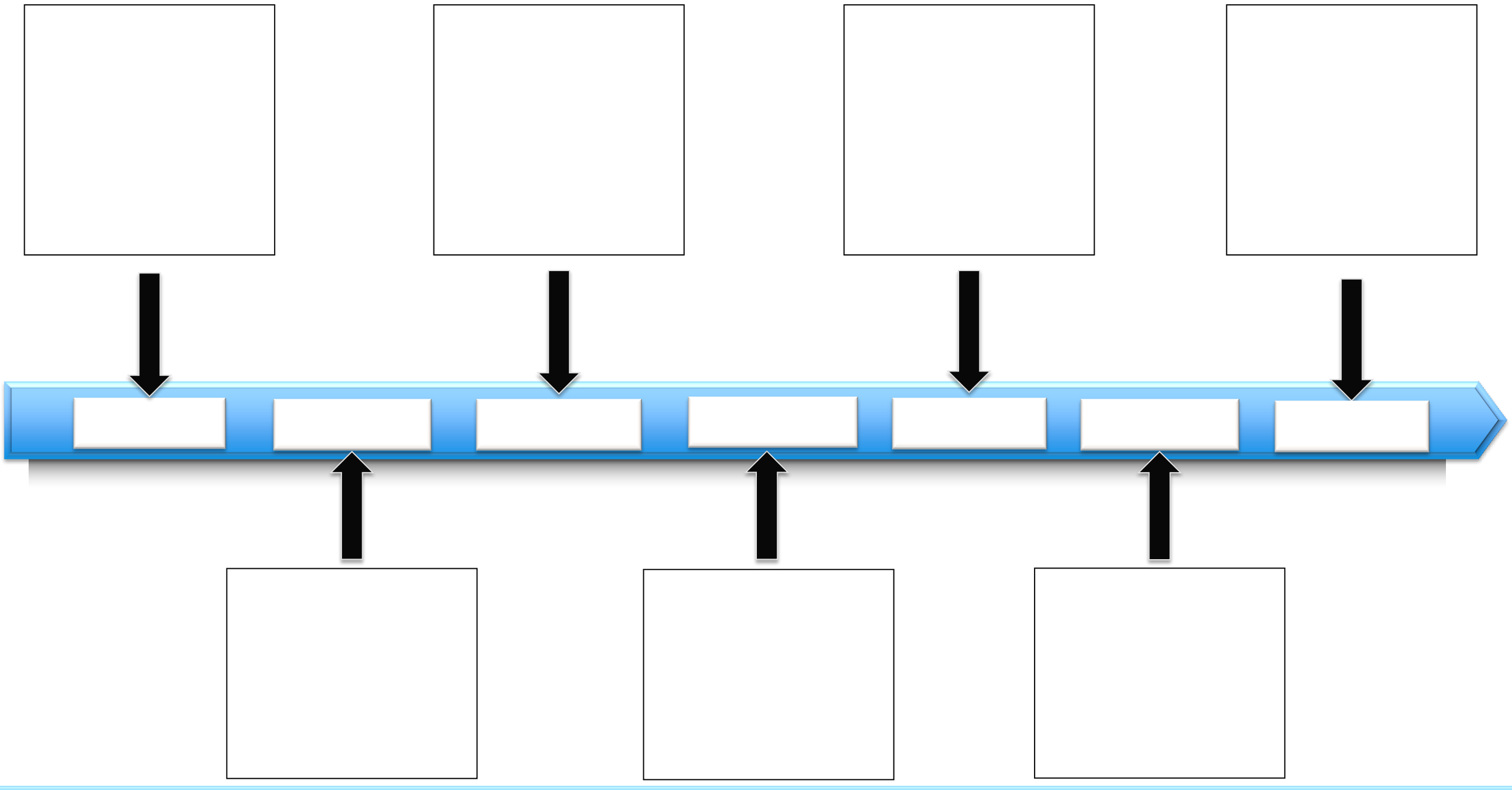
Optional Extension Activities

1. Create a TV news report about the case of Bob Agriculture, using movie-making software.

2. Create sketches of the suspects.

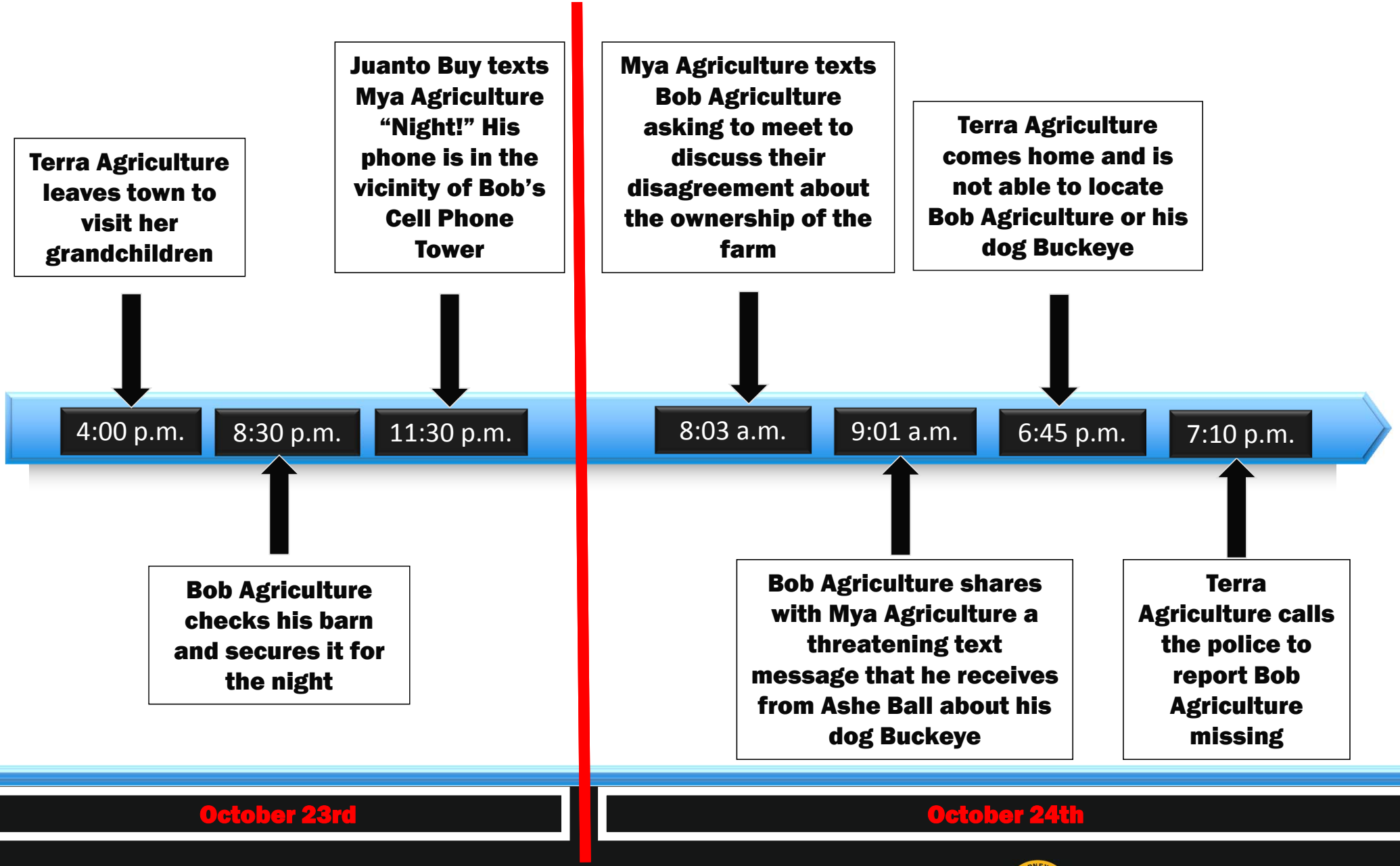
3. Students can take the information on the different suspects and create a realistic fictional story about the lives of each suspect.

Timeline of Friday, Oct. 23 to Saturday, Oct. 24



Juanto Buy's Location

Timeline of Friday, Oct. 23 to Saturday, Oct. 24



Prepared By:
Criminal Intelligence Unit, Ohio BCI

Bob Agriculture's Cell Phone Records

Date	Time (EST)	Calling Number	Called Number	Incoming/ Outgoing	Duration of Call (seconds)	Type	Tower Location	Sector Azimuth	Content
10/23	10:43 PM	330-555-1943	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Goodnight, Bob!
10/23	10:45 PM	330-555-6215	330-555-1943	Outgoing	0	Text Message	39.526547, -82.49895	90 Degrees	Goodnight, Terra!
10/23	8:50 PM	330-555-1943	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Having fun here!
10/23	8:55 PM	330-555-6215	330-555-1943	Outgoing	0	Text Message	39.526547, -82.49895	90 Degrees	Glad to hear you are enjoying yourself.
10/23	8:43 PM	330-555-1943	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	The grandbabies are fast asleep, snug in their beds. :)
10/23	9:10 PM	330-555-6215	330-555-1943	Outgoing	0	Text Message	39.526547, -82.49895	90 Degrees	See you tomorrow night. Xoxo
10/24	8:03 AM	614-555-9314	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Morning, Bob! I know we have had our differences since Dad died, but I've been doing a lot of thinking lately. Is it okay if I come by your place this morning to discuss a few things?
10/24	8:17 AM	330-555-6215	614-555-9314	Outgoing	0	Text Message	39.526547, -82.49895	90 Degrees	Sure. I just finished breakfast and was going to head out. When were you thinking?
10/24	8:20 AM	614-555-9314	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Let me quickly change out of my pajamas, and I'll be over around 8:45ish.
10/24	8:25 AM	330-555-6215	614-555-9314	Outgoing	0	Text Message	39.526547, -82.49895	90 Degrees	Sounds good. I'll just wait here at the house.
10/24	9:01 AM	937-555-3838	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Bob, for the last time…please keep your dog quiet.
10/24	9:01 AM	937-555-3838	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	I'm in the middle of a manuscript and he is interrupting my concentration.
10/24	9:01 AM	937-555-3838	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	If you cannot keep Buckeye quiet, I will be forced to take matters into my own hands.
10/24	6:45 PM	330-555-1943	330-555-6215	Incoming	0	Text Message	39.526547, -82.49895	90 Degrees	Hey honey! I'll be home around 8:30-8:45 tonight. Have some cute pics of the kids to share with you.
10/24	8:50 PM	330-555-1943	330-555-6215	Incoming	30	Call	39.526547, -82.49895	90 Degrees	

Juanto Buy's Cell Phone Records

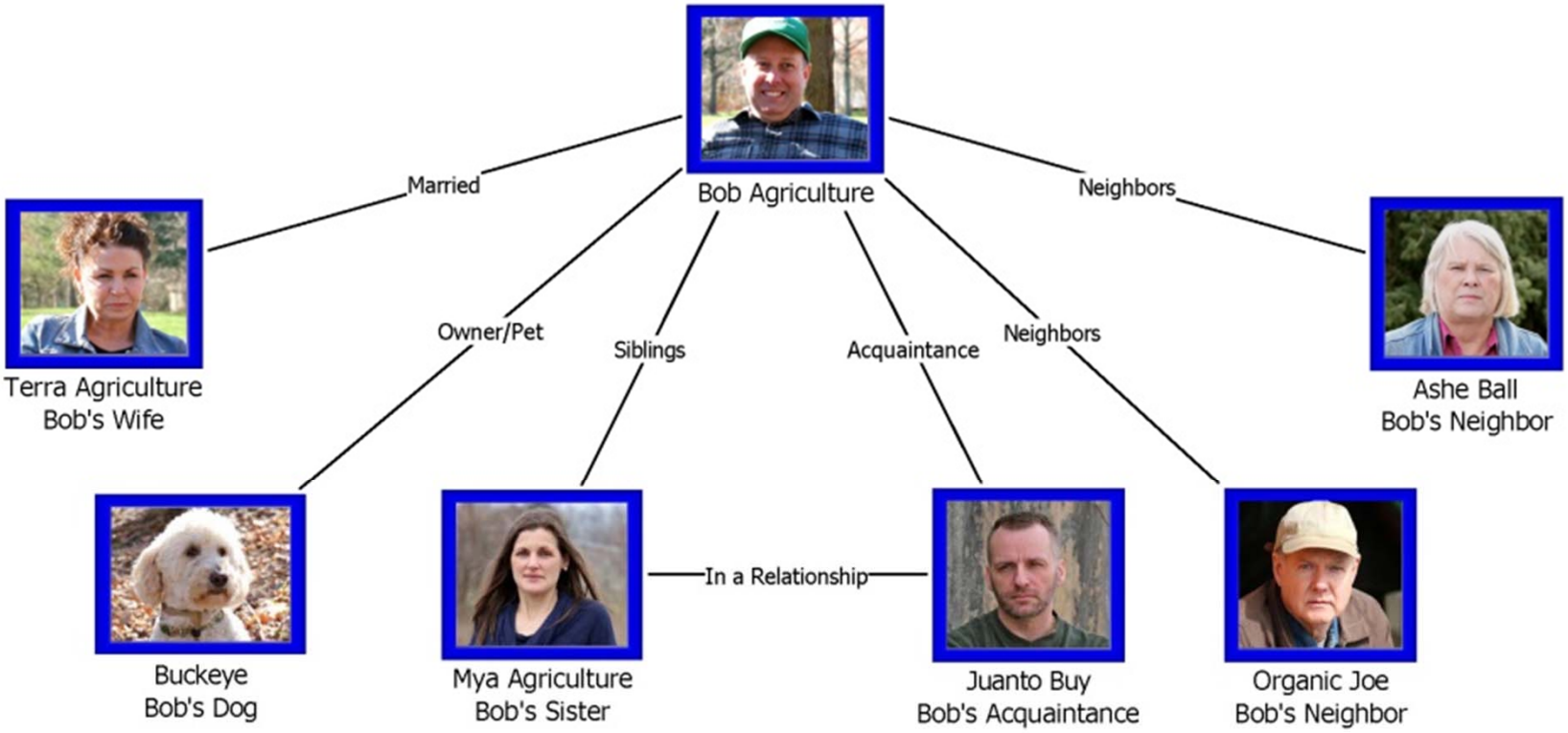
Date	Time (EST)	Calling Number	Called Number	Incoming/ Outgoing	Duration of Call (seconds)	Type	Tower Location	Sector Azimuth	Content
10/23	10:17 PM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Hey! Hope you had a good day. I'm so tired. I cleaned out my parent's attic today.
10/23	10:18 PM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	I'll have to show you some photos I found of me as a kid.
10/23	10:19 PM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	It got me thinking…I'm going to reach out to Bob tomorrow and see if he wants to talk.
10/23	10:20 PM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Anyway, good night and let's figure out our plans for next weekend soon
10/23	10:21 PM	740-555-2757	513-555-9874	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Did you see that call?
10/23	10:22 PM	513-555-9874	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Missed it!
10/23	10:23 PM	740-555-2757	513-555-9874	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	The refs are pathetic!
10/23	10:24 PM	513-555-9874	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Doesn't surprise me! They've been making bad calls all game.
10/23	10:30 PM	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Hey there! I did have a good day, but it would have been better if I saw your pretty face.
10/23	10:31 PM	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Call me tomorrow. I'm curious what you are going to chat with Bob about, and btw I can go to the game next Saturday so let's get tickets soon. Night!
10/23	10:32 PM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Ok, goodnight
10/23	11:30 PM	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.526547, -8249895	90 Degrees	Night!
10/24	9:30 AM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	Morning! If you are home, I'm going to head over ot your house.
10/24	9:32 AM	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Yes, I'm home. Come on over. Already at Bob's house this a.m.?
10/24	9:35 AM	614-555-9314	740-555-2757	Incoming	0	Text Message	39.578745, -82.521130	270 Degrees	I want you to look at my car tire. I think I ran over a nail or something on the way to Bob's house.
10/24	9:38 AM	740-555-2757	614-555-9314	Outgoing	0	Text Message	39.578745, -82.521130	270 Degrees	Oh no! I'll see you soon and can't wait to hear about your conversation with Bob.
10/24	9:40 PM	614-555-9314	740-555-2757	Incoming	240	Call	39.578745, -82.521130	270 Degrees	

OHIO ATTORNEY GENERAL'S

BCI SCIENCE SCHOOL

BUREAU OF CRIMINAL INVESTIGATION

Bob Agriculture Link Chart



OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 12
Crime Scene

Materials Needed
- Copy of Activity Master 25 (one set per classroom, to be placed on bulletin board)
- Glue stick
- Science journals
- Paper for sketch and observation of crime and suspect
- Pencil
- Colored pencils
- Equipment to project video clip
- Interactive white board, ELMO, or overhead projector to display photos from Activity Master 25
- One exit ticket per student
- Super glue
- One zip lock bag
- One plastic 8 oz. clear cup

Approximate Time
- 50 minutes

Corresponding Required Resources
- Video Clip 11 — *Crime Scene* (1:13)
- Activity Master 25

Lesson Objectives
- Students will analyze crime scenes.
- Students will plan investigations.
- Students will effectively work and discuss in groups.

Lesson Overview:

Students will take part in a few observation activities, look at pictures of the crime scene, and document their observations and questions.

Lesson Preparation:

- Find a willing participant (staff member or student that is available for a few minutes) to come into your classroom and "commit a crime" (e.g., stealing a stapler from your desk) at a specific time you agree upon ahead of time.

Review of Lesson 11:

- What did you discover from analyzing Bob and Juanto Buy's historic cellphone records? (Juanto Buy was in the area of Bob's house around 11:30 Friday night.)

Word Study

Timeline	Forensic Scientist
Statement	Process
Analyze	Crime
Alibi	Document
Suspects	Robber
Examine	Criminal Investigator
Evidence	Criminal
Clues	Photographs

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in the science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Communicate about observations, investigations and explanations. 5. Review and ask questions about the observations and explanations of others.

Activity: Crime Scene Investigation

Instructional Strategies:

1. Show the students Video Clip 11 — *Crime Scene* and discuss the information that was shared in the video and how crime scene investigators must be extremely careful when documenting and collecting evidence.

2. Have students come to the carpet area and project Activity Master 25, the photos from the crime scene. Have the students look at the photos of the crime scenes. You can also pass around a copy for students to examine.

3. Have the students look carefully at each of the photos and take notes in their science journals on what they observe.

4. After about three minutes, ask the students if they want to share any observations they made after looking closely at the crime scene photos.

5. Explain to the students that they can refer back to the crime scene images, which you will have posted on the bulletin board. (You may want to create a bulletin board with “Crime Scene” information so you have to make only one copy of each crime scene image.)

6. Next, have students go back to their seats. Put the students into pairs and explain that they are going to practice their observation skills. Tell the pair to look at each other closely, and then have them both turn around facing away from each other. While they have their backs turned, they need to change one small thing about themselves (e.g., take out an earring, put their hair behind their ears, untie a shoe, unbutton a button on their shirt, etc.) When the partners turn back around to face each other, they need to try to figure out the one thing that was changed.

7. Have students do this activity for about three to five minutes. While they are doing the activity, make sure that the staff member (or student) is ready to come in and make a big, but fairly quick, production out of stealing the stapler. It would work best if it is a staff member or student that the class does not see often or every day.

8. After the "crime" is committed, ask the partners to stop playing the observation game and quickly write down in their science journals or on scrap paper everything they remember about the suspect. Have the students draw a picture or sketch of the suspect.

9. Once the students have had about five to 10 minutes to write everything down that they remember about the crime and the suspect, and have created a picture of the suspect, have the staff member/student come back in and have the students see how accurate and observant they were as a witness to the crime. Discuss the results and compare them to when witnesses to real crimes are questioned about their observations.

10. Have students fill out an "exit ticket" about what they learned in the lesson about crime scene investigation and crime witnesses.

<u>Fifteen Minute Prep for Lesson 14 on Latent Prints:</u>

1. Explain to the students that last night somebody came into your classroom and drank the water you had left in your plastic cup, which was sitting on your desk.

2. Tell students that you knew your door was locked when you left, so that it had to be somebody who had a key to your classroom. Explain that meant it could only be the school principal, counselor, secretary, custodian/janitor, or another teacher. Tell the students that you reviewed the tape on the security camera, and the only teacher that was in your classroom was your grade-level teaching partner (fill in blank with an actual teacher on your team), as well as the principal, counselor, custodian, and school secretary.

3. Using rubber gloves, hold up the plastic cup to the light and explain that you think you can see fingerprints on the cup. Tell the class that you are going to demonstrate a forensic technique called "fuming" to check for fingerprints on the plastic cup. Note to teachers: At BCI, forensic scientists use Cyanoacrylate Fuming Cabinets, but you will show your students today (and tomorrow) on a smaller scale how that process works. Super glue in liquid form is made up of many small molecules called monomers. When fingers touch the surface of a plastic or glass cup, they leave oil and water fingerprints, which are hard to see. Super glue is made up of a chemical called cyano acrylate, which at room temperature, quickly turns into a gas. By placing a few drops of super glue inside a sealed container (a Ziploc bag) with the cup, this gas spreads throughout the bag, staying fairly concentrated because the gas cannot escape. When the gas comes into contact with the oil and water fingerprints on the cup, it turns into a solid white plastic, revealing the fingerprints. The monomers have been joined to form chains of long repeating molecules called polymers, which make up the solid plastic.

4. Demonstrate to the students as you put the plastic cup into a Ziploc bag. Then, add three or four drops of super glue to the bag. Make sure you place the glue so that it doesn't directly touch the cup. Seal the bag and let it sit at least overnight, until you are ready to use it in the lesson. Explain to the students that over a few hours the super glue will adhere or stick to the oils on the fingerprints and make them appear white and easier to see and identify.

Optional Extension Activities

1. Students can create other observation games for their classmates to play. (They could have the students look at their classroom, then close their eyes while the teacher changes one thing about the room. Then, the students have to figure out what changed.)

2. If approved by your school district and you as the teacher, students could play an App like, “Crime Scene,” “Criminal Case,” or “CSI: Hidden Crimes.”

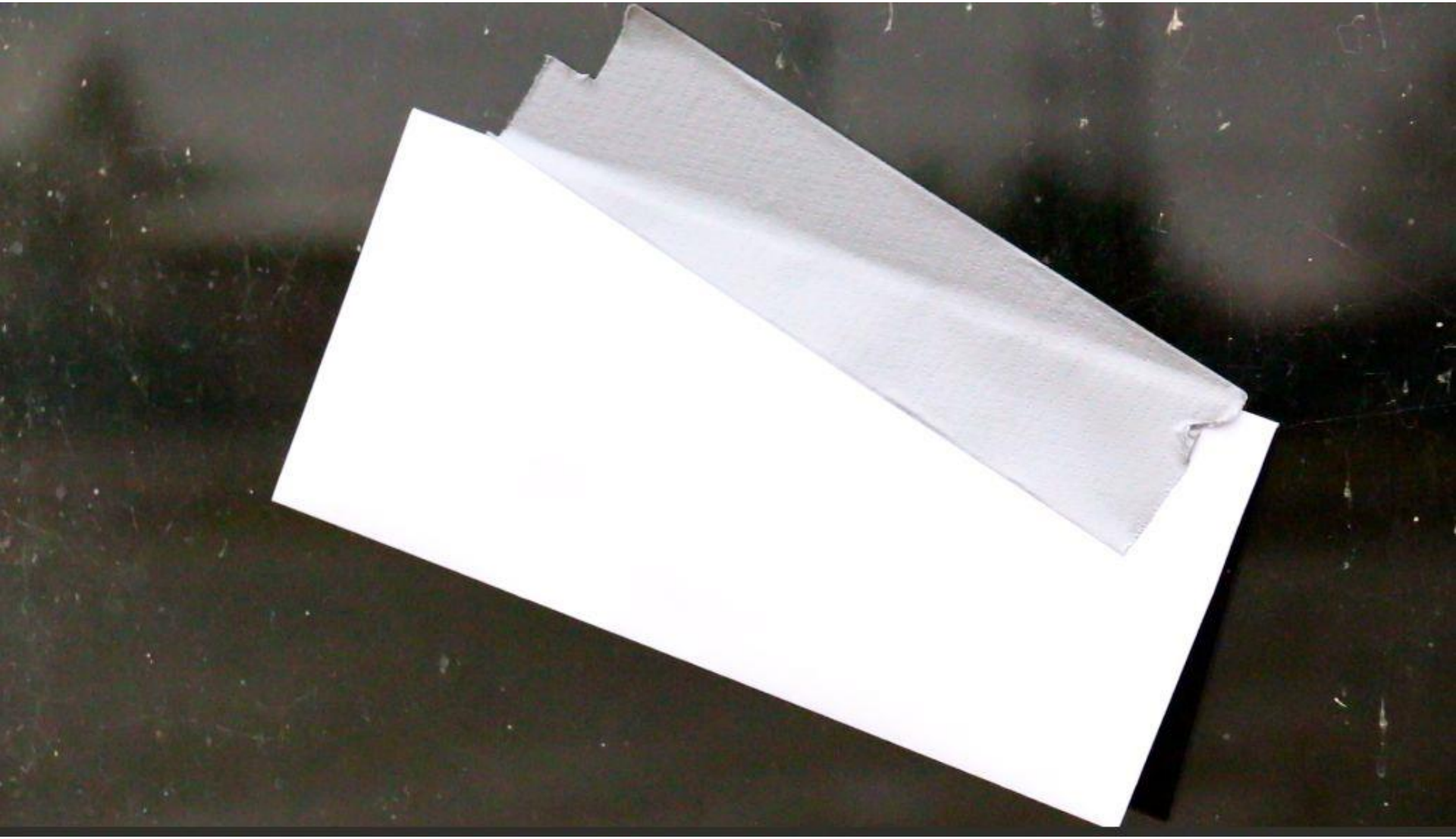
Crime Scene Photos

OHIO ATTORNEY GENERAL'S
BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Student Activity Master 25


FERTILIZER
FERTILIZER
FERTILIZER
FERTILIZER


FERTILIZER



OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 13

Optional: Algae Blooms

Materials Needed

- Pencil
- Glue stick
- Science journals
- Copies of Activity Masters 26 and 27 (one copy per student)
- Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different colors
- Four glass jars, spaghetti sauce-sized (Possibly reuse the sinkhole experiment jars) Note: If you have enough supplies, the students could do this activity in small groups.
- OPTIONAL — One aquarium water-quality test kit — or a kit that tests for pH, phosphate level, dissolved oxygen (enough to test both sets of water for at least 10 days) Note: The kits can be expensive and have to be used only by the teacher and with care because the chemicals can be harmful.
- Thermometer to measure water temperature
- Microscope and slides and coverslips, if available
- Magnifying glasses
- One bottle of liquid plant food
- Source of heat (sunlight in windowsill works well)
- Algae from freshwater pond or lake
- Distilled or bottled water (at least 40 ounces/ 10 per jar)
- Pipette or eyedropper

Lesson Overview:

(Optional Lesson) Students will take part in a scientific experiment involving the creation of an algae (or algal) bloom. This will be an ongoing experiment that they check every day for a few minutes to take measurements and observe changes. This is tied to the case because Organic Joe's possible motive to break into Bob's barn would be because he believes Bob's use of fertilizers on his farm causes algae blooms in the adjacent waterways.

Student Prerequisites:

- At least some prior knowledge of how to write a paragraph, and an understanding of the necessary parts of a paragraph (e.g., main idea/topic sentence, supporting details, and concluding sentence)
- At least some prior knowledge of transition words (e.g., *first*, *then*, *next*, *in addition*, *in conclusion*)
- How to work effectively in groups in order to reach a common goal

Review of Lesson 12:

- What do crime scene investigators do?

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Masters 26 and 27

Lesson Objectives

- Students will conduct the experiment to create algae.
- Students will make observations of the algae over the course of a few days and keep a record of what they see.

Background Information for the Teacher:

Environmental Enforcement Unit — The Ohio Attorney General's Bureau of Criminal Investigation has an Environmental Enforcement Unit. Members of the unit are responsible for assisting the Ohio Environmental Protection Agency, other state and federal agencies, and local law enforcement in investigating criminal environmental activity. The unit's work encompasses hazardous, solid, and infectious waste as well as air and water pollution. Agents are specially trained in environmental investigations, analytical investigative methods, and Occupational Safety and Health Administration requirements.

Algae/Algal Blooms — Algae are simple, green aquatic plants. They have no flowers, leaves, or roots. They form the basis for many aquatic food webs and produce most of the oxygen in the Earth's atmosphere. Algal blooms are rapid increases in the amount of algal cells that take over or dominate the planktonic community of a pond, river, lake, or ocean. In order to live, algae are dependent on water, carbon dioxide, sunlight, and nutrients. All of those factors are abundant in aquatic environments except for sunlight and nutrients. Where runoff occurs, nutrients are abundant. Rising water temperatures also add to the algal bloom equation. The nutrients come from the land and farms, animal and people waste flushing into the watersheds. Laundry detergent and farm fertilizer are chemicals that have a lot of phosphates in them, which have a major influence on plant growth. When the algal cells get everything they need to grow, they can divide very rapidly and potentially create a bloom. Algal blooms may block out sunlight in a pond, river, or lake — killing other plants in the water. As the other plants die, oxygen is used up, creating harmful, toxic conditions, which kill fish and other aquatic creatures as well as creating a hazard to the people in the area using the water for activities.

Ohio Department of Education 4th Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During the years of PreK-4, all students must become proficient in the use of the following scientific processes with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment; 2. Plan and conduct simple investigations; 3. Employ simple equipment and tools to gather data and extend senses; 4. Use appropriate mathematics with data to construct reasonable explanations; 5. Communicate about observations, investigations and explanations; and 6. Review and ask questions about the observations and explanations of others.

Content Area: Science
Life Science
Earth's Living History
Content Statement
Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

Activity: Algae Bloom Experiment

Instructional Strategies:

1. Have students read Activity Master 26. Discuss how changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

2. Explain to the class that you would like to do an experiment to see if you can simulate or recreate how algae blooms form in aquatic environments. Have the students help you come up with a question for the experiment. (e.g. Will fertilizer and/or laundry detergent create an algae bloom in a jar?)

    a. If you want this experiment to be inquiry based, have the students help you develop how to design the experiment, making sure you guide them to have all variables controlled, except one.
    b. NOTE to teacher: You can be flexible and let the children develop their own experiments, and then you can guide them in another experiment prompting them to use certain supplies in order to set up an algae bloom experiment if the experiments they design are not accomplishing the objective/concept that you are trying to illustrate. You could also give them certain materials as a guide/parameter for the experiment and have the students design their own experiments in small groups. Finally, you could simply have the students conduct the following experiment if you do not wish to do an inquiry-based algae bloom simulation. You can do this as a demonstration, with volunteers in the classroom to help with the set up if you want to save time and money on collecting and purchases more supplies. It is your choice, as the teacher, to have students take part in this lesson as a demonstration or in small groups.

3. Set up four spaghetti sauce jars with equal amounts of distilled or bottled water.

4. Add about four drops of pond water to each.

5. Label the jars, A – D.

6. Prepare the jars as described below:

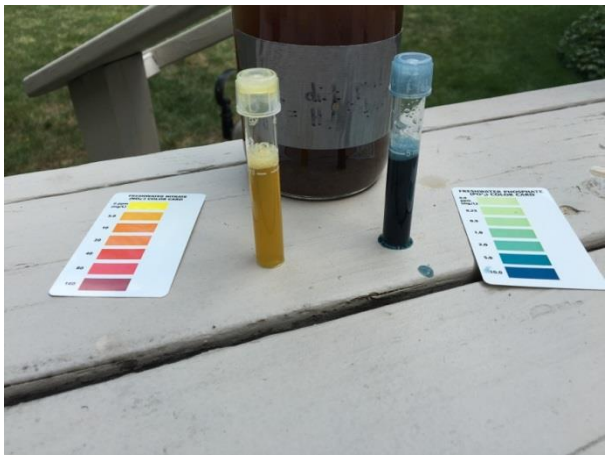
    a. Jar A = water + 4 drops of pond water (algae) + heat source (windowsill) (The Control Jar)
    b. Jar B = water + 4 drops of pond water (algae) + heat source (windowsill) + liquid plant food/fertilizer (add the amount of fertilizer recommended on the label/amount of water). (I used Miracle Grow for this and it does tinge the water blue a little bit. I then used organic plant fertilizer and it made the water a bit murky until the fertilizer settled to the bottom of the jar. For both experiments I used a tablespoon of the fertilizer/ 2 cups of distilled water.)
    c. Jar C = water + 4 drops of pond water (algae) + heat source (windowsill) + laundry detergent (add the amount of detergent recommended on the label/amount of water)
    d. Jar D = water + 4 drops of pond water (algae) + heat source (windowsill) + laundry detergent (add the amount of detergent recommended on the label/amount of water – I added one tablespoon. Again, this will give the water a blue tinge, unless you use clear laundry detergent.) + the same amount of liquid plant fertilizer you added to jar B.

7. Have students make a prediction/hypothesis as to what they think will happen in this experiment.

8. Next, have the students make observations on the color of each jar, take the temperature of each jar (if you have access to a thermometer), use an aquarium test strip in each jar (if you purchased them), etc. Please have them record their observations on Activity Master 27. Explain that they can use their colored pencils to help draw what each jar looks like each day, or if they have access to digital cameras, they can take pictures of the jars daily. (Students can store this experiment in their science notebook/folder.)

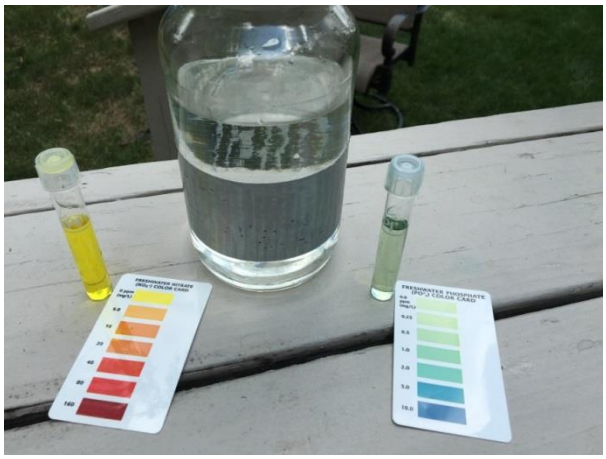
9. After at least a week or two of making observations, have the students make a conclusion to this experiment on Activity Master 27. And answer this questions together as a class:

    a. What is your conclusion for this experiment? How does your conclusion relate to what really happens in ponds, lakes, rivers, and oceans with algae blooms?
    b. Opinion: Do you think Farmer Bob is responsible for the algae blooms in the water ways adjacent to Organic Joe's property? Do you think farmers in general can be good stewards of the Earth and take precautions before applying fertilizers to their crops? What are your ideas?



    c. You can point out that farmers are supposed to check the weather and make records of what type of fertilizer, how much, what the weather conditions were to prove that they are making responsible decisions in regard to the Earth.

10. Collect students Activity Master 27 when you have concluded the experiment.



Optional Extension Activities

1. Research on algal blooms.

2. Read these articles about algal blooms in the Toledo area by Scientific American, “Deadly Algae Are Everywhere, Thanks to Agriculture” and try to defend farmers in an argument against the author’s stance. http://www.scientificamerican.com/article/deadlyalgaeareeverywherethankstoagriculture/

3. Read this article and share information on algae blooms in the Ohio River with your classmates. http://cin.ci/1F6JC8S

Name: _____ Date: _____

Algae and Algal Blooms

Algae are simple, green aquatic plants. They have no flowers, leaves, or roots. They form the basis for many aquatic food webs and produce most of the oxygen in the Earth's atmosphere.

Algal blooms are rapid increases in the amount of algal cells that take over or dominate the planktonic community of a pond, river, lake, or ocean. In order to live, algae are dependent on water, carbon dioxide, sunlight, and nutrients to grow. Except for sunlight and nutrients, all of those factors are plentiful in aquatic environments.

Where runoff occurs, nutrients are abundant. Rising water temperatures also add to the algal bloom equation. The nutrients come from the land and farms, as well as animal and people's waste, flushing into the watersheds. Laundry detergent and farm fertilizer are chemicals that have a lot of phosphates in them, which have a major influence on plant growth.

When the algal cells get everything they need to grow, they can divide very rapidly and potentially create a bloom. Algal blooms may block out sunlight in a pond, river, or lake — killing other plants in the water. As the other plants die, oxygen is used up, creating harmful, toxic conditions, which kill fish and other aquatic creatures as well as create a hazard to the people in the area who are using the water for activities.

Name: _____ Date: _____

Algal Blooms Experiment

Make an observation/ask a question:

Create a hypothesis/make a prediction:

Test the hypothesis:

1. Take a drop of water from each sample and look at it under a microscope or magnifying glass, recording observations below. (Can skip this step if you do not have access to microscopes or magnifying glasses.)
2. Record the measurements your teacher takes of the level of pH, nitrate or ammonia concentrations (phosphates), and dissolved oxygen levels, if your teacher is using an aquatic test kit.
3. Write down observations of the color of the control water sample vs. nutrient-rich water sample. (Describe color, opacity, and smell.)
4. If you have access to a thermometer, take the temperature of each water sample and record on the observation sheet.

Daily observations: Each day you observe your experiment, take a drop of water from each sample and look at it under a microscope or magnifying glass, if you have one, recording observations below.

1. Measure the level of pH, nitrate, or ammonia concentrations (phosphates), and dissolved oxygen levels. Record observations below.

2. Write down observations of the color of the control water sample vs. nutrient-rich water sample. (Describe color, opacity, and smell.)

3. If you have access to a thermometer, take the temperature of each water sample and record on the observation sheet.

Record your observations:

DATE:	OBSERVATIONS:

What is your conclusion for this experiment? How does your conclusion relate to what really happens in ponds, lakes, rivers, and oceans with algal blooms?

_____

_____

_____

_____

_____

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 14
Latent Prints

Materials Needed
- Pencil
- Highlighter
- Glue stick
- Science journals
- Copies of Activity Masters 28 and 29 (one copy per student)
- Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters 28, 29) and overhead pens of different colors
- Equipment to project Video Clip 12 — *Fingerprints* and Video Clip 13 — *Results*
- Magnifying glasses are optional, but recommended

Approximate Time
- 50 minutes

Corresponding Required Resources
- Video Clip 12 — *Fingerprints* (1:59)
- Video Clip 13 — *Fingerprints Conclusion* (0:18)
- Activity Masters 28 and 29

Lesson Objectives
- Students will learn, through reading and answering questions on an informational text, about latent prints, and the different types of prints that a person can have.
- By analyzing and identifying different fingerprint patterns, students will learn more about the forensic science portion of BCI.

Lesson Overview:

Students will learn more about how forensic scientists in the Latent Print Unit of BCI use fingerprints and palm prints found at crime scenes to help link suspects to the crime.

Review of Lesson 12 (and 13, if you did algae blooms optional lesson):

- What do crime scene investigators do?
- What are algae blooms?

Word Study

AFIS (Automated Fingerprint Identification System)
Ninhydrin
Examine
Photographs
Criminal
Preserve
Palm Prints
Latent Prints (Hidden)
Statement
Process
Evidence
Clues
Capture
Suspects
Arch
Criminal Investigator
Adhered
Document
Submitted
Forensic Scientist
Whirl
Analyze
Crime
Loop
Fingerprints
Magnifier

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Communicate about observations, investigations and explanations. 5. Review and ask questions about the observations and explanations of others.

Preparation Ahead of Time:

Do Lesson Prep (on Lesson 12) a day or two before doing this lesson.

Activity: Finding Fingerprints

Instructional Strategies:

1. Show the students Video Clip 12 —*Fingerprints* and discuss the information that was shared in the video. Make sure you stress that nobody has the same fingerprints or palm prints. Talk about how prints can be compared and identified through different features, such as the arch pattern, the loop pattern, and the whorl pattern. Also, by looking for characteristics like ridges that end or split.

2. Pass out Activity Masters 28 and 29. Have the students look over the informational texts about fingerprints and explain that they need to read over the comprehension questions first to help them determine their purpose for reading.

3. Display the text from Activity Master 28 on the interactive white board, ELMO, overhead projector, etc. and read over the text while the students follow along on their own copy, highlighting the information they think will help them answer the comprehension questions.

4. Have the students read over the questions and answer the comprehension questions.

5. When the class has had time to finish that task, have the students look at the fingerprints on Activity Master 29. They are the latent prints that the forensic scientist found on the envelope that was taped to the barn. The suspects' prints are also attached. Have students compare and analyze the fingerprints. Can they determine which suspect the latent prints belong to?

6. Next, show Clip Video 13 — *Fingerprints Conclusion*. Ask students if they determined that Juanto Buy's fingerprints were on the envelope.

7. Have students discuss briefly with you why they think Juanto's fingerprints were on the envelope.

Optional Extension Activities

1. Have students write their own "Who Dun It?" activity with fingerprint activity to accompany it.

2. Have students create fingerprint art.

If you are doing the algae bloom experiment, make sure to have the class make and record observations today.

Name: _____ Date: _____

Informational Text on Fingerprints

Directions: Please read the comprehension questions below first. Then, read the text selection below on fingerprints. Finally, answer the multiple choice questions below the passage by circling the correct answer. Note: Questions 4 and 5 cover material found in the video clip.

Fingerprints

Everyone in the entire world has a unique set of fingerprints. In other words, each person's prints are unlike those of any other person. Although everyone's fingerprints are unique, basic patterns can always be found in each person's prints. These patterns help forensic scientist classify fingerprints.

There are three basic fingerprint patterns. The three patterns are whorl, loop, and arch.

A whorl pattern has lots of circles that do not leave either side of the print. A loop pattern has lines that start on one side of the print, rise toward the center, and then turn back and leave on the same side of the print from which they started. Finally, an arch pattern has lines that start on one side of the print, rise toward the center, and leave on the other side of the print.

Latent prints are prints that are usually invisible and left on objects when you touch them. Latent prints are very important in solving crimes. They can be made visible by doing different chemical procedures. Once the latent prints are visible, they are compared to the suspect's inked fingerprints. Forensic scientists are trying to see if any of the suspect's fingerprints link them to evidence connected with the crime. If there are no suspects in the case, forensic scientists can search a database called AFIS to look at fingerprints that have been collected from criminals in the past.

1. What are the three main fingerprint patterns used for identification of fingerprints?
   a. loop, swirl, arch
   b. loop, arch, whorl
   c. swoop, arch, loop
   d. droop, arch, whorl

2. Latent prints are prints that are usually _____.
   a. smudged
   b. visible
   c. invisible
   d. inaccurate

3. True or False: Everyone in the entire world has a unique set of fingerprints.

4. True or False: Your fingerprints will always stay the same no matter how old you become.

5. True or False: Identical twins have the same set of fingerprints.

Name: _____ Date: _____

Suspect Fingerprints

Directions: Examine each of the suspect's prints and identify their print pattern. Then compare their print to the latent print found on the envelope from the barn window. Finally, circle the suspect's name whose print matches the latent print.

Juanto Buy's Print

NOTES:
Print Pattern:

Ashe Ball's Print

NOTES:
Print Pattern:

Latent Print from envelope on window of barn

NOTES:

Organic Joe's Print

NOTES:
Print Pattern:

Mya Agriculture's Print

NOTES:
Print Pattern:

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 15

Optional: Latent Prints – A Closer Look

Materials Needed

- Pencil
- Highlighter
- Glue stick
- Seven rolls of scotch tape
- Science journals
- Copies of Activity Master 30 (one copy per student)
- Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters 30) and overhead pens of different colors
- Plastic cup in bag that was "fumed" previously
- Paper towels
- Scrap paper (for creating graphite patch to make fingerprints)
- Magnifying glasses (optional, but recommended)
- One exit ticket per student

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Master 30

Lesson Objectives

- Students will plan and conduct simple investigations.
- Students will use simple equipment and tools to gather data and extend senses.

Lesson Overview:

Students will learn more about how forensic scientists in the Latent Print Unit of BCI use fingerprints and palm prints found at crime scenes to help link suspects to the crime.

Review of Lesson 14:

- What does the Latent Prints Unit of BCI do?

Word Study

AFIS (Automated Fingerprint Identification System)
Ninhydrin
Examine
Photographs
Criminal
Preserve
Palm Prints
Latent Prints (Hidden)
Statement
Process
Evidence
Clues
Capture
Suspects
Arch
Criminal Investigator
Adhered
Document
Submitted
Forensic Scientist
Whorl
Analyze
Crime
Loop
Fingerprints
Magnifier

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Communicate about observations, investigations and explanations. 5. Review and ask questions about the observations and explanations of others.

Activity: A Closer Look at Fingerprints

Instructional Strategies:

1. Pass the bag with the fumed fingerprint/cup around for students to see how the fuming process made the fingerprint on the glass visible.
2. You can say that you discovered that your teaching partner _____ drank out of the cup because they knew you would not mind.
3. You may want to show students how to take fingerprints using graphite and scrap paper so that they can practice before doing Activity Master 30.
4. Using a No. 2 pencil, rub a small black patch of graphite onto a piece of scrap paper.
5. Have students rub either of their pointer fingers back and forth across the graphite. Make sure students are not getting the tip of their fingers, but rather the area between the tip and the bend at the first knuckle on their hand.
6. After students have blackened their fingers, have them use a piece of scotch tape to “lift” the fingerprint directly from their pointer finger.
7. Then have the students place the piece of tape on a clean part of their scrap paper.
8. Walk around the room making sure that students’ prints are not too dark and the tape is not wrinkled on the scrap paper.

9. Then have students (using magnifying glasses if possible) examine their fingerprint. See if they think it has a whorl, arch, or loop pattern to it.

10. Pass out Activity Master 30. Have students use the same method that they practiced with on scrap paper, and complete Activity Master 30. Encourage students try to make "lifts" of all of their fingerprints on one hand, labeling what pattern they think each print is beside it.

11. Have students (using magnifying glasses if possible) really examine each of their fingerprints. Have them classify each finger as a whorl, arch, or loop pattern.

12. Next, have students share their fingerprints with the other students in their group, comparing the differences.

13. Then have students fill out an exit ticket about what they learned in these lessons about fingerprinting.

Optional Extension Activities

1. Have students create fingerprint art.

2. Have students survey the class' individual fingerprint pattern results and create a graph showing the data they collect. This can be done on grid paper or using a graphing application.

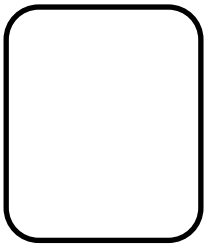
***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

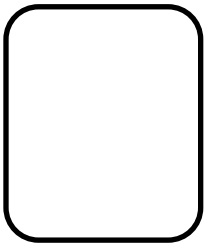
Fingerprint Rub Activity

Directions: Please follow the instructions below on how to create your own fingerprints.

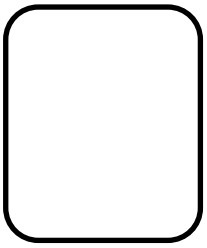
1. Using a No. 2 pencil, rub a small black patch of graphite onto the bottom of this paper.
2. Rub your pointer finger, on one hand, back and forth across the graphite. Make sure you are not getting the tip of your finger, but rather the area between the tip and the bend at the first knuckle on their hand.
3. After you have blackened your finger, use a piece of scotch tape to "lift" the fingerprint directly from your pointer finger.
4. Then place the piece of tape on a clean part of this paper.
5. If you have access to a magnifying glass, really examine your fingerprint. See if your print has a whorl, arch, or loop pattern to it and compare it to a neighbor's print.



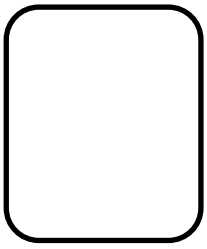
Pattern:



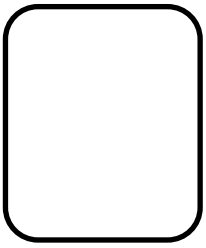
Pattern:



Pattern:



Pattern:



Pattern:

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 16
DNA Introduction

Materials Needed
- Make copies of Activity Masters 31 and 32 (one copy per student)
- Pencil
- Highlighter (optional) – students can underline instead
- Science journals and/or reading/writing journals
- Interactive white board, ELMO, or overhead projector (with transparency of Activity Masters and overhead pens of different colors
- Equipment to project video clip

Approximate Time
- 50 minutes

Corresponding Required Resources
- Video Clip 14 — *DNA Testing* (5:10)
- Activity Masters 31 and 32

Lesson Objectives
- Students will engage effectively in groups through discussions.
- Students will learn more about how forensic scientists in the DNA Unit of BCI test DNA found at crime scenes to help link suspects to the crime.
- Students will read an article as a class, determining whether or not obtaining and cloning dinosaur DNA is possible by recording evidence on a t-chart
- Students will discuss how fossils help us determine what happened to plants and animals in the past.

Lesson Overview:

Students will learn more about how forensic scientists in the DNA Unit of BCI test DNA found at crime scenes to help link suspects to the crime. They will watch a segment of the movie *Jurassic Park* illustrating how DNA works. Then, they will compare the suspects' DNA to the DNA found on the envelope left at the crime scene. Finally, they will read an article together as a class from the HowStuffWorks website to determine whether they can find evidence to support the ability to clone dinosaurs using fossilized DNA, or that refutes or proves it is impossible to get/obtain dinosaur DNA.

Review of Lesson 15:

- Ask students what they learned about fingerprints?
  - Everyone has a unique fingerprint, even identical twins.
  - You can identify and classify fingerprints based on different features (arch, loops, whorls, and ridges that end or split).
  - Fingerprints are sometimes invisible or latent, regardless, fingerprints can link a suspect with a crime. Which suspect's fingerprints did we find on the note and envelope? (Juanto Buy)

NOTE: If you did not complete the optional Lesson 15, please notify the students that your teaching partner drank out of your water cup because he/she knew you would not mind.

Word Study

Suspects	Forensic Scientist
Amber	Examine
Process	Criminal Investigator
Evidence	Criminal
Document	Preserve
Extraction	Dinosaurs
Alleles	Fossils
DNA	Comparison
Sample	Analyze
Gram	Clues
Crime	Capture
Nanogram	Saliva
Submitted	Purified

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations, and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: Science
Life Science
Topic: Earth's Living History — This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.
Content Statement
Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.

Note to teachers:

DNA testing is a powerful scientific tool that is used to identify the source of biological evidence (substances produced by your body such as blood and saliva) by comparing it with a sample from a victim or suspect. When an item first comes in to the DNA Unit, it is tested to see if substances produced by the body are present on the item. This is done using presumptive color/reaction tests. After scientists determine that there is a substance present from the body, then they will do tests to create a DNA profile from the substance. Each person has their own specific genetic code that is found in the substances produced by the body, which is their DNA. Forensic scientists can match the code from evidence to the code from a known sample of the suspect. Generally the match is so specific that only about one person in a trillion could have the same code, making it clear that the substance is a match to the suspect.

Principles of DNA:

1. Everyone has their own genetic code, except identical twins.
2. Your genetic code does not change; it is the same as when you were born.

Activity: Learning About DNA

Instructional Strategies:

1. Show the students Video Clip 14 — *DNA Testing* and discuss the information that was shared in the video. Make sure you stress that each person's DNA is unique, unless they are an identical twin.

2. Pass out copies of Activity Master 31 and have a copy of it displayed on the interactive whiteboard, ELMO, or overhead projector. Explain to the students that Abby from the DNA unit sent you these DNA allele comparisons between the suspects and the DNA found on the envelope taped on the barn window. Ask the students to work in their table groups comparing the samples to determine which suspect's DNA matches the DNA found on the envelope that was taped to the barn window.

3. After the students have had a few minutes to analyze the results, call the students' attention back to the copy you are projecting, and confirm that everyone should have concluded that Juanto Buy's DNA was a match with the DNA on the envelope from the crime scene. Have students glue Activity Master 31 into their science journals.

4. Next, ask students whether they think scientist can actually get/obtain a dinosaur's DNA from a mosquito fossilized in amber, and clone them like they saw in the movie clip? Explain to the class that you will be reading and dissecting with them, an article courtesy of HowStuffWorks, based on that topic.

5. Display Activity Master 32 on the interactive whiteboard, ELMO or other projector. Explain to the students that their purpose for reading is to find evidence or facts that support the ability to clone dinosaurs using fossilized DNA, and that refutes or proves it is impossible to get/obtain dinosaur DNA.

6. Display the article from the Internet, http://science.howstuffworks.com/environmental/earth/geology/dinosaur-cloning.htm. Explain to students that they should raise their hand when they hear/read evidence that supports or refutes the ability to extract DNA from dinosaurs. Then you can briefly discuss with the class if they agree, and if so, have them fill out their graphic organizer with evidence from the text. Complete the remainder of the text with the students this way, and have them conclude whether the claim made in the movie *Jurassic Park* was accurate or fictional. Collect student's Activity Master 32.

Optional Extension Activities

1. Have students research how studying fossils are similar to studying clues left behind at crime scenes, and have students learn how crime scene investigation has changed throughout the years with the increase in scientific knowledge and technology.

2. Have students make a digital storyboard, or one on paper, outlining how fossilization occurred in the past.

3. Have students go on a supervised fossil hunt and take a paper and crayon or pencil to do fossil rubbings/etchings. (If you cannot find fossils, have students do leaf rubbings.)

4. Have students create a persuasive speech supporting or rejecting the idea of cloning dinosaurs.

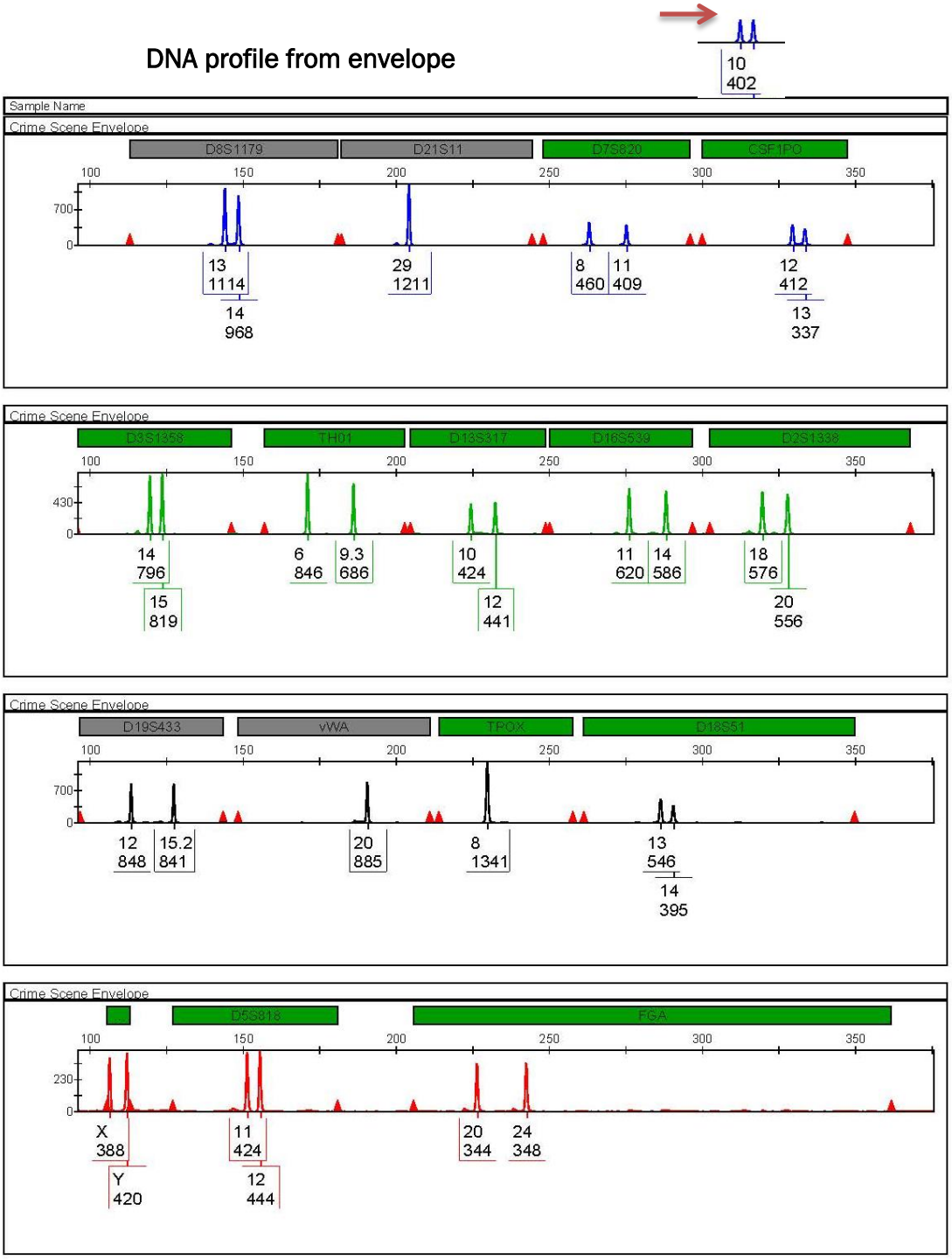
***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

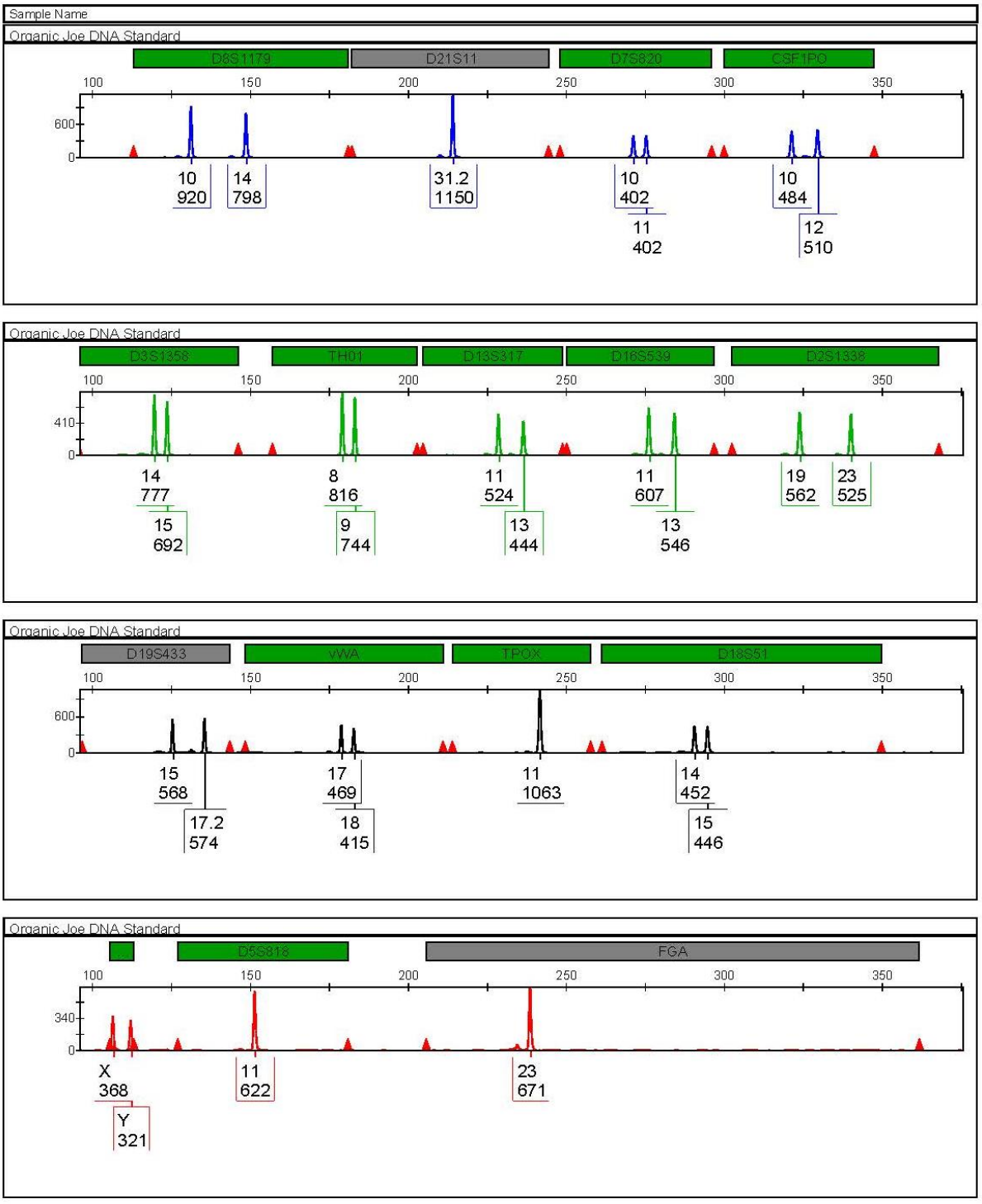
DNA Comparison

Match the DNA found on the envelope at the barn to one of the suspects. Remember, you only need to look at and compare the numbers at the top of each set.

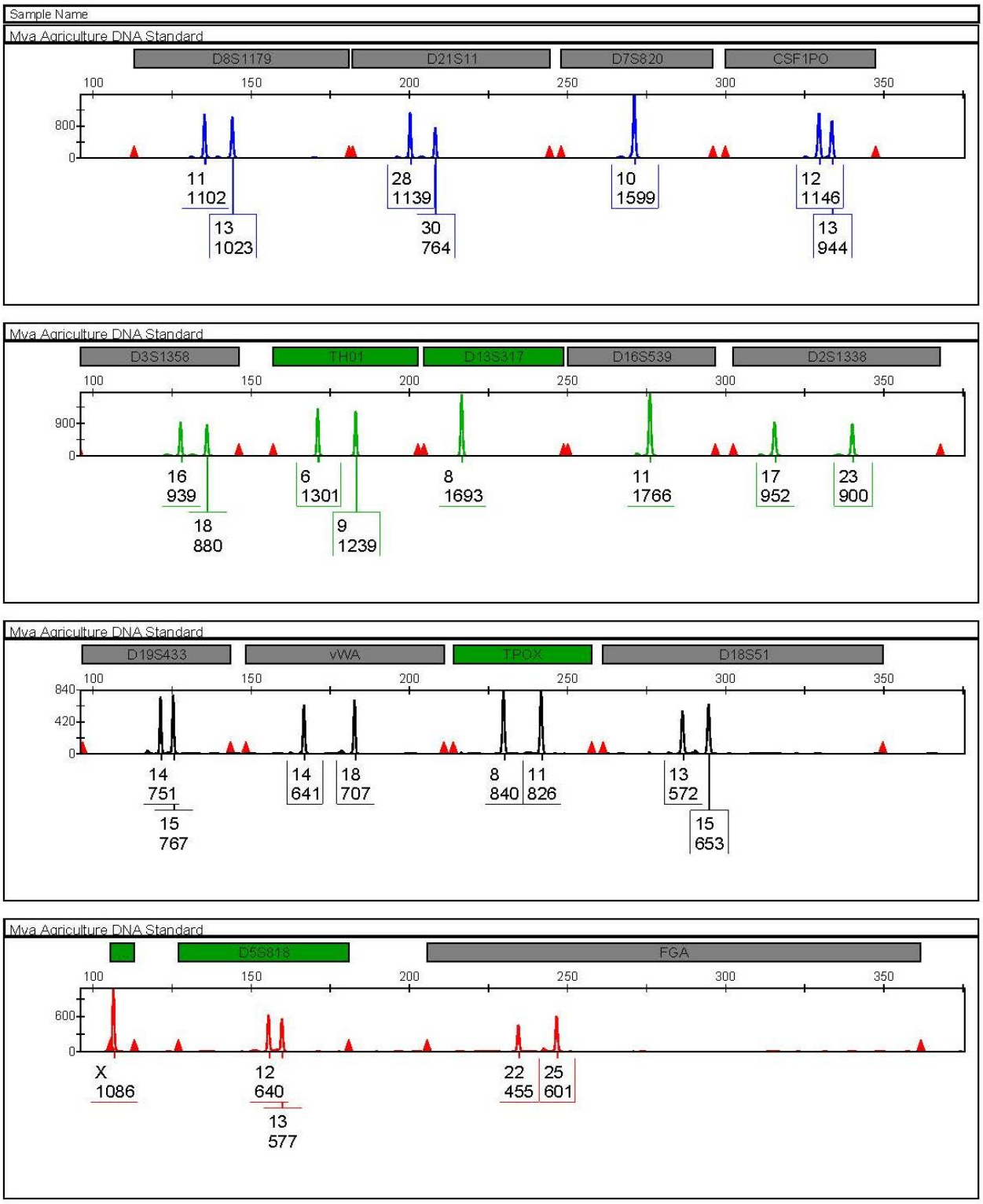
DNA profile from envelope



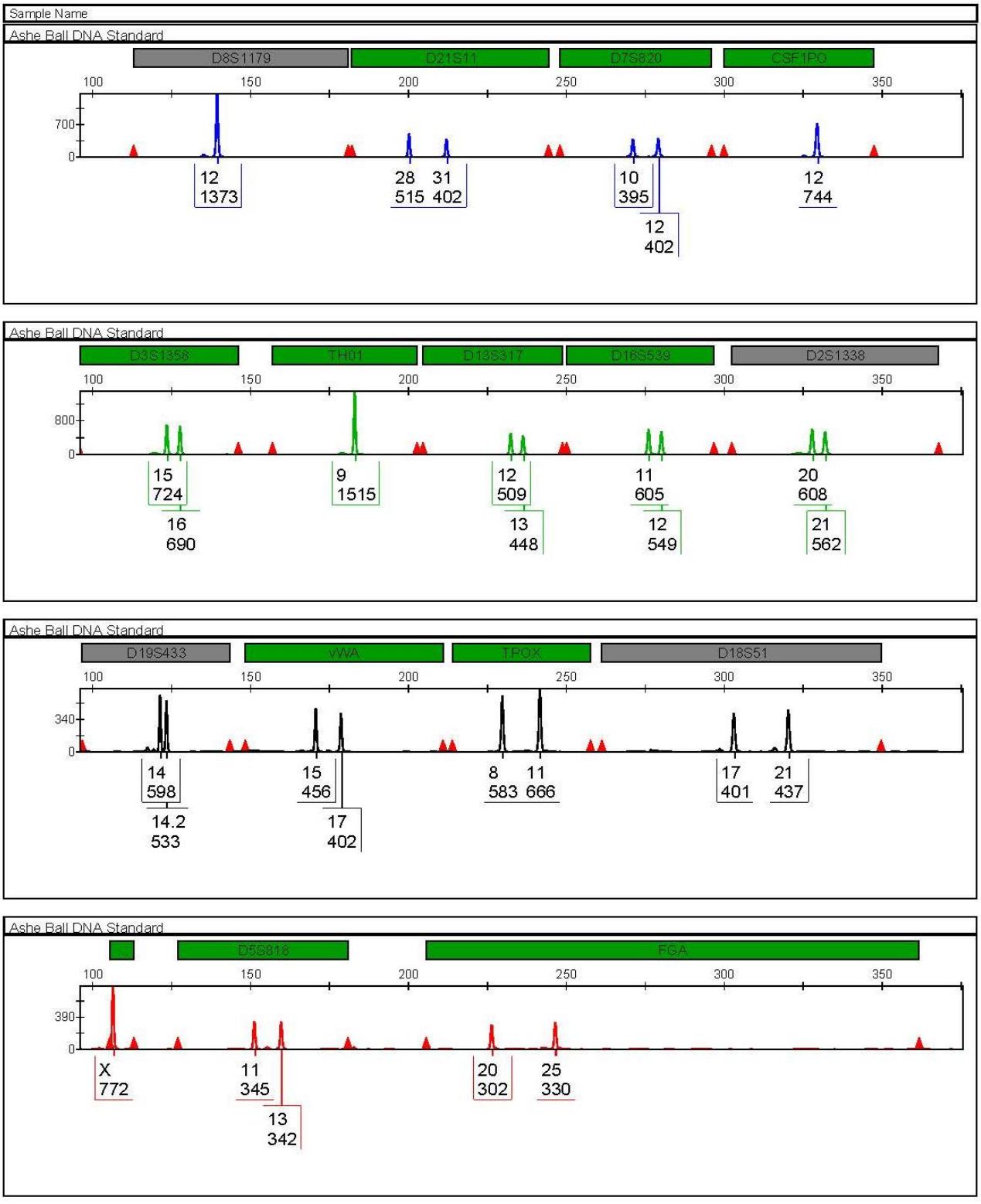
Organic Joe's DNA Profile



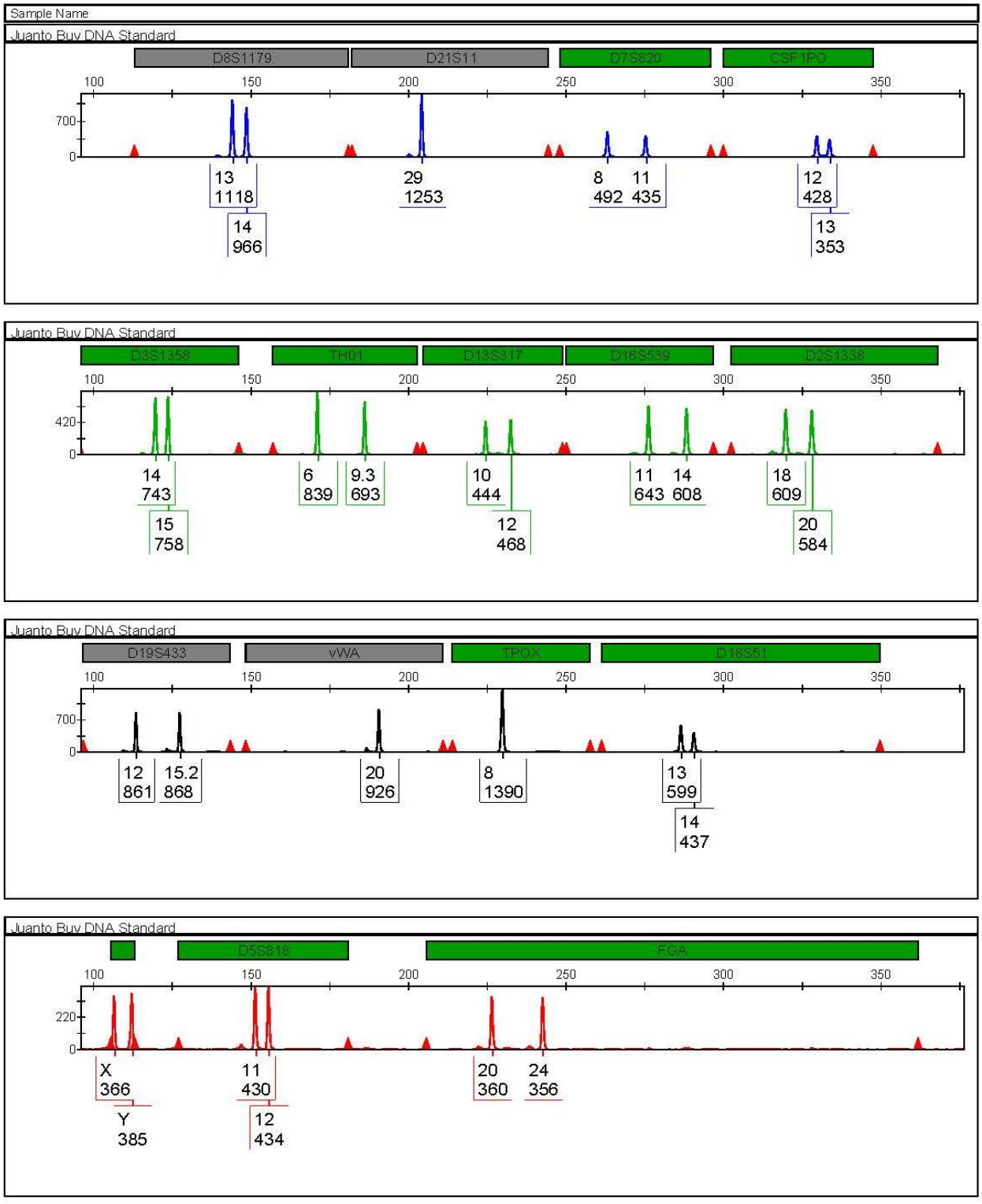
Mya Agriculture's DNA Profile



Ashe Ball's DNA Profile



Juanto Buy's DNA Profile



Name: _____ Date: _____

Graphic Organizer on – "Can Scientists Clone Dinosaurs?" article

Directions: Please complete the t-chart graphic organizer below while we read this article together as a class.

Evidence from text *supporting* ability to clone dinosaurs using fossilized DNA:	Evidence from text *refuting* ability to clone dinosaurs using **fossilized DNA:**

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 17

Fossil Molds and Casts

Materials Needed

- Copies of Activity Masters 33 and 34 (one copy per student)
- Pencil
- Science journals
- Magnifying glasses (optional)
- One seashell, twig, or other small object (plastic insect) per student or group
- About ¼ to ½ cup plaster of Paris/student or small group, about 3½ to 4 cups total
- Seven or eight small margarine dishes
- Seven or eight plastic forks
- About ¼ to ½ cup of water per student or small group
- Tub of petroleum jelly
- Seven or eight paper cups
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 33 and 34) and overhead pens

Approximate Time

- 60 minutes

Corresponding Required Resources

- Activity Masters 33 and 34

Lesson Objectives

- Students will refer to details and examples in the text to determine the main idea and supporting details of the text.
- Students will discover how fossils can be compared to one another and to present-day organisms.

Note: This activity might take longer for the mold to dry to be able to create the fossil cast. However, time has been allotted in Lesson 18 for the fossil cast creation.

Lesson Overview:

Students will learn how fossils can be compared to one another and to present-day organisms. Students will also make a fossil mold and a fossil cast.

Review of Lesson 16:

- Everyone has their own genetic code, except identical twins.
- Your genetic code does not change; it is the same as when you were born.
- Juanto Buy's DNA (from salvia/spit) was found on the envelope taped to Bob's barn window.
- So far, scientists have not been able to collect DNA from fossilized organisms to re-create that extinct plant or animal.

Word Study

DNA
Amber
Analyze
Process
Clues
Capture
Pyrite
Permeated
Sample
Evidence
Comparison
Document
Extraction
Silica
Forensic Scientist
Examine
Crime
Replacement
Submitted
Fossils
Criminal Investigator
Criminal
Perminerlization
Preserve
Dinosaurs
Molds
Casts

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten to fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations, and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: Science
Life Science
Topic: Earth's Living History — This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.
Content Statement
Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Note to teachers:

DNA testing is a powerful scientific tool that is used to identify the source of biological evidence (substances produced by your body such as blood and saliva) by comparing it with a sample from a victim or suspect. When an item first comes in to the DNA Unit, it is tested to see if substances produced by the body are present on the item. This is done using presumptive color/reaction tests. After scientists determine that there is a substance present from the body, then they will do tests to create a DNA profile from the substance. Each person has their own genetic code that is found in the substances produced by the body, which is a person's DNA. Forensic scientists can match the code from evidence to the code from a known sample from the suspect. Generally the match is so specific that only about one person in a trillion could have the same code, making it clear that the substance is a match to the suspect.

Principles for DNA:

1. Everyone has their own genetic code, except identical twins.
2. Your genetic code does not change; it is the same as when you were born.

Activity: Fossil Molds and Casts

Instructional Strategies:

1. Have the students come to the carpet with their science journals and pose this question to students:

   How can fossils help provide us with clues to our past? What can fossils tell us about plants and animals that lived in the past?

2. Collect student ideas on chart paper, on an interactive whiteboard, or a projector.

3. Put students into pairs and then pass out Activity Master 33.

4. Go over the questions about fossils on Activity Master 33 with the students, and then have the pairs study the fossils and answer the questions on the Activity Master.

5. Call student pairs back to the carpet area and discuss as a class their discoveries and observations and collect Activity Master 33.

6. Pass out copies of Activity Master 34, "Everybody Loves Fossils" (courtesy of the Ohio Department of Natural Resources) http://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/Education/HandsOn/HandsOn03.pdf.

7. Take turns having volunteers read over the text.

8. Discuss as a class:

    a. What are fossils? (Collect answers on chart paper.)
    b. How do fossils form? (Collect answers on chart paper.)
    c. What are the differences between a cast and a mold? (Collect answers on chart paper.)

9. Next, have students break into small groups, or work as individuals on creating their cast and mold fossils.

10. Once students are done creating their examples, discuss as a class the differences between how the two types of fossils are formed.

11. Have the students clean up the lab activity area and return to their seats.

12. Have the students fill out an exit ticket on the following questions:

    a. How are fossils formed?
    b. What is the difference between a cast and a mold fossil?
    c. How are cast fossils similar to shoeprint casts that BCI uses in crime scene investigations?

13. Collect the students' exit tickets.

Optional Extension Activities

1. Have students research how studying fossils is similar to studying clues left behind at crime scenes. Have students learn how crime scene investigation has changed throughout the years with the increase in scientific knowledge and technology.

2. Have students make a digital storyboard, or one on paper, outlining how fossilization occurred.

3. Have students go on a supervised fossil hunt and take a paper and crayon or pencil to do fossil rubbings.

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Sample Ohio Fossils

Directions: You are going to be a fossil detective! Please study each fossil image below and answer the questions beside each image as best you can.

What type of plant or animal is this?

What type of habitat would this organism need to survive?

What do you think happened to this organism?

How is this fossil helpful in providing us clues to our past?

What type of plant or animal is this? (Hint: Nickname is the "Dunk" and this is just its head.)

What type of habitat would this organism need to survive?

What do you think happened to this organism?

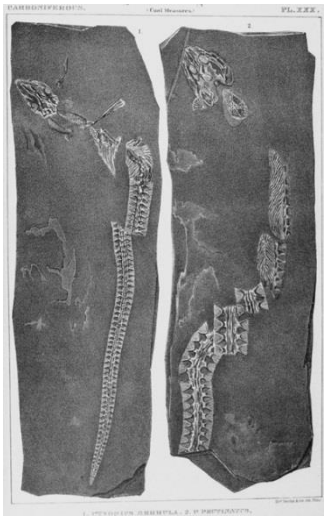
How is this fossil helpful in providing us clues to our past?

What type of plant or animal is this?

What type of habitat would this organism need to survive?

What do you think happened to this organism?

How is this fossil helpful in providing us clues to our past?



What type of plant or animal is this?

What type of habitat would this organism need to survive?

What do you think happened to this organism?

How is this fossil helpful in providing us clues to our past?

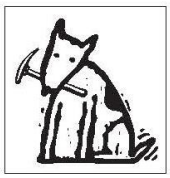
What type of plant or animal is this?

What type of habitat would this organism need to survive?

What do you think happened to this organism?

How is this fossil helpful in providing us clues to our past?

Name: _____ Date: _____



Division Of Geological Survey

HANDS ON EARTH SCIENCE No. 3

EVERYONE LOVES FOSSILS

by Sherry L. Weisgarber

What exactly are fossils? Fossils are the remains of past life. This definition includes anything that is a clue to past life, such as the bones of dinosaurs and mammoths, the tiny shells of one-celled animals, trails and footprints, worm burrows, leaves, tree trunks, seeds, and microscopic spores of fungi.

Fossils occur in sedimentary rocks such as limestone, shale, and sandstone. Because Ohio is covered with sedimentary rocks, fossil collecting is a popular hobby for many Ohioans.

How do fossils form? Some of the plants and animals that died in the geologic past were buried by sediments before they could decompose. After burial, the soft tissue of the organism slowly decomposed, but the harder parts of the plant or animal remained intact. The sediments eventually were hardened into rocks, preserving the harder parts of the organisms, such as bones, shells, teeth, leaves, and stems, that we find as fossils today.

Fossils are preserved in a variety of ways. The hard parts of some organisms are permeated by minerals in a process called permineralization. Petrified wood is an example of permineralization. Many plants are preserved as compressions. In this process, the remains of the organism are squeezed by the rocks that surround it until all of its liquids and gases are removed, leaving only a thin film on the surface of the rock. The hard parts of many Ohio fossils were dissolved by ground water moving through the sediment or rock and replaced with minerals in the water. This process is called replacement. In Ohio, common replacement minerals are pyrite and silica. Ground water also may dissolve the original material without replacing it with other minerals. If the sediment hardened into rock before the fossil was dissolved, the rock retains the imprint of the fossil, which is called a mold. A mold may later be filled with other sediment or minerals precipitated from ground water, making a cast of the fossil. A cast is a replica of the original fossil in a different material.

The following classic activity illustrates the concepts of molds and casts.

Each student will need the following materials:

sea shell, twig, or other small object	plastic fork	petroleum jelly
1/4 to 1/2 cup plaster of paris	1/4 to 1/2 cup water	paper cup
small plastic margarine dish		

Cover the small object, representing a dead organism, with a thin layer of petroleum jelly to keep it from sticking in the plaster of paris when it hardens. Put the plaster of paris into the margarine dish. Add water gradually to the plaster of paris, stirring gently with the fork until the plaster is thick and creamy. Gently tap the bottom of the dish onto the table to force out any air bubbles in the plaster. This layer represents the soft sediment that the organism fell into when it died. Let the plaster harden for about 1 minute so the object won't sink to the bottom of the container. Press the small, petroleum-covered object into the plaster and allow it to dry thoroughly, preferably overnight. Remove the object from the plaster. You now have a mold of your object. Leave the mold in the container and coat the entire surface of the dry plaster with a thin layer of petroleum jelly. Mix another batch of plaster of paris in the paper cup. Pour this mixture over the mold and allow it to dry. This layer represents the overlying sediments or the minerals precipitated from ground water that fill in the mold, making a cast of the original object. When the plaster is dry, separate the cast from the mold. It should separate easily along the layer of petroleum jelly. You now have a fossil cast and a fossil mold of your original object.

SOURCE: *Ohio fossils*, ODNR, Division of Geological Survey; *Water, stones, & fossil bones*, National Science Teachers Association; and *The earth science book*, Dinah Zike.

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 18
Handwriting Analysis

Materials Needed
- Pencil
- Glue sticks
- Science journals
- Colored pencils or crayon, one/student
- Copies of Activity Masters 34, 35 and 36 (one copy per student)
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different colors
- Equipment to project video clips
- Magnifying glasses (optional)

Approximate Time
- 70 minutes

Corresponding Required Resources
- Video Clip 15 — *Handwriting* (1:34)
- Video Clip 16 — *Handwriting Results* (1:32)
- Activity Masters 34 (from Lesson 17), 35 and 36

Lesson Objectives
- Students will engage effectively in groups through discussions.
- Students will learn more about forensic science by reading and answering comprehension questions on informational text.
- Students will analyze handwriting samples to help link suspects to the crime.
- Students will plan and conduct simple investigations.

Lesson Overview:

Students will learn more about how forensic scientists in the Questioned Documents Unit of BCI use handwriting analysis to help link suspects to the crime.

Review and Completion of Lesson 17:

- What are fossils?
- How do fossils form?
- How are fossil molds made?
  - Finish the lesson activity from Lesson 17 "Everybody Loves Fossils." Have the students get their lab materials out from Lesson 17 and remove the object from the plaster that they had dry overnight. Inform students that they now have a mold of their object.
- How are fossil casts made?
  - Inform the students that they will find out next. Tell the students to leave the mold in the container and coat the entire surface of the dry plaster with a thin layer of petroleum jelly. Mix another batch of plaster of Paris in the paper cup. Pour this mixture over the mold and allow it to dry. This layer represents the overlying sediments or the minerals, precipitated from groundwater, that fill in the mold, making a cast of the original object. When the plaster is dry, separate the cast from the mold. It should separate easily along the layer of petroleum jelly. Inform the students that they now have a fossil cast and fossil mold of their original object. Finally, have the students clean up their lab areas.

Word Study

Suspects	Alleles	Forensic Scientist	Fossils
Amber	DNA	Examine	Clues
Process	Sample	Criminal	Capture
Evidence	Gram	Preserve	Analyze
Document	Crime	Dinosaurs	
Extraction	Nanogram	Saliva	

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations, and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: Science
Life Science
Topic: Earth's Living History — This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.
Content Statement
Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Activity: Handwriting Impressions/Indentations

Instructional Strategies:

1. Ask the students if their handwriting is similar to anyone else's they know? Discuss how they think people's handwriting differs.

2. Explain to students that in the Questioned Documents section of BCI, forensic scientists are trained to look closely at handwriting. The forensic scientists in this section of the lab analyze other types of evidence too — such as indentations (which are like fossil molds) on paper and notes found at crimes, tear patterns of paper, documents that were falsely made with the intent to trick someone, alterations/changes to papers, such as checks and other important documents. However, today, the students are focusing mainly on handwriting analysis and indented writing.

3. Hand out Activity Master 35. Have students read over the information about the Questioned Documents section of the lab at BCI and then have them list three important facts that they learned from reading the information in the section provided below it.

4. Show the students Video Clip 15 — *Handwriting* and discuss the information that was shared in the video.

    a. What do forensic scientist look for when analyzing handwriting? (unique features — letters sitting above or below the line on the paper, letters that are written closer together, size, and spacing)

5. Hand out Activity Master 36. Ask students to look over the handwriting samples from the suspects and compare it to the handwriting found on the threatening note left at the barn scene.

6. Have students write down on their Activity Master 36 who they think had handwriting that matched the threatening note. Ask if students determined that Juanto Buy wrote the threatening note? Ask students which unique features helped them determine it was Juanto Buy's handwriting? (Answer: the "n" does not have a stick, some letters are close together, and the "g" has a squiggly.)

7. Show Clip Video 16 — *Handwriting Results*.

Optional Extension Activities

1. Have students research how handwriting analysis has changed over the past 100 years, reporting their findings to their classmates.

2. Have students write a mystery story, including secret, indented notes placed sporadically throughout the story, where students have to reveal the secret.

3. Have students develop a secret code and then write notes to their classmates that their classmates have to decipher with the secret code.

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Informational Text on Handwriting Analysis and Questioned Documents

Directions: Please read the comprehension question below first. Then, read the text selection on handwriting analysis and other questioned documents. Finally, answer the comprehension question below the text passage.

Handwriting Analysis and Questioned Documents

In the Questioned Documents section of the BCI lab, the forensic scientists are able to look at handwriting, alterations, indented writing, and more. They do many types of examinations to determine that the document is authentic, how the document was made/produced, and what information can be obtained from the document. Many of the examinations that they perform are handwriting comparisons.

There are three main principles of handwriting comparisons. The first principle is that no two people write exactly alike. The second principle is that no person writes exactly the same way twice. The final principle of handwriting comparison is that no person can write above their skill level.

In making comparisons, forensic scientists look at more than just how a letter was formed. They also look at size, speed of writing, slant, spacing, ending strokes, beginning strokes, pressure used, etc. They compare known samples of handwriting from a person or suspect to the unknown samples found at crime scenes or in suspect's belongings to determine if the known author could have written the questioned document. This type of evidence can help link a suspect to a crime.

Please list below three important facts that you learned from reading the information on handwriting analysis and the Questioned Documents Unit of the BCI lab.

1.

2.

3.

Name: _____ Date: _____

Informational Text on Handwriting Analysis and Questioned Documents

Directions: Please read the comprehension question below first. Then, read the text selection on handwriting analysis and other questioned documents. Finally, answer the comprehension question below the text passage.

Handwriting Analysis and Questioned Documents

In the Questioned Documents section of the BCI lab, the forensic scientists are able to look at handwriting, alterations, indented writing, and more. They do many types of examinations to determine that the document is authentic, how the document was made/produced, and what information can be obtained from the document. Many of the examinations that they perform are handwriting comparisons.

There are three main principles of handwriting comparisons. The first principle is that no two people write exactly alike. The second principle is that no person writes exactly the same way twice. The final principle of handwriting comparison is that no person can write above their skill level.

In making comparisons, forensic scientists look at more than just how a letter was formed. They also look at size, speed of writing, slant, spacing, ending strokes, beginning strokes, pressure used, etc. They compare known samples of handwriting from a person or suspect to the unknown samples found at crime scenes or in suspect's belongings to determine if the known author could have written the questioned document. This type of evidence can help link a suspect to a crime.

Please list below three important facts that you learned from reading the information on handwriting analysis and the Questioned Documents Unit of the BCI lab.

Answers will vary (look at above text selection to help assess for correct information), but here are some examples:

The Questioned Documents Unit of BCI is able to look at handwriting, alterations, indented writing, and more.

There are three main principles of handwriting comparisons. (Could list them in own words.)

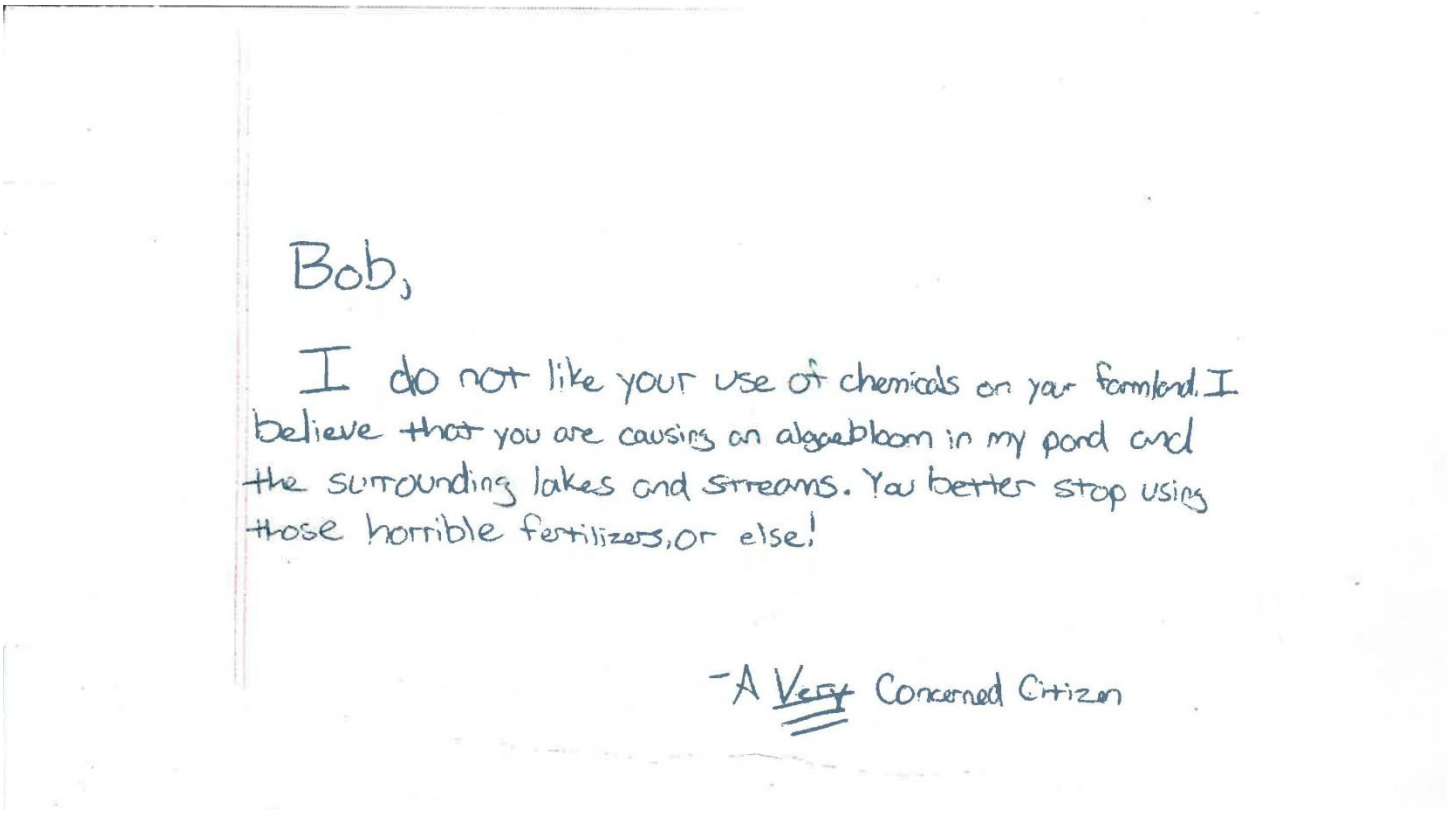
Forensic scientists in this section look at how letters were formed, their size, speed of writing, slant, spacing, pressure used, etc.

Name: _____ Date: _____

Who Wrote the Note?

Compare the threatening note from the barn on this page to the handwriting samples on the following samples.

Note from the barn:



Bob,

I do not like your use of chemicals on yar farmland. I believe that you are causing an algaebloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

-A Very Concerned Citizen

Handwriting Samples

Robert (Bob) Agriculture

Bob,

I dont like your use of chemicals on your farmland, I Believe that you are causing an algaebloom in my Pond and the surrounding lakes and streams, you better Stop using those horrible fertilizers, or else!

- a Very Concerned Citizen

Juanto Buy

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

—A Very Concerned Citizen

Handwriting Samples

Mya Agriculture

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algaebloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

-A very Concerned citizen

Ashe Ball

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

- A Very Concerned Citizen

Handwriting Samples

Terra Agriculture

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using those horrible fertilizers, or else!

- A very concerned citizen

Organic Joe

Bob,

I do not like your use of chemicals on your farmland. I believe that you are causing an algae bloom in my pond and the surrounding lakes and streams. You better stop using these horrible fertilizers, or else!

- A very concerned citizen

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 19

Optional: Handwriting Identification

Materials Needed

- One exit ticket per student
- Pencil
- Glue stick
- Science journals
- Colored pencils or crayon, one/student
- Magnifying glasses (optional)

Approximate Time

- 50 minutes

Corresponding Required Resources

- N/A

Lesson Objectives

- Students will engage effectively in groups through discussions.
- Students will learn more about forensic science.
- Students will analyze handwriting samples to help link suspects to the crime.
- Students will use simple equipment and tools to gather data and extend senses.
- Students will plan and conduct simple investigations.
- Students will review and ask questions about the observations and explanations of others.

Lesson Overview:

Students will learn more about how forensic scientists in the Questioned Documents Unit of BCI use handwriting analysis and the examination of imprints/indentations to link suspects to the crime.

Review of Lesson 18:

- What does the Questioned Documents Unit at BCI specialize in?
- Which suspect's handwriting matched the handwriting on the note left on Bob's barn window?

Word Study

Evidence
Characteristics
Size
Spacing
Indentations
Hump
Conjunction
Document
Clues
Preserve
Baseline
Imprints
Stick
Crime
Impressions
Capture
Anonymous
Casts
Squiggly
Criminal
Features
Submitted
Fossils
Molds
Variations

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations, and explanations. 6. Review and ask questions about the observations and explanations of others.

Activity: Handwriting Indentation/Impression Activity

Instructional Strategies:

1. Explain to the class that like some fossils leave an imprint or a mold in rock, when people write, they can leave behind indentations on the paper or notepad below the page upon which they are writing, just like Jessica from BCI shared in the video clip.

2. Share with students that the forensic scientist used an Electro Static Detection Apparatus (ESDA) in the lab at BCI, to help develop the indented writing that left an imprint in the notepad found at Juanto Buy's house. The scientist was able to determine that the notepad was the one Juanto used to write the threatening note to Bob.

3. Explain to students that although they do not have access to equipment like an ESDA, they can do a simple activity in their science journals to demonstrate how to develop indented writing.

4. Have students get their science journals, a pencil, and a crayon or colored pencil.

5. Have students find their next blank page of journal paper. Ask them to use a pencil and press firmly as they write what their favorite part of this crime investigation has been so far. Then, have them carefully tear or cut out the paper upon which they wrote, leaving behind only the other pages of the journal.

6. Then, have the students exchange journals and ask them to take their colored pencil or crayon and rub over the indented journal page, to reveal their classmate's message.

7. Ask students if they think they could figure out another way to reveal the indentations on a piece of paper or notepad? (For example, they could use silly putty and a mirror to reveal the message.)

8. Then have students fill out an exit ticket about what they learned in the lesson about analyzing handwriting.

Optional Extension Activities

1. Have students research how handwriting analysis has changed during the past 100 years, reporting their findings to their classmates.

2. Have students write a mystery story, including secret, indented notes placed sporadically throughout the story, where students have to reveal the secret.

3. Have students develop a secret code and then write notes to their classmates, that their classmates have to decipher with the secret code.

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 20
Chemistry

Materials Needed

- Pencil
- Glue Stick
- Science journal
- Pencils upon which to tape paper towel strips containing ink dots/group of four students, so about six to eight depending on class size
- Black pens for chromatography experiment (have paper towel strips cut, dotted, and labeled prior to the lesson)
- One Zebra fine-point gel pen (label as Pen #1)
- One Optiflow fine-point pen (label as Pen #2) Note: Students will eventually discover that this is Juanto Buy's pen, which was used to write the threatening note to Bob.
- One Bic Mark-it ultrafine-point pen (label as Pen #3)
- One Sharpie fine-point pen (label as Pen #4) Note: These are the pens used in the video. You can do this as a demonstration to save on materials, but it would be more powerful to have students do this in small groups. Regardless, you only need one set of pens for this experiment.
- One pair of scissors for teacher to cut paper towel strips
- Plastic cups for chromatography experiment (clear 8 oz. ones work well) one cup/group (so about six to eight if you have a class you are dividing into groups of four)
- Water source
- Scotch tape
- Quality paper towels (Bounty)

Lesson Overview:

Students will learn more about how forensic scientists in the Chemistry Unit of BCI use chromatography to help them link the ink found on the threatening note to ink from one of the ink pens found at the suspects' homes.

Review of Lesson 19:

- What do forensic scientists look for when analyzing handwriting? They look for unique features such as letters sitting above or below the line on the paper, letters that are written closer together, size, and spacing.
- How are fossils and writing similar? Like some fossils leave an imprint in rock, when people write, they can leave behind indentations on the paper or notepad below the page on which they are writing.
- Whose handwriting matched the handwriting on the threatening note left on the barn? (Juanto Buy's)

Word Study

Suspects
Statement
Investigator
Analyze
Chromatography
Submitted
Pigment
Chemistry
Examine
Evidence
Clues
Separate
Anonymous
Chromatogram
Forensic scientist
Process
Crime
Document
Mixtures
Ink
Control
Mixtures
Criminal Investigator
Criminal
Characteristics
Chemicals
Saturate

- Copies of Activity Masters 37 and 38 (one copy per student)
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 37 and 38) and overhead pens of different colors
- Equipment to project video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 17 — *Chromatography* (1:18)
- Video Clip 18 — *Chromatography Results* (0:28)
- Activity Masters 37 and 38

Lesson Objectives

- By reading an informational text about this topic and answering comprehension questions, students will learn more about how forensic scientists in the Chemistry Unit of BCI use chromatography.
- Students will learn how chromatography can be used to link the ink back to the pen that was used to write the threatening letter.
- Students will effectively engage in group discussions.
- Students will plan and conduct simple investigations.
- Students will use simple equipment and tools to gather data and extend senses.

Note to Teachers:

A pigment is a chemical that makes something (ink, candy coating, etc.) look a certain color. The black color of the black pen ink is a mixture of different colored pigments, which, when combined, appear black.

When a piece of paper with pigment on it is dipped in water, the water slowly moves through a water soluble stain and it dissolves the pigments in the stain. Depending on the size, shape, and weight of pigment, it may be carried along by the water a large or small distance up the paper.

When a substance/stain is made of a mixture of pigments, each pigment will be carried up the paper in a different way. This results in different bands of color, with each color representing a different pigment.

This "streak" up the paper is called a chromatogram. We can recognize the chromatogram from the ink used to write the threatening note, by comparing its chromatogram to that of the streak of black ink coloring from each of the suspect's black ink pens.

Preparation:

Set up a chromatography lab.

1. Cut paper towels into 1½- inch by 3½- inch strips — about six to eight total, depending on class size (six to eight strips/small group)

2. Tape the strips to the pencils and mark each strip with a dot (labeled underneath with the number of pen it came from), and with a dot from the ink used to write the threatening note. (See images of experiment setup below.)

3. Note: It is important to fill up each plastic cup with enough water (about a centimeter or less), or enough water so that when the paper towel strip is suspended from a pencil, just the end of it will be in the water, and the ink dots will be above the waterline. (Have the students place the pencil paper towel strip setups in the cups when they begin conducting the experiment.)

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statement
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: English Language Arts	
Strand	**Topic**
Reading	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Activity: Chromatography Experiment

Instructional Strategies:

1. First, pass out Activity Master 37 to students. Read over the multiple-choice questions before reading the informational text on chromatography together as a class.

2. Have students answer the multiple-choice comprehension questions about chromatography.

3. Show students Video Clip 17 — *Chromatography* and discuss the information that the forensic scientist shares in the video.

4. Hand out Activity Master 38. Discuss how to set up the chromatography experiment that students will be conducting in small groups to determine which suspect's pen was used to write the threatening note left on Bob's barn window. Set up the experiment according to the Activity Master, and allow students to complete the activity.

5. After the students have spent several minutes letting the water travel up the paper to the dots, and have compared and recorded the results they observed, ask students to share what conclusions they came to and why.

6. Then, have students clean up their lab areas and return to their desk.

7. Show the students Video Clip 18 — *Chromatography Results* and discuss.

8. Finally, collect students' Activity Masters 37 and 38.

Optional Extension Activities

1. Students can create either a paper version, or an electronic version of a storyboard describing the process of chromatography with captions and images/pictures.

2. Students can research more about forensic chemists and create a Keynote or PowerPoint presentations about their findings.

3. Students can create their own chromatography investigations with pens of different ink colors, note what they observed, and share those results with their classmates.

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Chromatography Informational Text and Comprehension Questions

Directions: Please read the comprehension questions below first. Then, read the text selection below on chromatography. Finally, answer the multiple choice questions below the passage by circling the correct answer.

A pigment is a chemical that makes something (ink, candy coating, etc.) look a certain color. The black color of the black pen ink is a mixture of different colored pigments, which, when combined, appear black.

When a piece of paper with pigment on it is dipped in water, the water slowly moves through a water soluble stain, and it dissolves the pigments in the stain. Depending on the size, shape, and weight of pigment, it may be carried along by the water a large distance up the paper, or a short distance.

When a substance/stain is made of a mixture of pigments, each pigment will be carried up the paper in a different way. This results in different bands of color, with each color representing a different pigment.

This "rainbow streak" up the paper is called a chromatogram. We can recognize the chromatogram from the ink used to write the threatening note, by comparing its chromatogram to that of the streak of black ink coloring from each of the suspect's black ink pens.

1. A _____ is a chemical that makes something look a certain color.

   a. chromatograph

   b. chromatogram

   c. "rainbow streak"

   d. pigment

2. When the piece of paper with pigment on it is dipped in water, what happens?

   a. The water slowly dissolves the pigments in the stain.

   b. The water does nothing to the pigments of the stain.

   c. The water in the cup the paper is dipped into turns brown.

   d. The water makes the stains disappear.

3. Depending on the size, shape, and _____ of pigment, it may be carried along by the water a large distance up the paper, or a short distance.

   a. taste

   b. color

   c. weight

   d. sound

4. This “rainbow streak” that is carried up the paper is called a _____.

   a. kaleidoscope

   b. mixture

   c. choreograph

   d. chromatogram

5. We can recognize the chromatogram from the ink used to write the threatening note, by_____ from each of the suspect’s black ink pens.

   a. comparing its chromatogram to that of the streak of black ink coloring

   b. combining its chromatogram to that of the streak of black ink coloring

   c. dissolving its chromatogram with the streak of black ink coloring

   d. disturbing its chromatogram with the streak of black ink coloring

Name: _____ Date: _____

Chromatography Informational Text and Comprehension Questions

Directions: Please read the comprehension questions below first. Then, read the text selection below on chromatography. Finally, answer the multiple choice questions below the passage by circling the correct answer.

A pigment is a chemical that makes something (ink, candy coating, etc.) look a certain color. The black color of the black pen ink is a mixture of different colored pigments, which, when combined, appear black.

When a piece of paper with pigment on it is dipped in water, the water slowly moves through a water soluble stain, and it dissolves the pigments in the stain. Depending on the size, shape, and weight of pigment, it may be carried along by the water a large distance up the paper, or a short distance.

When a substance/stain is made of a mixture of pigments, each pigment will be carried up the paper in a different way. This results in different bands of color, with each color representing a different pigment.

This "rainbow streak" up the paper is called a chromatogram. We can recognize the chromatogram from the ink used to write the threatening note, by comparing its chromatogram to that of the streak of black ink coloring from each of the suspect's black ink pens.

1. A _____ is a chemical that makes something look a certain color.

   a. chromatograph

   b. chromatogram

   c. "rainbow streak"

   d. pigment

2. When the piece of paper with pigment on it is dipped in water, what happens?

   a. The water slowly dissolves the pigments in the stain.

   b. The water does nothing to the pigments of the stain.

   c. The water in the cup the paper is dipped into turns brown.

   d. The water makes the stains disappear.

3. Depending on the size, shape, and _____ of pigment, it may be carried along by the water a large distance up the paper, or a short distance.

   a. taste

   b. color

   c. weight

   d. sound

4. This “rainbow streak” that is carried up the paper is called a _____.

   a. kaleidoscope

   b. mixture

   c. choreograph

   d. chromatogram

5. We can recognize the chromatogram from the ink used to write the threatening note, by_____ from each of the suspect’s black ink pens.

   a. comparing its chromatogram to that of the streak of black ink coloring

   b. combining its chromatogram to that of the streak of black ink coloring

   c. dissolving its chromatogram with the streak of black ink coloring

   d. disturbing its chromatogram with the streak of black ink coloring

Name: _____ Date: _____

Chromatography Activity

Directions: Please follow the instructions below, making sure you complete each step in order.

Today you will be assisting the Chemistry Unit of the BCI. You will be conducting a chromatography experiment to determine which suspect's pen was used to write the threatening note left on Bob's barn window. Using your background knowledge on chromatography, please make a prediction of what you think will happen to each ink dot when you place the paper towel strip into the water.

Prediction:

Draw a picture of what happened to each ink dot after you placed the paper towel strip into the water for several minutes. Describe the process that took place beside the image of the water cup.

Description of Process:

After conducting this experiment, what can you conclude about the suspect's pens?

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 21
Trace Evidence

Materials Needed

- Copies of Activity Masters 39 and 40 (one copy per student)
- Pencil
- Highlighter (optional) — students can underline instead
- Science journals
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters 39 and 40) and overhead pens
- Equipment to project video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 19 — *Fracture Match* (5:24)
- Video Clip 20 — *Fracture Match Results* (0:27)
- Activity Masters 39 and 40

Lesson Objectives

- Students will explain procedures and concepts in a scientific text based on specific information in the text.
- Students will plan and conduct simple investigations.
- Students will communicate with one another about their observations, investigations and explanations.

Lesson Overview:

Students will learn more about how forensic scientists in the Trace Evidence Unit of BCI analyze and examine evidence found at crime scenes. In the Trace Evidence section, forensic scientists examine microscopic evidence, in the effort to discover how a suspect, victim, and crime scene were in contact with one another. The scientists in this unit examine glass, fibers, paint, shoe prints, tire tracks, fracture matches, and other miscellaneous items that may be found in relation to a crime. Today, students will learn specifically about fracture matches and how they are used to link suspects to crime scenes.

Word Study

Suspects	Forensic Scientist
Statement	Process
Investigator	Crime
Analyze	Document
Chromatography	Mixtures
Submitted	Ink
Pigment	Control
Chemistry	Mixtures
Examine	Criminal Investigator
Evidence	Criminal
Clues	Characteristics
Separate	Chemicals
Anonymous	Saturate
Chromatogram	

Note to teachers:

Principles of Trace:

1. When two items come in contact, there is an exchange.
2. Items can be compared to determine if they are similar. Sometimes the comparison can determine that two objects came from the same source.

Fracture Matches:

1. When an item is broken or torn, a unique edge or pattern is created.
2. The pattern or edge of a broken item is unique because the random forces used to break or tear the item are not reproducible (torque/momentum/force, acceleration/speed).
3. Unique edges can be fit back together like a jigsaw puzzle.

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: English Language Arts	
Strand	**Topic**
Reading — Informational Text	Key Ideas and Details

Standard Statements

1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
2. Determine the main idea of a text and explain how it is supported by key details; summarize the text.
3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area.
5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:

Content Statements:

1. Observe and ask questions about the natural environment.
2. Plan and conduct simple investigations.
3. Employ simple equipment and tools to gather data and extend senses.
4. Use appropriate mathematics with data to construct reasonable explanations.
5. Communicate about observations, investigations and explanations.
6. Review and ask questions about the observations and explanations of others.

Review of Lesson 20:

1. What is chromatography? (the physical separation of a mixture into its individual components)

2. How is it used to help solve crimes? (Students learn how to use the process of chromatography to separate the ink from the threatening note and compare it to the ink from the different ink pens found in the suspects' homes.)

3. Which suspect's pen matched the ink pen used to write the threatening note found on Bob's barn window? (Juanto Buy's — Pen #2)

Activity: Trace Evidence Informational Text and Fracture Match Experiment

Instructional Strategies:

1. Hand out Activity Master 39. First, go over the two, short-answer questions the students will have to answer individually. Then, read over the information with students about what the Trace Evidence Unit of BCI does, and specifically what a fracture match is and examples of fracture matches.

2. Have students individually fill out the questions below the informational text on Activity Master 39.

3. Show the students Video Clip 19 — *Fracture Match* and discuss.

4. Hand out Activity Master 40 and go over the fracture match activity with students.

5. Next, have the students work on their own, or in pairs, to figure out which fracture match, matches the one from the tape used at the crime scene and determine who the tape belonged to out of the suspects.

6. Discuss with students their results, and then ask if there are any questions?

7. Next, show the students Video Clip 20 — *Fracture Match Results*.

8. Collect student's Activity Master 40.

Optional Extension Activities

1. Have students use different rolls of tape (decorative) to make tape art projects.

2. Have students create their own fracture match activity for their classmates to solve.

3. Have students write a mystery story, including a fracture match situation, that, when solved, leads the police to the culprit behind the crime.

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Trace Evidence Informational Text and Comprehension Questions

Directions: Please read the comprehension questions below first. Then, read the text selection below on the Trace Evidence Unit of the Ohio BCI. Finally, answer the questions below the text selection.

In this section of the Ohio BCI laboratory, evidence is examined to figure out how a suspect, victim, and crime scene were in contact with each other. The forensic scientists in this unit examine glass, fibers, paint, shoe prints, tire tracks, fracture matches, and other miscellaneous items that may be found in relation to a crime.

The forensic scientists in this unit have two principles that they like to follow when examining evidence. The first principle is that when two items come in contact with each other there is an exchange. The second principle is that two or more items can be compared to determine if similar, but they cannot determine if it is the actual source.

The scientists in this unit (and in the Questioned Documents Unit) study fracture matches. A fracture match is made when an item is broken or torn because a unique edge or pattern is created between the pieces of the object. This happens because the random forces that broke the item are not reproducible. A fracture match can be made when the unique edges of an object or item can be fit back together like a jigsaw puzzle. These materials can be analyzed to provide investigative leads and also can be compared to known samples to associate a suspect with a victim or a suspect with a crime scene.

1. What is a fracture match? Please give an example of one.

2. Which principle of examining evidence do you think is more important and why?
   a. When two items come in contact with each other there is an exchange, or
   b. Two or more items can be compared to determine if similar, but forensic scientist cannot determine if it is the actual source

Name: _____ Date: _____

Trace Evidence Informational Text and Comprehension Questions

Directions: Please read the comprehension questions below first. Then, read the text selection below on the Trace Evidence Unit of the Ohio BCI. Finally, answer the questions below the text selection.

In this section of the Ohio BCI laboratory, evidence is examined to figure out how a suspect, victim, and crime scene were in contact with each other. The forensic scientists in this unit examine glass, fibers, paint, shoe prints, tire tracks, fracture matches, and other miscellaneous items that may be found in relation to a crime.

The forensic scientists in this unit have two principles that they like to follow when examining evidence. The first principle is that when two items come in contact with each other there is an exchange. The second principle is that two or more items can be compared to determine if similar, but they cannot determine if it is the actual source.

The scientists in this unit (and in the Questioned Documents Unit) study fracture matches. A fracture match is made when an item is broken or torn because a unique edge or pattern is created between the pieces of the object. This happens because the random forces that broke the item are not reproducible. A fracture match can be made when the unique edges of an object or item can be fit back together like a jigsaw puzzle. These materials can be analyzed to provide investigative leads and also can be compared to known samples to associate a suspect with a victim or a suspect with a crime scene.

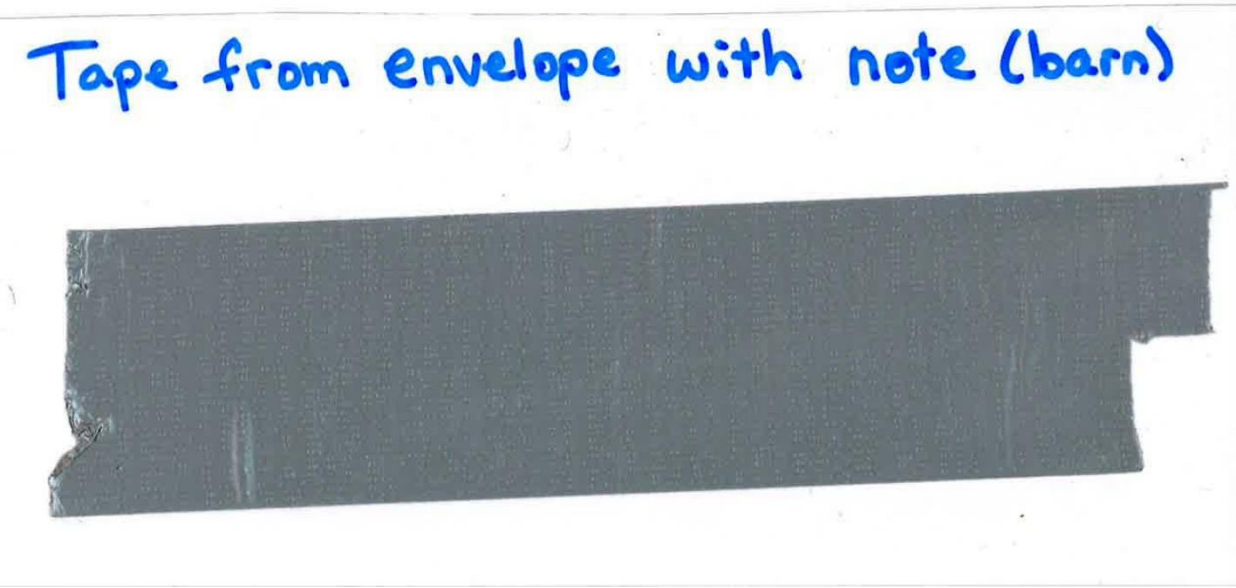
1. What is a fracture match? Please give an example of one.

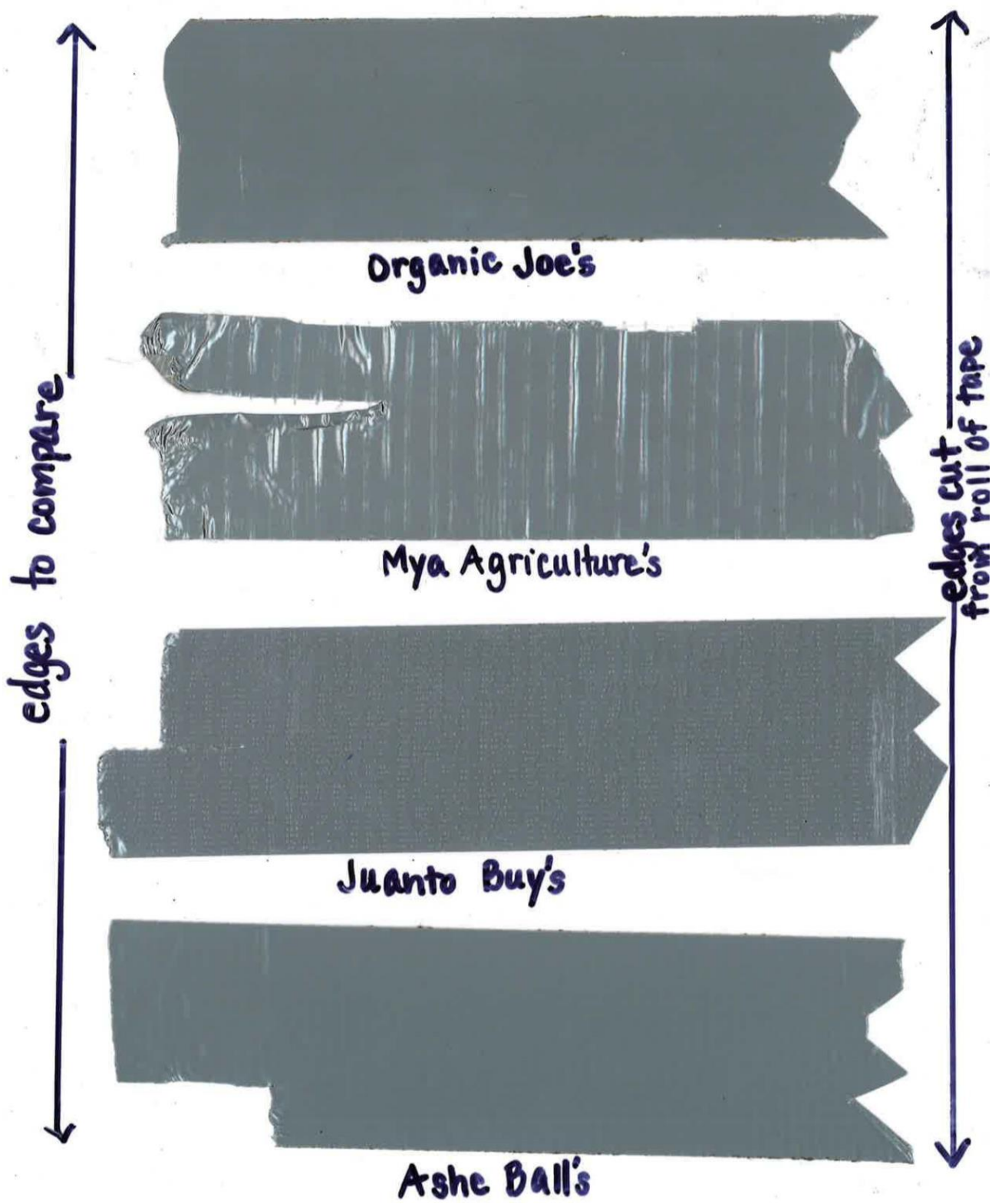
A fracture match is made when an item is broken or torn because a unique edge or pattern is created between the pieces of the object. Examples: tape, glass, paper, etc.

2. Which principle of examining evidence do you think is more important and why?
   a. When two items come in contact with each other there is an exchange, or
   b. Two or more items can be compared to determine if similar, but forensic scientist cannot determine if it is the actual source

Answers will vary. There is no right or wrong answer here. As long as students pick one principle and provide evidence to support their choice, they should be given full credit for their answer.

Name: _____ Date: _____




edges to compare
edges cut from roll of tape
Organic Joe's
Mya Agriculture's
Juanto Buy's
Ashe Ball's

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 22
Trace Evidence

Materials Needed

- Copies of Activity Master 41 (one copy per student)
- Piece of scrap paper large enough for each student's shoeprint
- Science journals
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters) and overhead pens of different colors
- Equipment to project video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 21 — *Shoeprint* (2:04)
- Video Clip 22 — *Shoeprint Results* (0:57)
- Activity Master 41

Lesson Objectives

- Students will observe and ask questions about the natural environment.
- Students will use simple equipment and tools to gather data and extend senses.
- Students will communicate about observations and investigations with others.
- Students will compare footwear impressions with fossil impressions.

Lesson Overview:

Students will learn more about how forensic scientists in the Trace Unit of BCI test shoeprints found at crime scenes to help link suspects to the crime. First, they will watch Video Clip 21 — *Shoeprint*. Then, the students will use the "top possible matches" on Activity Master 41 that Suzanne received from her computer search to see if there is a match to the shoeprint found at the barn crime scene. Next, students will watch Video Clip 22 — *Shoeprint Results* and conclude that shoeprint No. 3 was a match.

Review of Lesson 21:

- What does the Trace Evidence Unit at the BCI do?
- What is a fracture match?
- What were the results of your fracture match tests on the duct tape found at the barn crime scene?

Word Study

Suspects
Sample
Criminal Investigator
Criminal
Preserve
Forensic Scientist
Examine
Analyze
Soft Tissue
Clues
Capture
Molds
Tread Patterns
Evidence
Intact
Document
Extraction
Stars
Process
Sedimentary Rock
Crime
Shoeprint
Submitted
Lugs

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statements:
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations and explanations. 6. Review and ask questions about the observations and explanations of others.

Content Area: Science
Life Science
Topic: Earth's Living History — This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.
Content Statements:
Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.

Activity: Shoeprint Comparison

Instructional Strategies:

1. Have each student remove one shoe, place a piece of scrap paper over the sole, and rub the paper with a colored pencil to create a rubbing or etching of the shoe pattern.

2. Show the students Video Clip 20 — *Shoeprint* and discuss. Have them compare their shoe rubbings with their tablemates' shoe rubbings. What do they notice? Discuss observations.

3. Distribute a copy of Activity Master 41 to each student. (If you would like to save paper, you could make one set of copies/table group.) Have the students work in their table groups to compare the shoeprint top matches with the shoeprint that was left at the crime scene. Have students write their observations about each footwear impression beside the samples. Have them pay special attention to the design of the sole, any unique markings, etc.

4. Have the students determine whether there is a match. (They should find that shoeprint No. 3 matched.)

5. Discuss with students their results, and ask if there are any questions.

6. Next, show the students Video Clip 22 — *Shoeprint Results*.

7. Collect student's Activity Master 41.

Optional Extension Activities

1. Have students create "How To" videos explaining how to make fossil molds and casts.

2. Have students create a digital movie, demonstrating how fossils formed over the years.

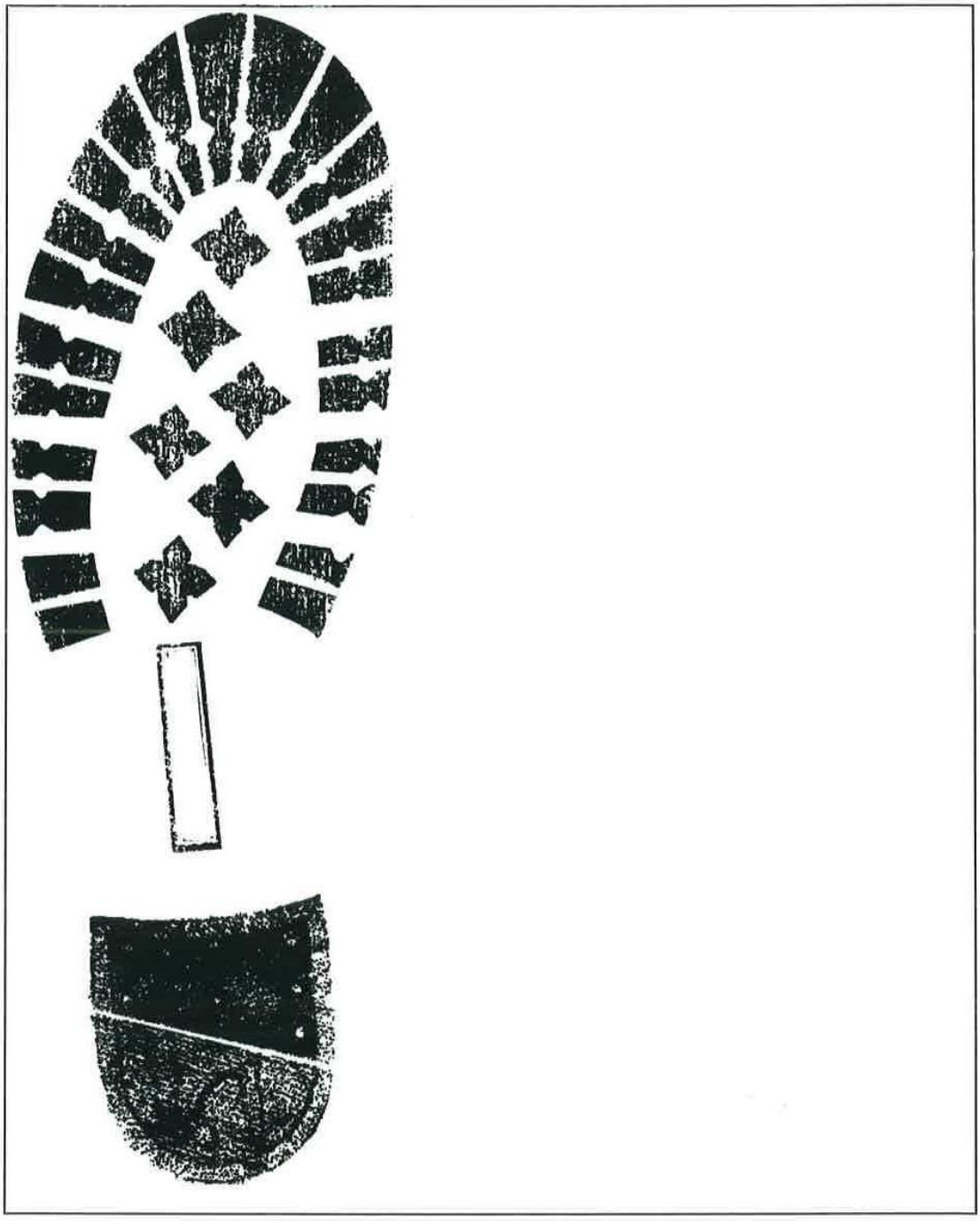
***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Shoeprint from the Crime Scene

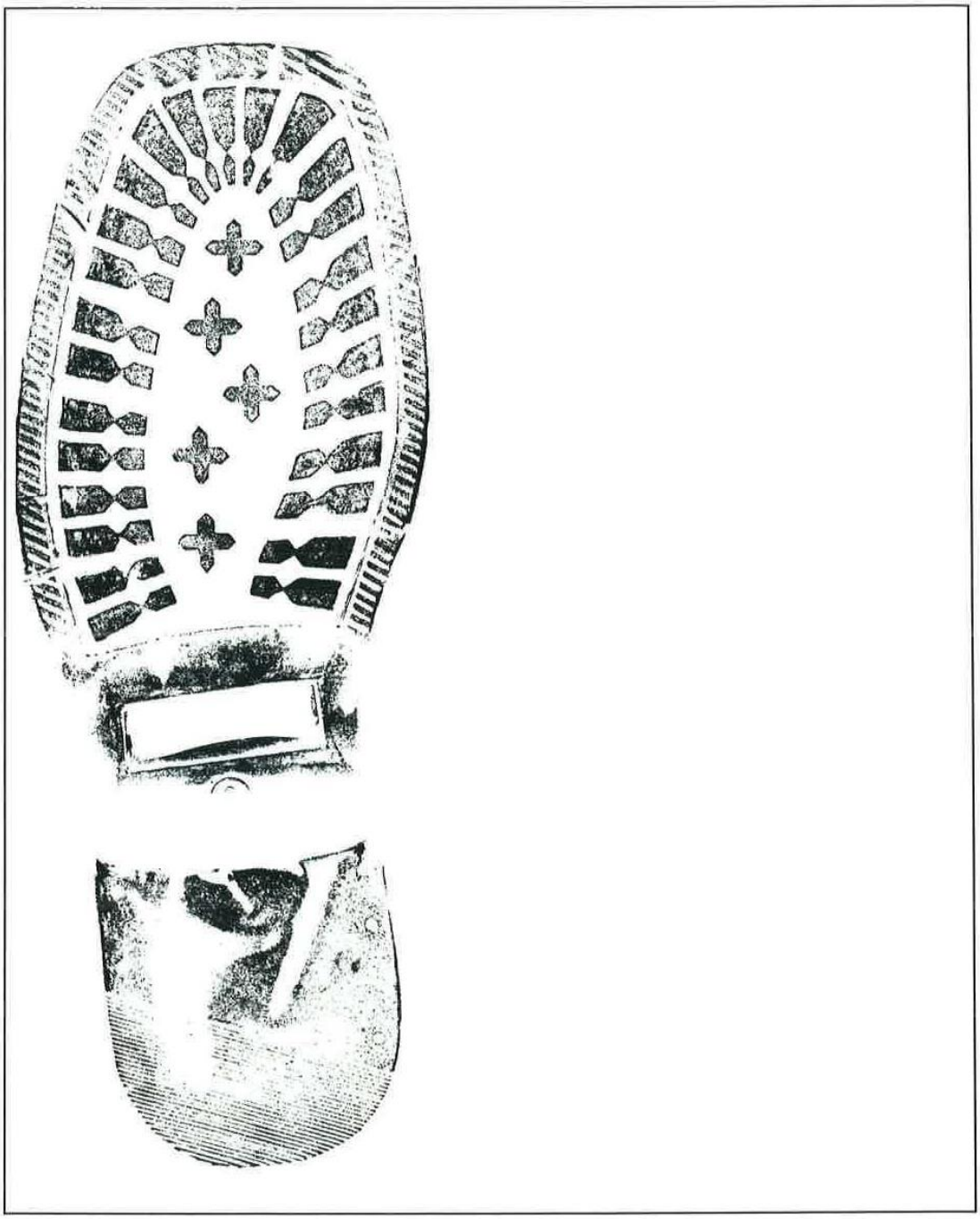
Shoeprints from SICAR Database

SICAR Evidence Report



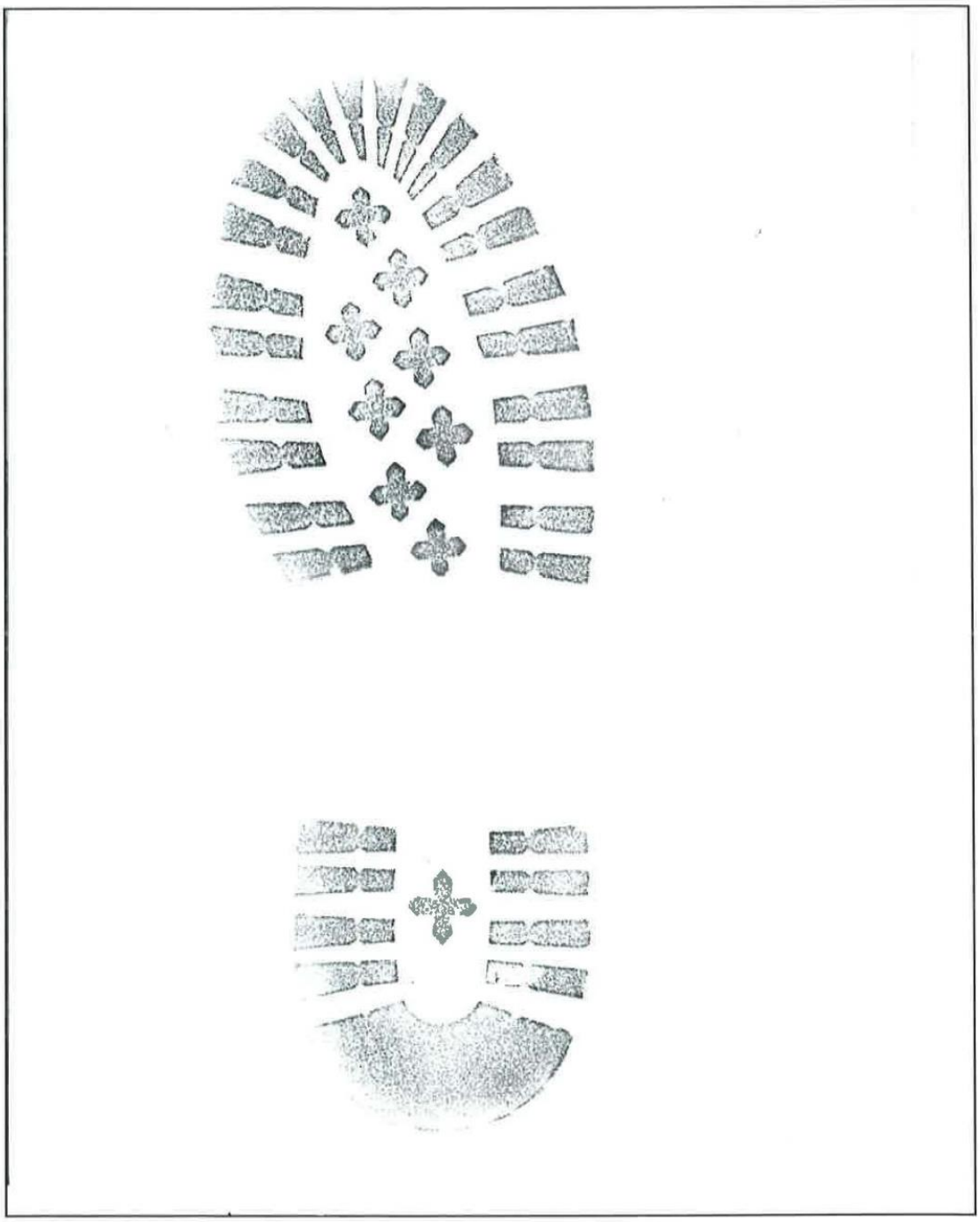
1

SICAR Evidence Report



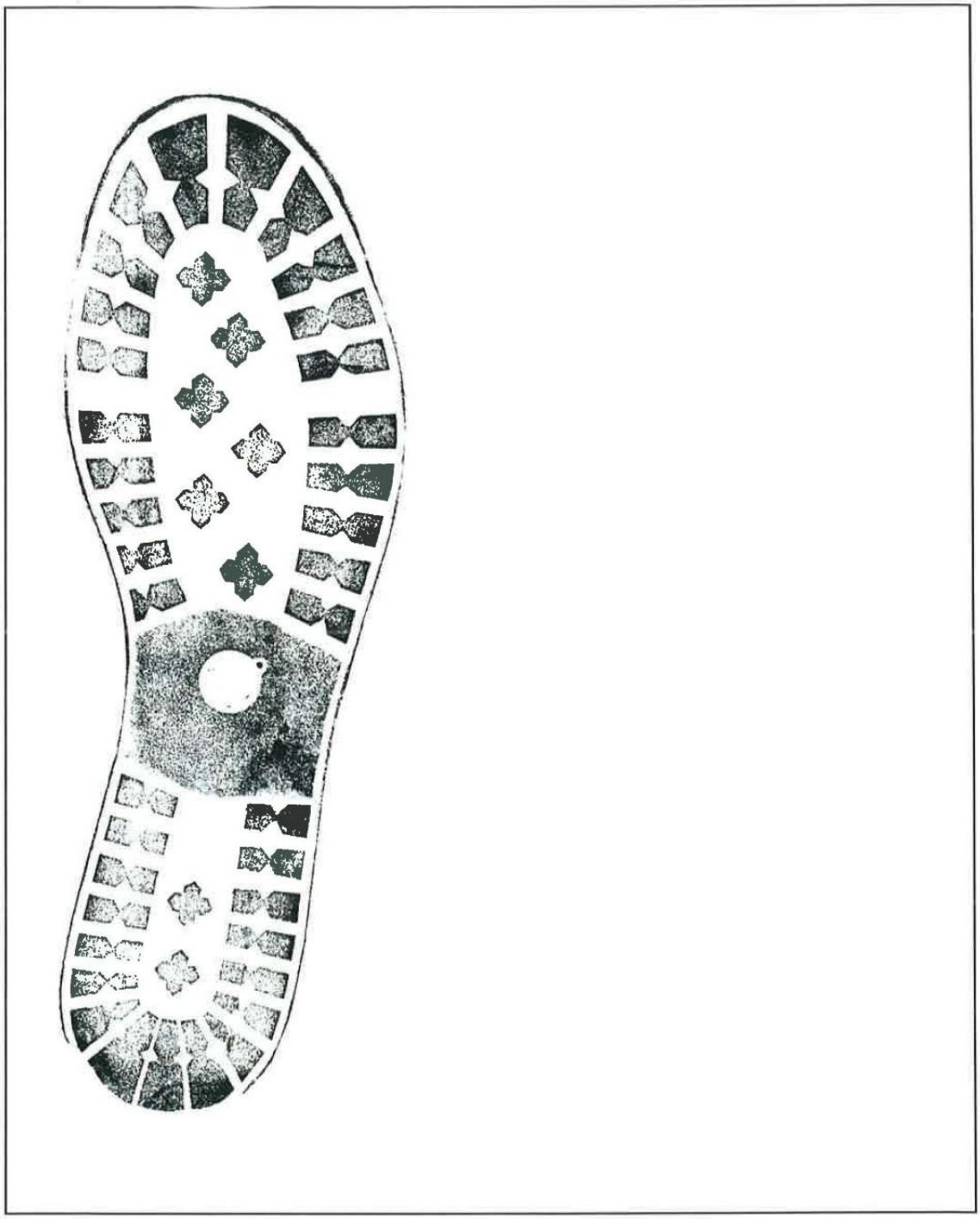
2

SICAR Evidence Report



3

SICAR Evidence Report



4

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 23
Toolmarks

Materials Needed

- Copies of Activity Master 42 (one copy per student)
- Pencil
- Science journals and/or reading/writing journals
- Silly Putty (the type used in occupational and physical therapy), about 1 oz./small group of students (about 8-10 oz. total, depending on class size)
- Ruler (with metric system)
- Seven regular screwdrivers (each labeled with tape and a number to keep students' records accurate)
- Magnifying glasses (optional)
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Master 42) and overhead pens
- Equipment to project video clip

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 23 — *Toolmarks* (1:18)
- Activity Master 42

Lesson Objectives

- Students will take and record measurements of striation patterns on screwdrivers.
- Students will make observations and conduct simple investigations using equipment and tools to gather and record data.
- Students will communicate about their observations, investigations and conclusions.

Lesson Overview:

Students will learn more about how forensic scientists in the Firearms and Toolmarks Unit of BCI study clues left at crime scenes. In this unit, the scientists examine all types of guns, knives, and other tools used in crimes. The scientists examine fired cartridge cases and fired bullets to look for small markings on bullets and cartridge cases through a microscope. These forensic scientists also study tools that are used in crimes, such as crowbars, to look for marks that match the tool and the markings left at the crime scene. First, students will watch Video Clip 23 — *Toolmarks*. Then, students will take part in an activity where they work in small groups comparing marks made by different screwdrivers to see how each tool leaves a unique set of marks or imprints.

Review of Lesson 22:

- Have students review what they know about shoeprints and how fossils that are discovered are similar to the shoeprint found at crime scenes.

Word Study

Suspects
Process
Intact
Submitted
Grooves
Forensic Scientist
Sample
Analyze
Crime
Impressions
Comparison Microscope
Markings
Striation pattern
Toolmarks
Examine
Criminal Investigator
Criminal
Preserve
Molds
Fossils
Patterns
Evidence
Clues
Capture
Casts

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Mathematics	
Domain	**Cluster**
Measurement and Data	Solve problems involving measurement and conversion of measurement from a larger unit to a smaller unit
Standard Statements	
1. Know the relative sizes of measurements from larger units within one system of units including km, m, cm; etc.	

Content Area: Science
Grade Band Theme
Interconnections Within Systems: This theme focuses on helping students recognize the components of various systems and investigate dynamic and sustainable relationships within systems using scientific inquiry. Science Inquiry and Application: During pre-kindergarten through fourth grade, all students must become proficient in the use of the following scientific processes with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content area:
Content Statements:
1. Observe and ask questions about the natural environment. 2. Plan and conduct simple investigations. 3. Employ simple equipment and tools to gather data and extend senses. 4. Use appropriate mathematics with data to construct reasonable explanations. 5. Communicate about observations, investigations and explanations. 6. Review and ask questions about the observations and explanations of others.

Activity: Shoeprint Comparison

Instructional Strategies:

1. First, students will watch Video Clip 23 — *Toolmarks* and discuss as a class what they learned about the Firearms and Toolmarks Unit of BCI.

2. Distribute Activity Master 42 and go over the instructions with the students.

3. Place students in small groups and assign them a lab station in the room. Students will take part in an activity where they work in small groups comparing marks made by different screwdrivers to see how each tool leaves a unique set of marks, grooves, or imprints. Note: Each lab station will have only one screwdriver to examine at a time. After each group has ample time to make a mark in their silly putty and record observations about the screwdriver, they will be asked by the teacher to rotate the screwdriver to the next group and so on, until every group has received all seven screwdrivers and tested and documented them.

4. When all screwdrivers have been tested and documented at each lab station, collect the screwdrivers, and have students collect and clean up everything before joining you in the carpet area to discuss what they learned from the "Toolmarks Lab" activity. You can collect student responses on chart paper.

5. Have students turn in Activity Master 42.

Optional Extension Activities

1. Students can create a video or storyboard about how the different types of fossils are formed (casts, molds, and imprints).

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today.**

Name: _____ Date: _____

Toolmarks Lab

Directions: During this lab you will work with your small group comparing marks made by different screwdrivers to see how each tool leaves a unique set of marks, grooves, or imprints.

At each lab station, you will need to do the following steps:

1. Roll the silly putty into a flat circle that fits on the desk, plate, or tray that your lab materials are on. Make several impressions of each screwdriver in your piece of silly putty.

2. Use your ruler and magnifying glass (if you have access to one) to record the measurements and observations for each tool impression. Make sure you note any unique characteristics you notice about each screwdriver or its impression. Please pay special attention to the following features:

   a. Dimensions of the impression
   b. Defects in the screwdriver, like nicks and chips
   c. Ridges or striation patterns

3. Please make your observations below:

Screwdriver #:	Width of Tip (mm)	Length of Tip (mm)	Unique Features and Characteristics:
1			
2			
3			
4			
5			
6			
7			

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 24

Fossil Imprints and Clues

Materials Needed

- Copies of Activity Master 43 (one copy per student)
- Pencil
- Science journals
- Waxed paper (one container)
- Metric ruler
- Rolling pins (optional — students can use a book or their hand to make indentations)
- White Sculpey clay, enough for each student group to have about 4 ounces
- Interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Masters for Day 14) and overhead pens of different colors
- Have students collect (or the teacher can supply) a variety of leaves, seashells, bones, plastic dinosaurs, stems, etc.
- Magnifying glasses (optional)

Approximate Time

- 50 minutes

Corresponding Required Resources

- Activity Master 43

Lesson Objectives

- Students will refer to details in a text when explaining what the text says explicitly and when drawing inferences from it.
- Students will compare fossils, molds, and casts and focus on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of factors.

Lesson Overview:

Students will read "How Fossils Work, an article projected on the interactive whiteboard or overhead from the HowStuffWorks website. This article explains how fossils tell a story, just like the clues at the scene of the crime. Then students can make their own fossil imprints, comparing that to both the use of impressions in the Firearms and Toolmarks Unit of BCI and to the shoeprint casts that crime scene investigators made of the shoeprint in this case.

Review of Lesson 23:

- What do forensic scientists do in the Firearms and Toolmarks section of BCI?

Word Study

Suspects
Amber
Process
Sedimentary Rock
Intact
Shoeprint
Submitted
Grooves
Forensic Scientist
Sample
Analyze
Decompose
Crime
Impressions
Dinosaurs
Toolmarks
Examine
Criminal Investigator
Soft Tissue
Criminal
Preserve
Molds
Fossils
Patterns
Evidence
Paleontologists
Clues
Capture
Casts

Ohio Department of Education Fourth Grade Statements Addressed

Content Area: Science
Life Science
Topic: Earth's Living History —This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.
Content Statements:
Fossils can be compared to one another and to present-day organisms according to their similarities and differences. The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.

Content Area: English Language Arts	
Strand	**Topic**
Reading — Informational Text	Key Ideas and Details
Standard Statements	
1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from it. 2. Determine the main idea of a text and explain how it is supported by key details; summarize the text. 3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. 4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade four topic or subject area. 5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	

Activity: Reading Informational Text on Fossils and Fossil Imprints

Instructional Strategies:

1. Have the students go to the carpet area or area where they can see the HowStuff Works website article "How Fossils Work" being projected onto the interactive whiteboard, ELMO, overhead projector, etc. Note: Stop reading at the sentence, "But fossils don't tell the whole story." To read the article, visit http://science.howstuffworks.com/environmental/earth/geology/fossil.htm.

2. Read the article to your students, or have volunteers read aloud to the class. Discuss what forensic scientists and paleontologist have in common. (Both use clues/evidence to figure out what happened in the past.)

3. Review what clues fossils provide us and how studying fossils can teach us a lot about our past. Collect their responses on chart paper.

    a. Example: What were the first life forms on our planet? Where did those life forms come from, and what happened to them? How has life on Earth changed over time? How has the Earth's climate changed over time? Where did new species of plants and animals come from, and how did they relate to species that died out?

4. Have students take turns picking one object from the materials you collected for the fossil imprint activity, or have them get out the object they brought in from home to use.

5. Put students into small groups of three.

6. Hand out 4 ounces of Sculpey clay to each student group (or about 1 ounce per student).

7. Hand out Activity Master 43.

8. Have students roll the clay into balls and smash it in between two layers of wax paper.

9. Have students peel off the top layer of waxed paper, and add their object to make their fossil imprint on top of the clay.

10. Next, have students use a rolling pin or book to press their object into the clay surface.

11. Have students gently peel their item out of the clay, to reveal the imprint they made. You can have the students discuss in their small groups and record on Activity Master 43 what they notice about the imprints they created. Also, have students try to hypothesize the answer to the following questions about their objects:

    a. Where did that life form come from and what happened to it?
    b. How has life on Earth changed over time?
    c. How has the Earth's climate changed over time?
    d. Where did these new species of plants and animals come from, and how do they relate to species that died out?

12. Have students turn in their Activity Master 43, clean up their lab stations, and return to their seats. Note: You can allow the students' fossil imprints to dry and let them take them home, or try to reuse the clay again the next time you teach this unit. However, you will have to seal the clay in an airtight container to preserve it.

Optional Extension Activities

1. Students can create a hypothetical animal with a food chain/web, habitat, and adaptations for it to survive in its environment.

2. Students can research and try to create possible solutions that might have been used to prevent the destruction of dinosaurs.

3. Students can create a video or storyboard about how the different types of fossils are formed (casts, molds, and imprints).

***If you are doing the algae bloom experiment, make sure to have the class make and record observations today. (Note: This is the last day for observations, before the class makes their conclusion on what happened with their experiment.)**

Name: _____ Date: _____

Fossil Imprint Activity

Use the imprint you made in the clay to answer the following activities:

1. Where did that life form come from and what happened to it?

2. How has life on Earth changed over time?

3. How has the Earth's climate changed over time?

4. Where did these new species of plants and animals come from, and how do they relate to species that died out?

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 25
Case Conclusion

Materials Needed

- Copies of Activity Master 44 (one copy per student) – OPTIONAL Project
- Pencil
- Science journal
- interactive whiteboard, ELMO, or overhead projector (with transparency of Activity Master 44) and overhead pens
- Equipment to project video clips

Approximate Time

- 50 minutes

Corresponding Required Resources

- Video Clip 24 — *Conclusion* (1:31)
- Activity Master 44

Lesson Objectives

- Students will be reviewing the evidence from the Bob Agriculture case.
- Students will be reviewing all content area standards introduced in BCISS to prepare for their summative assessment.

Lesson Overview:

Students will watch Video Clip 24 — *Conclusion* and will verify that all the evidence from the investigation leads to Juanto Buy. Students will learn that Juanto Buy was arrested for breaking into Bob and Terra Agriculture's barn and stealing farm fertilizer and chemicals, as well as placing a threatening note on the barn window. Thankfully, Bob falling into the sinkhole was just an accident and nobody wished to hurt him. Students will then be given directions for an optional small group performance assessment project they will work on, part of which will be used to "help" the prosecuting attorneys prepare their case against Juanto Buy. Students will be asked to make visual aids and charts to help share the results of their investigation and testing of evidence.

Word Study

Arrested	Prosecute
Graphs	Charts

NOTE: All ODE standards introduced in BCISS will be touched upon in today's lesson.

Activity: Assessment Project

Instructional Strategies:

1. Have students watch Video Clip 24 — *Conclusion* and briefly discuss.

2. If you choose to do the optional project, hand students a copy of Activity Master 44 "Small Group Performance Assessment Information," while you display it on an interactive whiteboard or other projection device. Note: If a student would benefit from doing the project individually, that is an option. If you are not taking part in the optional project, then skip down to No. 6 and continue the lesson from that point.

3. Go over the project details with the students, making sure you explain each option.

4. Answer any questions the students have about the options. Have them take a moment (on their own) to decide which option most interests them. Ask the students to make sure their name is on the Activity Master and that they put a No. 1 by the option that is their first choice, a two by their second, and a three by their third.

5. Then collect the students' papers. Note: The teacher can decide how to group students, or offer this as an individual project. Also, the teacher should feel free to alter project requirements depending on student needs and the time available.

6. Next, you will review for the content area test with your class. If you are making up your own review sheet, interactive poll, or review game, please make sure you include the following content or concepts:
    - Cardinal and intermediate directions
    - Map scales, map titles, map legends
    - Landforms
    - Erosion
    - Sngle measurement (identifying and labeling whether an angle is acute, obtuse, or right)
    - Linear measurement (metric)
    - Deposition
    - Sinkholes
    - Heat energy
    - Algal blooms
    - Timelines
    - Weathering
    - Fossils
    - Reading/interpreting charts and graphs
    - Reading for detail and answering short and extended questions

Optional: Algae Bloom Lesson Conclusion (Science Content Focus)

1. After observing the four jars (A –D) for one to two weeks, have students record their final observations on Activity Master "Algae Experiment Observation Sheet and Follow-up Questions."

2. Have the students join you on the carpeted area, discuss the following questions with the class and record their responses on chart paper:

    a. At the end of the observation timeframe, which jar had the most algae? (How could you tell?)
    b. Was your original prediction correct?

c. How did the laundry detergent affect algae growth?
d. How did the fertilizer affect algae growth?
e. How did the combination of laundry detergent and fertilizer affect algae growth? Explain in detail.
f. How did temperature affect algae growth?
g. Which variables (temperature, laundry detergent and/or fertilizer) seem to have the most effect on algae growth from this experiment?

Optional Extension Activities for Algae Blooms

1. Research on algal blooms.

2. Read these articles about algal blooms in the Toledo area by *Scientific American*, "Deadly Algae Are Everywhere, Thanks to Agriculture" and try to defend farmers in an argument against the author's stance.
    a. https://www.scientificamerican.com/article/deadly-algae-are-everywhere-thanks-to-agriculture/

3. Read this article and share information on algae blooms in the Ohio River with your classmates.
    a. http://cin.ci/1F6JC8S

Small Group Performance Assessment Product Options

PART 1: All individuals or small groups are required to:

A. Complete a one page written or typed summary of evidence and case against Juanto Buy for prosecuting attorneys, including any visual representation of evidence with charts, graphs, and relevant images

B. Share their timeline of Juanto Buy's whereabouts during the crime timeframe

C. Provide at least one paragraph summarizing what they learned about forensic scientists, and about crime scene investigators/special agents

PART 2: *And* choose one of the following products to create…

_____Option One Product:
Create a Power Point or Keynote presentation that could be used to educate the public on what the case involved - the suspects, details and evidence involved in this case. Also, you must include a title slide and at least eight (8) total slides.

_____Option Two Product:
Create a Storyboard or Comic Strip that summarizes what happened in this case, including the suspects, details and evidence involved in this case. Your storyboard/comic strip must have a picture or image to go with the captions and information. It must contain at least twelve (12) squares with pictures and images.

_____Option Three Product:
Write a play, musical, or movie script that portrays what happened in this case, including the suspects, details and evidence involved in this case. This creation needs to include all the facts of this case and must be at least 3 pages in length.

_____Option Four Product:
Conduct a "mock" interview with Farmer Bob, Juanto Buy, or play the role of the lead investigating agent or forensic scientist on this case, including the suspects, details and evidence involved in this case. You can record the interview and have group members or classmates play different parts, or simply have a written copy of your interview.

_____Option Five Product:
Write a newspaper article about this case that includes the suspects, details and evidence involved in this case, and what you think the outcome was. In other words, which suspect did it?

_____Option Six Product:
Create an original design solution to reduce and/or prevent erosion and weathering in a particular area of the world.

_____Option Seven Product:
Create an original solution to reduce or prevent sinkholes.

_____Option Eight Product:
Develop an app that can store crime scene photos, take notes, include GPS coordinates, etc. May need help from technology support.

_____Option Nine Product:
Develop a possible solution to prevent/reduce the growth of algae blooms.

_____Option Ten Product:
Use the free software Scratch or Tynker to create an original product pertaining to the case. Must seek teacher approval for this choice.

_____Option Eleven Product:
Take an actual fossil found in Ohio (i.e. isotelus –trilobites, bryozoans, chinoderms, graptolites, etc.) and create an adaptation to the plant or animal and describe how that adaptation could have helped that plant or animal survive the changes in Ohio's climate/environment with the new adaptations. Explain how the food chain or food web might be impacted by this change as well.

_____Option Twelve Product:
Attempt to create a prototype container to be able to deliver fresh and warm pizza (insulating heat energy) within 12 hours (traveling across several miles, taking on a camping trip, etc.), without burning the pizza or spoiling the ingredients.

_____Option Thirteen Product:
Create alternative experiments or demonstrations helping classmates further understand erosion, deposition, weathering, thermal energy, or algae blooms, etc. Conduct the experiment and create a lab sheet to record observations and conclusions with the class.

_____Option Fourteen Product:
Write 20 math story problems to be solved based on facts, that can be proven, from the BCI and content area information (thermal energy, erosion, deposition, weathering, sinkholes, fossils, etc.), and include your strategy for solving them.

_____Option Fifteen Product:
You can develop an idea for your own product idea and propose it to your teacher. Teacher must approve idea to complete as an option.

Describe Original Product Idea Here:

Timeline of product deadlines checklist:

_____ Product needs to be approved by teacher.___
(Date)

_____ Product needs to be half-way complete and inspected by teacher.___
(Date)

_____ Product needs to be completed in rough draft form.___
(Date)

_____ Product needs to be ready for presentation.___
(Date)

OHIO ATTORNEY GENERAL'S BCI SCIENCE SCHOOL
BUREAU OF CRIMINAL INVESTIGATION

Lesson 26

Thank You

Materials Needed

- Copies of Activity Master 45 Content Area Assessment (one copy per student)
- Pencil
- Materials needed if you are doing the final small group performance assessment project (optional)
- Equipment to project video clips

Approximate Time

- 60 minutes

Corresponding Required Resources

- Video Clip 25 — *Thank You* (0:38)
- Activity Master 45 (Content Area Assessment)

Lesson Objectives

- Students will be assessed on all content area standards introduced in BCISS on the summative assessment they will complete during this class session.

Lesson Overview:

Students will watch Video Clip 25 — *Thank You* and complete the content area-based assessment. If they have time after they finish taking their assessment, and you've opted to have the students participate in the small group performance assessment project, then students will work on the product they had approved by you for the remainder of the class period.

Word Study

Arrested	Prosecute
Graphs	Charts

Note: All ODE standards introduced in BCISS will be touched upon in today's lesson.

Activity: Wrapping It All Up

Instructional Strategies:

1. First, play Video Clip 25 — *Thank You*.
2. Then pass out Activity Master 45, the content area assessment. Go over the directions with the students and answer any questions they have before they begin the assessment.
3. When students are finished taking their assessment, have them turn it in to you and then they can either work quietly on their small group performance assessment project for the remainder of the class or they can read silently or free-write until everyone has completed the assessment.
4. If your students are taking part in the performance-based assessment, have the students work quietly on this project for the remainder of the class time. If you are not having them take part in the performance-based assessment, then you have now completed the BCISS Curriculum. Congrats!

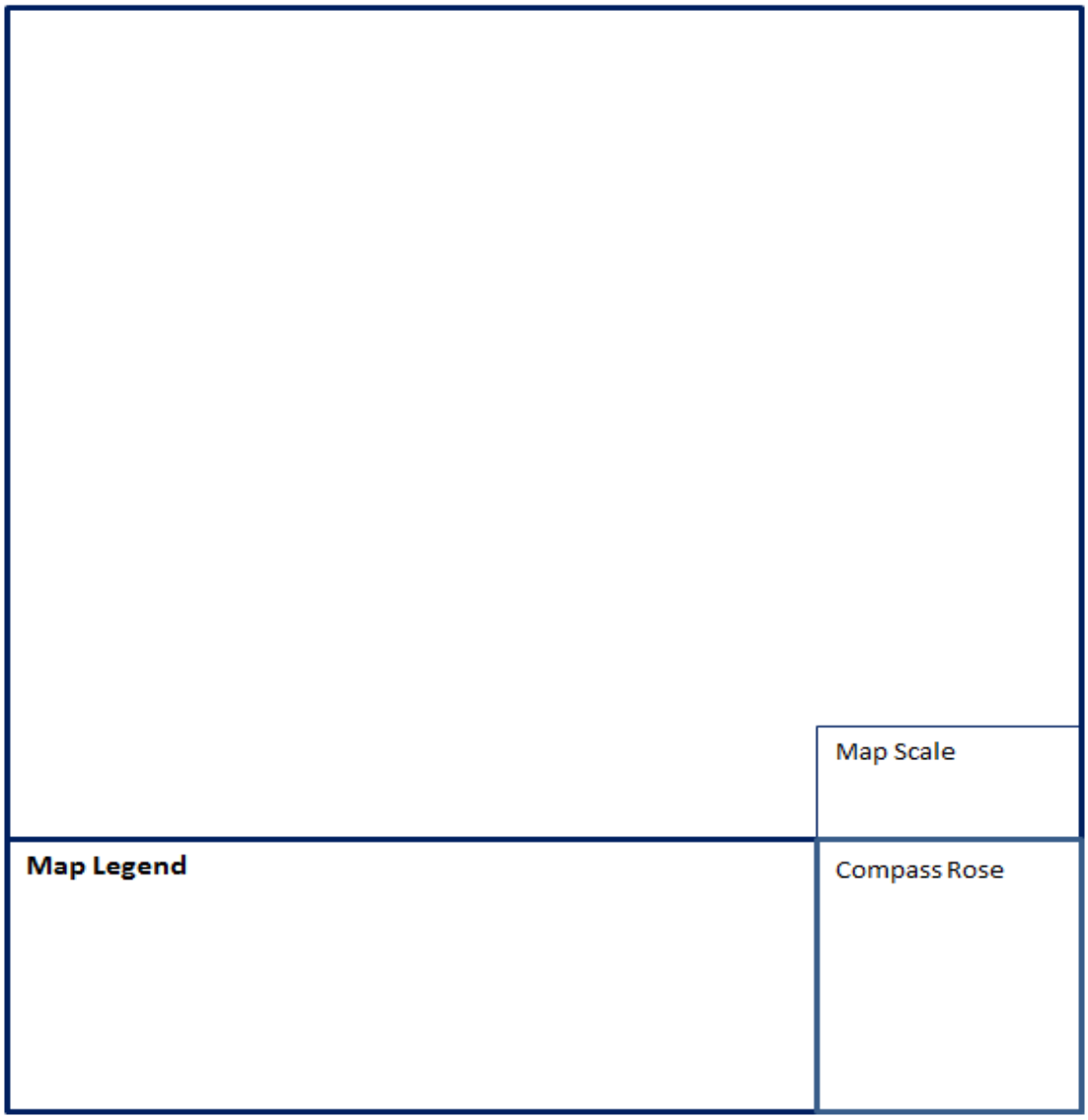
Name: _____ Date: _____

BCISS Content Area Summative Assessment

Directions: Please answer the following assessment questions. Don't forget to double-check your answers!

1. Create a bird's eye view of the classroom that includes:
    - Compass rose – cardinal and intermediate directions
    - map scale
    - map title
    - map legend

Map Title: _____



2. Label the map below with at least four (4) landforms you observe, drawing a line to where they are located on the map:

Landform 1:

Landform 2:

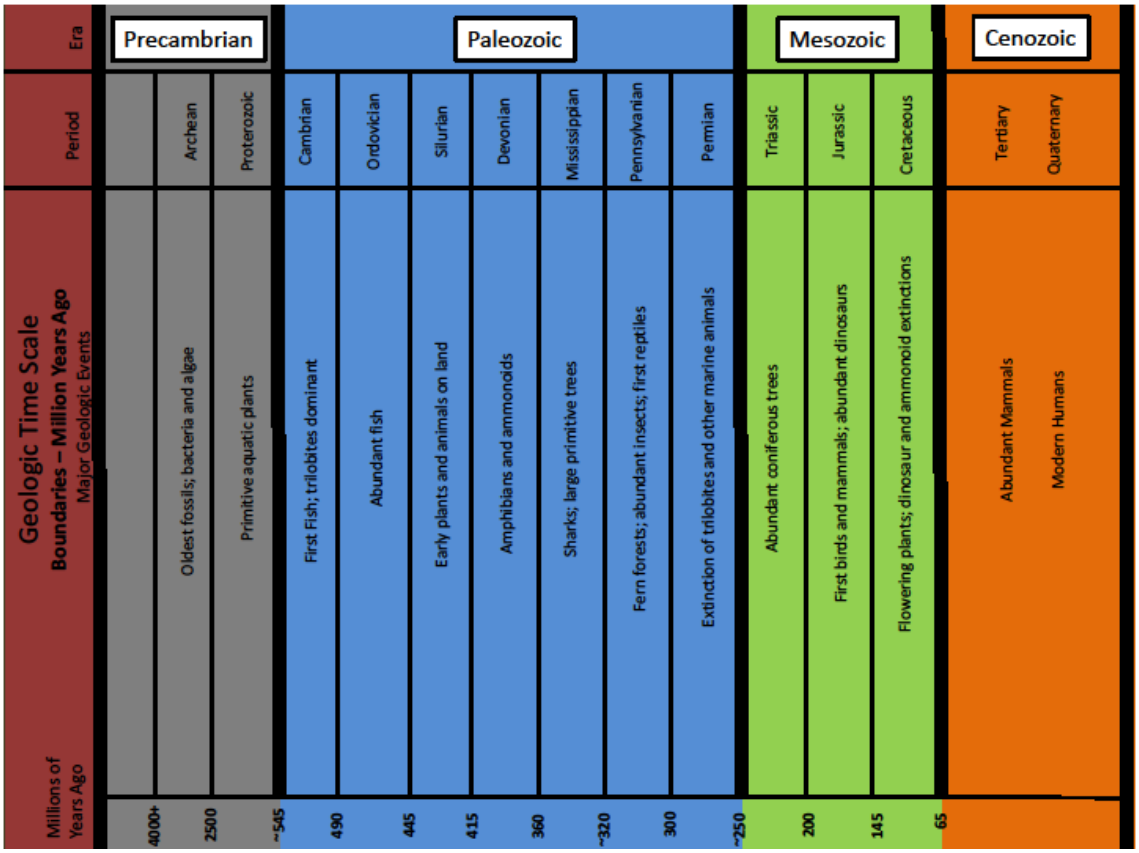
Landform 3:

Landform 4:

3. Sometimes sinkholes occur in cities underneath major streets. How can city engineers and geologists better prevent sinkholes from happening in the future?

Describe and design a way below that might help provide a solution to this problem?

4.



What are the four major eras listed on this Geologic Time Scale?

What period were trilobites dominant and the first fish appeared?

What period are the oldest fossils from?

5. Answer the following questions based on the image of the fossil below:

a. What can you hypothesize (educated guess) about this fossil?

b. How was the fossil most likely made (cast or mold) and why do you believe that?

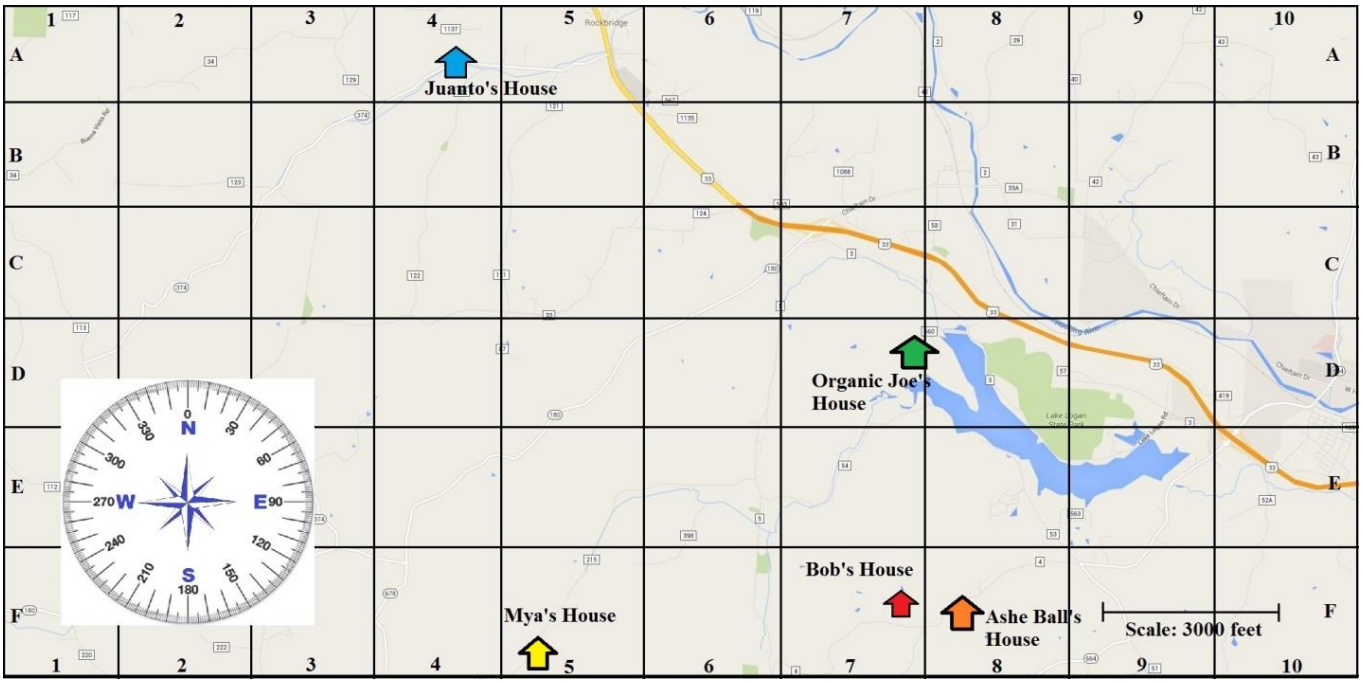
c. Why didn't this fish survive?

d. What changes would have needed to take place in the fish's habitat in order for it to survive?

6. If you wanted to buy a house along the coast, but you noticed that the beach area was starting to erode and the cliff where the house sits was starting to be weathered away, what could you do to prevent or slow down the erosion process in this situation?

7. Explain how weathering, erosion, and deposition are tied together and how all of these processes have contributed to Ohio's landforms and terrain.

8. Using only the following materials (cardboard, aluminum foil, plastic wrap, packing peanuts, bubble wrap, scraps of cloth, newspaper, paper towels, and tape), how could you develop a device to bake a pizza outside without an oven?



9. Using the map provided of Bob Agriculture's neighborhood/area above, please answer the questions below:

a. If you drew a line from Juanto Buy's house to Organic Joe's and then another line from Organic Joe's house to Mya's house, what type of angle would that create?

b. If you drew a line from Organic Joe's house to Mya's house and then another line from Mya's house to Bob's house, what type of angle would that create?

c. If you drew a line from Ashe Ball's house to Organic Joe's house and then another line from Organic Joe's house to Juanto Buy's house, what type of angle would that create?

d. The numbered lines run parallel or perpendicular to each other?

e. When the numbered lines and the lettered lines cross they form parallel or perpendicular lines?

Name: _____ Date: _____

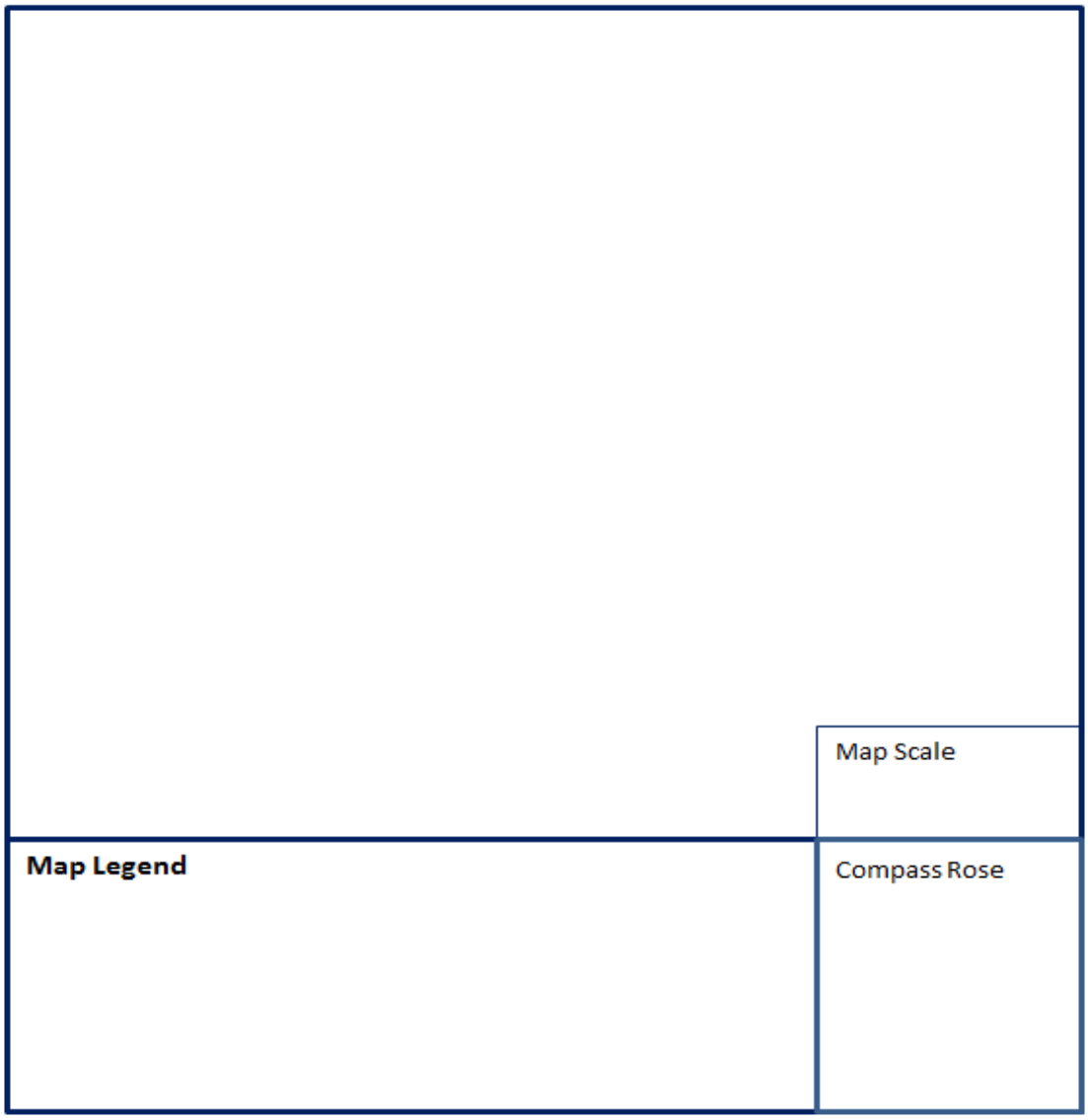
BCISS Content Area Summative Assessment

Directions: Please answer the following assessment questions. Don't forget to double-check your answers!

1. Create a bird's eye view of the classroom that includes:
   - Compass rose – cardinal and intermediate directions
   - map scale
   - map title
   - map legend

You can decide on your own point scale for scoring, but I would make sure that each of these elements are included, that they are accurate, and that the map was completed in a neat fashion.

Map Title: _____



2. Label the map below with at least four (4) landforms you observe, drawing a line to where they are located on the map:

Landform 1:

Landform 2:

Landform 3:

Landform 4:

Possible Answers:
Ocean, mountains, lakes, rivers, plains, peninsulas, etc.

Make sure students list relevant landforms and draw a line connecting to areas on map.

3. Sometimes sinkholes occur in cities underneath major streets. How can city engineers and geologists better prevent sinkholes from happening in the future?

Answers will vary, but could include:

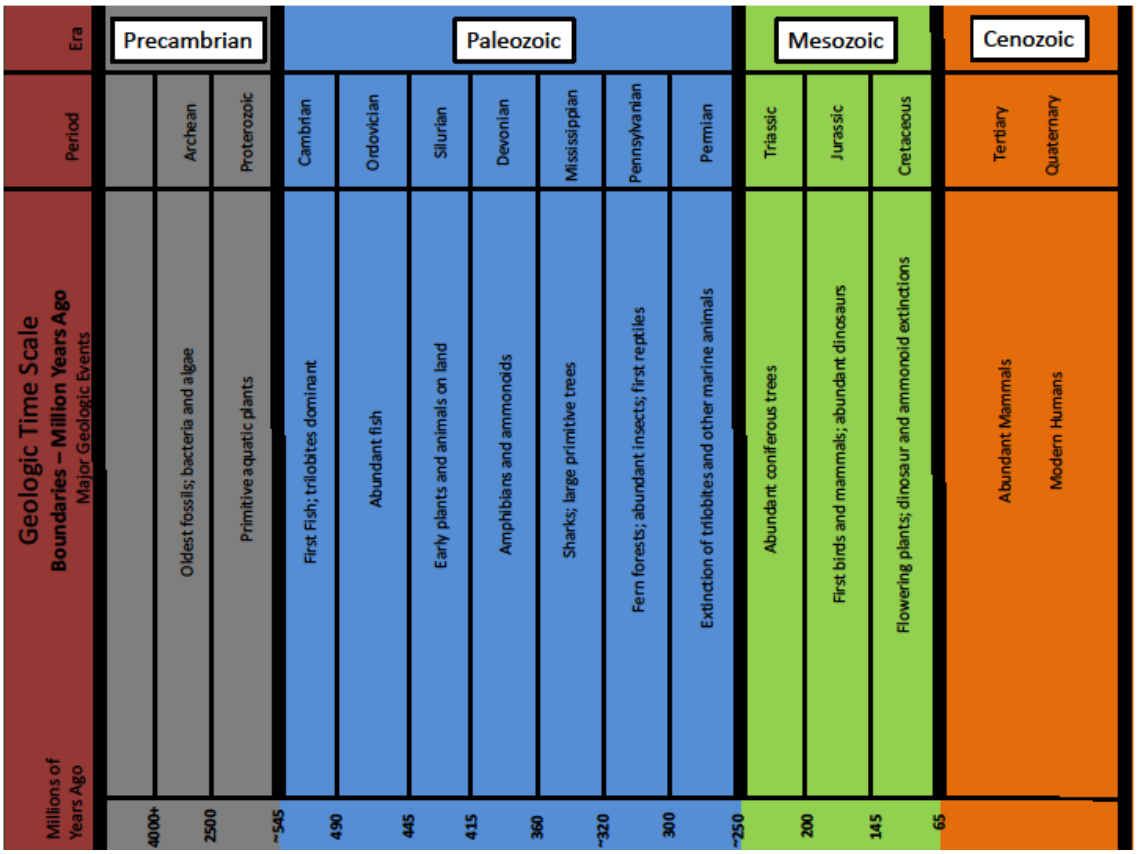
- identifying areas where signs of sinkholes are occurring (slumping in ground), cracking of asphalt, cracking of foundations, where water is not draining properly, areas where too much water is being pumped out of are

- Adding structures of support, changing drainage systems, identifying and fixing before major sinkholes occur

Describe and design a way below that might help provide a solution to this problem?

Answers will vary, but as long as students provide a reasonable solution an complete description, they should receive full credit.

4.



What are the four major eras listed on this Geologic Time Scale?
Precambrian, Paleozoic, Mesozoic, and Cenozoic

What period were trilobites dominant and the first fish appeared?
Cambrian Period

What period are the oldest fossils from?
Archean Period

5. Answer the following questions based on the image of the fossil below:

Answers will vary, as long as student answers all parts of the question completely and provides reasonable explanations for his/her responses, they should receive full credit.

a. What can you hypothesize (educated guess) about this fossil?

b. How was the fossil most likely made (cast or mold) and why do you believe that?

c. Why didn't this fish survive?

d. What changes would have needed to take place in the fish's habitat in order for it to survive?

6. If you wanted to buy a house along the coast, but you noticed that the beach area was starting to erode and the cliff where the house sits was starting to be weathered away, what could you do to prevent or slow down the erosion process in this situation?

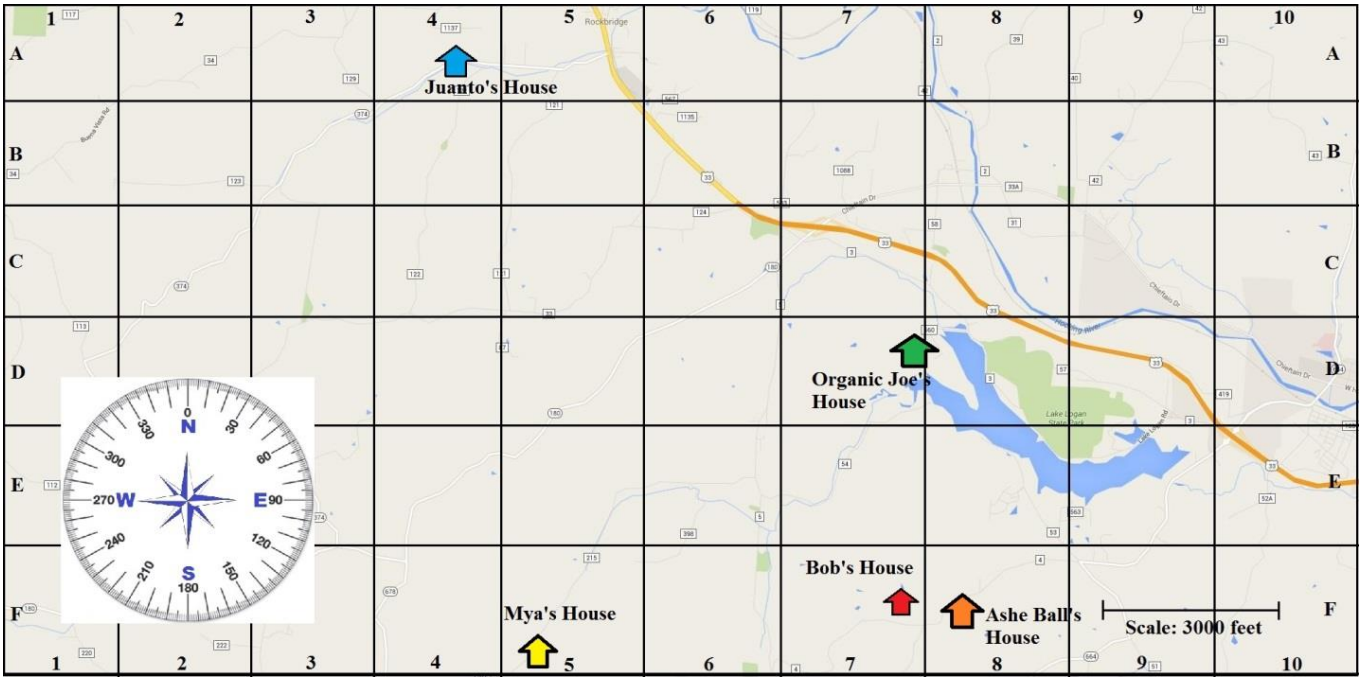
Answers will vary but include:
Adding a protective buffer to coastline and cliff area, adding vegetation to area to help prevent erosion and weathering.

7. Explain how weathering, erosion, and deposition are tied together and how all of these processes have contributed to Ohio's landforms and terrain.

Answer should be something like this: Deposition is the transfer of collected sediment being dropped or dumped from one location to another. Deposition is tied to the processes of weathering and erosion. First, rocks are broken down into small pieces. This is weathering.
Then, the small pieces of dirt and sand are picked up by forces of nature which is erosion. When those pieces of sediment are moved to a new place, that is deposition.

8. Using only the following materials (cardboard, aluminum foil, plastic wrap, packing peanuts, bubble wrap, scraps of cloth, newspaper, paper towels, and tape), how could you develop a device to bake a pizza outside without an oven?

Answers will vary but should include something about use of sun and aluminum to accelerate heating process… if the sun is out, you can use foil and line the card board with it creating an oven.



9. Using the map provided of Bob Agriculture's neighborhood/area above, please answer the questions below:

a. If you drew a line from Juanto Buy's house to Organic Joe's and then another line from Organic Joe's house to Mya's house, what type of angle would that create?
Students will probably say either a right angle or an acute angle if they are measuring it with a protractor

b. If you drew a line from Organic Joe's house to Mya's house and then another line from Mya's house to Bob's house, what type of angle would that create?
An acute angle

c. If you drew a line from Ashe Ball's house to Organic Joe's house and then another line from Organic Joe's house to Juanto Buy's house, what type of angle would that create?
An obtuse angle

d. The numbered lines run parallel or perpendicular to each other?
Parallel to each other

e. When the numbered lines and the lettered lines cross they form parallel or perpendicular lines?
Perpendicular lines

Ohio Attorney General's Office

Bureau of Criminal Investigation

BCI Science School

Teacher Resource Guide

How to contact us

Bureau of Criminal Investigation
1560 State Route 56 SW
London, OH 43140

800-282-0515
BCI@OhioAttorneyGeneral.gov
www.OhioAttorneyGeneral.gov/BCI

MIKE DEWINE
OHIO ATTORNEY GENERAL

www.OhioAttorneyGeneral.gov