4 | *Earth and Space Science*

Earth Processes in New York State

Teacher's Guide

Processes that Shape the Earth

BOCES 4 Science

Earth Processes in New York State

Teacher's Guide

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Written by teachers and administrators from public school districts within the borders of the NYS Midwest Joint Management Team in conjunction with the BOCES 4 Science Educators
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12/18

Foreword

BOCES 4 Science is a collaboration between four New York State BOCES (Board of Cooperative Educational Services within the Midwest Region. This collaborative of science educators came together to respond to the need for instructional resources based on the New York State pK-12 Science Learning Standards (NYSSLS). The research behind the Next Generation Science Standards (NGSS) and the National Research Council (NRC) publication, A Framework for K-12 Science Education, is the basis for the NYSSLS and the BOCES 4 science units.

We believe that the future health and well-being of our world depends on scientifically literate people making informed decisions. The development of scientific literacy begins at the earliest grades. Elementary children must have concrete experiences upon which to hook their understanding and new vocabulary – this is especially true in the discipline of science. We embrace the notion that students should experience phenomena and solve real problems to learn about the world. We strive to present lessons and materials that will make high quality science instruction available for all students through cost-effective resources for teachers.

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About this Unit

Overview

The *Earth Processes in New York State* unit is designed for 4th grade. Students try to figure out the origin of a bone that is found in local soil. Could it have belonged to a dinosaur? The mystery bone provides an introduction to the main ideas in this unit, such as: rock formations and fossils provide evidence for the causes of changes in a landscape over time; the effects of weathering and erosion caused by water, ice, wind and vegetation can be observed and measured; the analysis of maps can describe patterns of Earth's features; and that various solutions can be generated that reduce the impacts of natural Earth processes on humans.

Scheduling

This unit is scheduled to be in the classroom for 13 weeks. There are 13 lessons in this unit with approximately 29 instructional sessions plus assessment time, based on 35 – 45 minutes each. Adjust your schedule accordingly. The unit could be divided into two parts if necessary. Part I includes Lessons 1 – 8. Part II includes Lessons 9 – 13. Please return the unit promptly or contact BOCES 4 Science to request an extension.

Materials to Obtain Locally

Some lessons require materials that are NOT supplied in the kit. These materials can be easily obtained by the teacher or the students. Materials that will need to be provided are indicated with an asterisk in the lesson materials list and are also listed below:

- Books (L4)
- Camera* (L4, L5)
- Chart paper (L1, L2, L3, L4, L9, L11)
- Freezer access (L4)
- Grass (L3)
- Markers (L1, L2, L3, L4, L9, L11)
- Resources about Tsunamis & Volcanoes (L11)
- Resources about Earthquakes (L11, L12)
- Scissors (L2, L3, L6)
- Tape (L2, L6)
- Video Recording device* (i.e. camera, iPad, cell phone) (L4, L5)
- Water (L1, L3, L4, L5)
- *Optional

Three Dimensions

Each of the BOCES 4 Science lessons includes at least one element from each of the three dimensions identified in the NYSSLS. The lesson page identifies the specific elements targeted; the NYSSLS topic page is included after the Features that Support 3-D Learning page.

Science and Engineering Practices (SEP) – These are the major practices that scientists employ as they investigate and build models of their understanding of the world. They also include key practices used by engineers as they design and build systems.

Disciplinary Core Ideas (DCI) – Selected to represent four major domains: the physical sciences; the life sciences; the earth and space sciences: and engineering technology, and the applications of sciences.

Crosscutting Concepts (CCC) – These big ideas have application across all domains of science and provide one way of linking across the domains of the DCI's. In addition, they link to ideas that are parts of other elementary subjects.

NYSSLS Shifts in Instruction

It is the intention of BOCES 4 Science that this unit provides lessons that demonstrate the following shifts in instruction:

- **Explaining Phenomena or Designing Solutions to Problems:** The unit focuses on supporting students to make sense of a phenomenon or design solutions to a problem.
- **Three Dimensions:** The unit helps students develop and use multiple grade-appropriate elements of the SEPs, CCCs, and DCIs which are deliberately selected to make sense of phenomena or design a solution to a problem.
- **Integrating the Three Dimensions for Instruction and Assessment:** The unit will elicit student artifacts that show direct, observable evidence of three dimensional learning.
- **Relevance and Authenticity:** By taking advantage of student questions and experiences in the context of their homes, neighborhood and community, the lessons in this unit will motivate student sense-making or problem-solving.
- **Student Ideas:** This unit provides opportunities for students to express clarify, justify, interpret or represent their ideas and to respond to peer and teacher feedback.
- **Building on Students' Prior Knowledge:** Since student understanding grows over time, this unit identifies and builds on students' prior learning in three dimensions in such a way as it is explicit to both students and teachers.

Assessment:

Providing opportunities for assessment of learning and feedback to students is an important step in the educational process. This unit includes formative assessments and summative assessments. The teacher is encouraged to use a variety of informal or anecdotal assessment strategies.

Additional Features of this Unit

The *Earth Processes in New York* State unit also includes a Student Science Journal. A digital version of the Student Science Journal is available online at the BOCES 4 Science website. (A web address and password are located on a color insert in the Teacher's Guide.)

Additional resources for the teacher, such as assessments, directions to assemble materials, ELA supports and direct links to videos or websites mentioned in the Teacher's Guide, etc. can also be found on the BOCES 4 Science website.

Features that Support 3-D Learning

Look for these features in the Teacher's Guide:

NYS pK – 12 Science Learning Standards within each lesson provide the teacher with specific information about the Performance Expectation and the 3-Dimensions that are targeted by the instruction in this lesson.

Performance Expectations:

4-ESS1-1 – Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

Science and Engineering Practices

Planning and Carrying Out Investigations

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation.
- Similarities and differences in patterns can be used to sort, classify, and communicate.

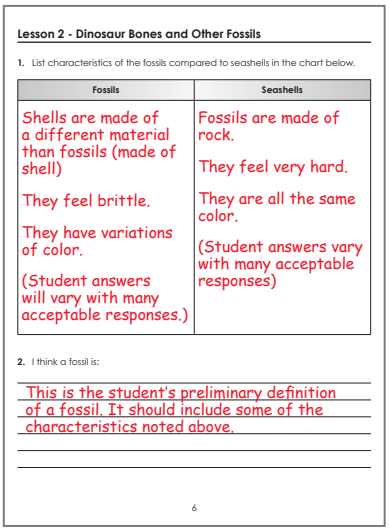
ELA/Math/Social Studies Connections:

ELA: 4R1, 4W1, 4W5, 4SL1

Social Studies: Practice A2, A4

Throughout the Teacher's Guide, the 3-Dimensional Domains are color coded within the text so that teachers know to emphasize or explicitly point out to students this connection to either the **Science and Engineering Practices (SEPs)** or the **Crosscutting Concepts (CCCs)**. In addition, small boxes on the side of the Procedure pages (see box in the blue column to the right) serve as a visual reminder, as well.

A small picture of the page(s) of the Student Science Journal (with answers) that students are using for each lesson has been included on the appropriate pages in the Teacher's Guide (see box to the right). This keeps the teacher from needing to go back and forth between various documents pertaining to a particular lesson.



Lesson 2 - Dinosaur Bones and Other Fossils

1. List characteristics of the fossils compared to seashells in the chart below.

Fossils	Seashells
Shells are made of a different material than fossils (made of shell) They feel brittle. They have variations of color. (Student answers will vary with many acceptable responses.)	Fossils are made of rock. They feel very hard. They are all the same color. (Student answers vary with many acceptable responses)

2. I think a fossil is:

This is the student's preliminary definition of a fossil. It should include some of the characteristics noted above.

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CCC: Crosscutting Concept(s):

Cause and Effect:

Events have causes that generate observable patterns.

New York State P-12 Science Learning Standards

Earth's Systems: Processes that Shape the Earth

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; tilted rock layers indicate past crustal movement; glacial scratches on rock formations indicating glacier movement; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water and/or loose Earth materials due to gravity, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)

ESS2.A: Earth Materials and Systems

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4-ESS2-2)

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4- ESS2-1),(4-ESS3-2)

New York State P-12 Science Learning Standards

Analyzing and Interpreting Data

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3– 5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points inan explanation. (4-ESS1-1)
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

ESS2.E: Biogeology

- Living things affect the physical characteristics of their regions. (4-ESS2-1)

ESS3.B: Natural Hazards

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)(Note: This Disciplinary Core Idea can also be found in 3.WC.)

ETS1.B: Designing Solutions to Engineering Problems

- Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3- 2)

Connections to Nature of Science

Scientific Knowledge Assumes an OrderandConsistencyinNatural Systems

- Science assumes consistent patterns in natural systems. (4- ESS1-1)

New York State P-12 Science Learning Standards

Connections to other DCIs in fourth grade: **4.ETS1.C** (4-ESS3-2)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-ESS3-2); **2.ESS1.C** (4-ESS1-1),(4-ESS2-1); **2.ESS2.A** (4-ESS2-1); **2.ESS2.B** (4-ESS2-2); **2.ESS2.C** (4-ESS2-2); **2.ETS1.B** (4-ESS3-2); **2.ETS1.C** (4-ESS3-2); **3.LS4.A** (4-ESS1-1); **5.ESS2.A** (4-ESS2-1); **5.ESS2.C** (4-ESS2-2); **MS.LS4.A** (4-ESS1-1); **MS.ESS1.C** (4-ESS1-1),(4-ESS2-2); **MS.ESS2.A** (4- ESS1-1),(4-ESS2-2),(4-ESS3-2); **MS.ESS2.B** (4-ESS1-1),(4-ESS2-2); **MS.ESS3.B** (4-ESS3-2); **MS.ETS1.B** (4-ESS3-2)

New York State Next Generation Learning Standards Connections:

ELA/Literacy –

4R1 Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (4-ESS3-2)

4R7 Identify information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, illustrations, and explain how the information contributes to an understanding of the text). (4-ESS2-2)

4W6 Conduct research to answer questions, including self-generated questions, and to build knowledge through investigating multiple aspects of a topic. (4-ESS1- 1),(4-ESS2-1)

4W7 Recall relevant information from experiences or gather relevant information from multiple sources; take notes and categorize information, and provide a list of sources.(4-ESS1-1),(4-ESS2-1)

4W5 Draw evidence from literary or informational texts to respond and support analysis, reflection, and research by applying grade 4 reading standards. (4-ESS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)

MP.4 Model with mathematics. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

NY-4.MD.1 Know relative sizes of measurement units: ft., in.; km, m, cm. Know the conversion factor and use it to convert measurements in a larger unit in terms of a smaller unit: ft., in.; Km, m, cm; hr., min., sec. Given the conversion factor, convert all other measurements within a single system of measurement from a larger unit to a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1), (4-ESS2-1)

NY-4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money. Solve problems involving fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams that feature a measurement scale, such as number line diagrams. (4-ESS2-1),(4-ESS2-2)

NY-4.OA.1 Interpret a multiplication equation as a comparison. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2) *Connection boxes updated as of September 2018*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the "Disciplinary Core Ideas" section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).

Lesson 1

Bones in our Neighborhood

Focus Question:
Did a dinosaur live in our neighborhood?

Vocabulary:
bone
dinosaur
model
prehistoric

Lesson Synopsis

Learning Target(s):
I can make observations and ask questions about a large bone found in a NYS neighborhood.
I can create an initial model to describe my explanation for the bone.
I can work with others to create a list of questions to investigate to explain this phenomenon.

Lesson Description:
Students observe a photograph showing a large bone that has been found in the ground nearby. They make observations and ask questions as a means to explain whether a dinosaur or other ancient animal once lived in the neighborhood. Working as a class, the students create a list of what they need to find out in order to answer their main questions. This is a 3 part lesson.

Management

Materials

For the class:
Photographs (Bone images 1 – 4 & Child with bone) showing a large animal bone from BOCES 4 Science website or use the Slides for this lesson from website
Example Model of how the bone became buried in the neighborhood (BOCES 4 Science website)
Sticky notes (four per pair)
Student Science Journals
Chart paper*
Water*

For each pair of students:
A dark marker* (choose one that will be easy to read on the sticky note paper)

*provided by teacher or students

Preparation:
Use the photographs of the bone from the BOCES 4 Science website or – if possible – bring in a large animal bone for this lesson.

Part A
The teacher will need 2 sheets of chart paper. One of the papers will be used for student observations and the other will be used for student questions. (You may wish to use "I notice…" and "I wonder…" as headings on the chart paper.)

Part B
The teacher will work with students to make a class model using either chart paper or a white board.

Part C
Use a sheet of chart paper with the heading, "What do we want to know?" This will be the list of the students' most important questions. Throughout the unit, as students find answers check off the list that was developed. As the unit progresses, create another chart paper entitled, "What we are figuring out" as a way to record their new understanding.

Teacher Background:
The Anchoring Phenomenon for this Unit

By providing students with intriguing questions, such as "How did this bone get here?" and "Is it a dinosaur bone?" we are attempting to frame the lessons that follow in this unit within that context. The anchoring phenomenon of a bone dug up locally provides a reason that we are conducting investigations and, ultimately, learning about the surface processes of the Earth in New York State.

NYSSLS relies on students constructing their own understanding rather than having the instruction "delivered". In this lesson, the stage is set for the investigations that will occur throughout the unit. The teacher, however, should use his/her discretion to determine whether the lessons, as described in this Teacher's Guide, fit appropriately into the list of investigation ideas developed by the class. Additional student-developed investigations may be needed to thoroughly answer the students' questions.

There are specific ideas and questions from the students that will most effectively address the NYSSLS for Grade 4: Earth Systems. Whenever possible, this Teacher's Guide will clue the teacher into the types of questions and ideas that will most closely follow the Science Standards and the lessons in this unit.

Scientist Circle

This strategy involves students in thinking and making learning decisions like a scientist. It includes specific norms such as:

- All students and teacher sit in a physical circle so that everyone has an equal opportunity to participate.
- Listeners are attentive and respectful to the speaker.
- The speaker shares one contribution and then gives another person an opportunity to speak by calling on the next person.
- A token item (such as a small stuffed animal) could be used to indicate the speaker.
- The teacher facilitates the discussion when standing but sits down and raises his/her hand to become a participant of the discussion.
- Often a record of the discussion is made on chart paper or using sticky notes.

Figuring it Out

The goal of the three sessions in this lesson is to develop a plan to "figure out" the answers to the student questions. This plan should include questions that the students need to investigate in order to answer the main question of this unit: Did a dinosaur live in our neighborhood?

At each lesson, students should be engaged in "figuring out" the answers to questions.

Vocabulary in Context

As students engage in different science experiences, they need words to describe a situation. Rather than pre-teaching vocabulary for each lesson, allow students to try to describe a situation or circumstance first. Then tell them that there is a word for that thing. For instance, if a student observes that water is causing deep gullies to form, we can tell him or her that the word for this is "erosion." Use the word in a sentence, share it with the whole class and incorporate vocabulary strategies after the new word has been used in context.

Standards

Performance Expectations:

4-ESS1-1. – Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. *(Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above layers with plant fossils and no shells, indicating a change from land to water over time; tilted rock layers indicate past crustal movement; glacial scratches on rock formations indicating glacier movement; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.) (Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.)*

Science and Engineering Practices

Planning and Carrying Out Investigations

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Asking Questions and Defining Problems

- Identify scientific (testable) and non-scientific (non-testable) questions.

Developing and Using Models

- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

ESS2.A: Earth Materials and Systems

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles, and move them around.

ESS2.E: Biogeology

- Living things affect the physical characteristics of their regions.

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation.
- Similarities and differences in patterns can be used to sort, classify, and communicate.

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change.

ELA/Math/Social Studies Connections:

ELA: 4SL1

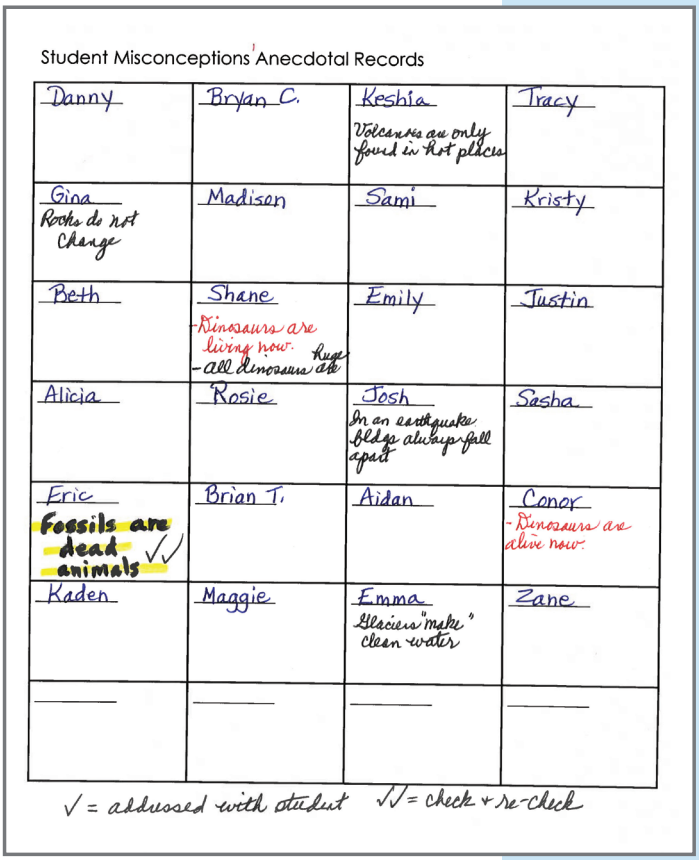
Vocabulary:

- **bone** - part of the skeleton of an animal
- dinosaur - a reptile that lived on Earth during the Jurassic period of Earth's history
- model - a sketch or other representation of student thinking about a concept
- **prehistoric** - something that occurred a long time ago, before written records

Bolded vocabulary words above could be assessed, all others are "nice to know".

Misconceptions:

It is possible that multiple misconceptions will be uncovered in this lesson. At this point, however, simply document information as students present it but be sure that the lessons that follow address those misconceptions. A teacher page for maintaining and addressing anecdotal records can be found in the Assessment folder for this unit on the BOCES 4 Science website.



Student Misconceptions' Anecdotal Records

Danny	Bryan C.	Keshia Volcanoes are only found in hot places	Tracy
Gina Rocks do not change	Madison	Sami	Kristy
Beth	Shane -Dinosaurs are living now. -all dinosaurs are huge	Emily	Justin
Alicia	Rosie	Josh In an earthquake bldgs always fall apart	Sasha
Eric Fossils are dead animals ✓✓	Brian T.	Aidan	Conor -Dinosaurs are alive now.
Kaden	Maggie	Emma Glaciers "make" clean water	Zane

✓ = addressed with student ✓✓ = check + re-check

Procedure

Phenomenon:

Students look at a photograph of a large animal bone or observe a large animal **bone** brought in by the teacher. The teacher tells the students that this bone was found nearby where some construction was occurring. It was found 2 feet down in the ground when soil was being moved.

Part A

1. Display the photographs of the bone. Have the students use the Student Science Journal page 4 to respond to Questions 1 and 2:
   - What do you **notice or observe** about the bone and where it was found?
   - What **questions** do you have about the bone and where it was found?

2. Form the students into a Scientist Circle near chart paper. Use the protocols from the Background Information to discuss each of the questions. Record the student observations and questions on two pieces of chart paper ("I notice…"/"I wonder…").

SEP: Science and Engineering Practice(s):

Planning and Carrying Out Investigations:

Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

SEP: Science and Engineering Practice(s):

Asking Questions and Defining Problems:

Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

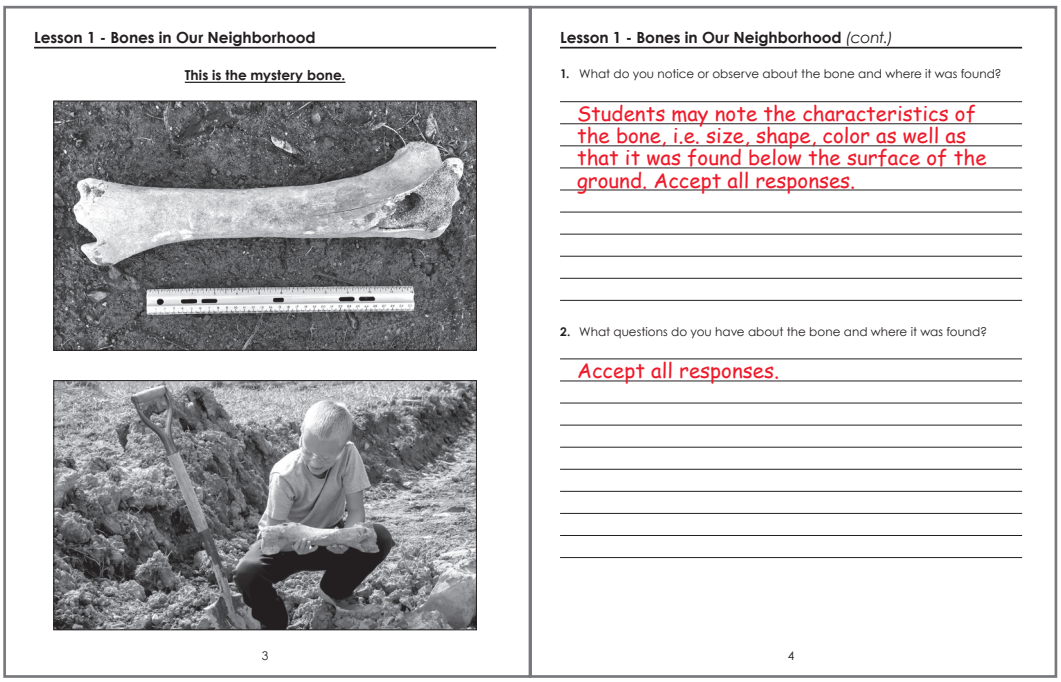
CCC: Crosscutting Concept(s):

Patterns:

Patterns can be used as evidence to support an explanation.

Discussion Questions:

- What did you **notice or observe** about the bone and where it was found? (Students may note the characteristics of the bone, i.e. size, shape, color as well as that it was found below the surface of the ground. Accept all responses but an observation that it was found in soil instead of rock is significant.)
- What **questions** do you have about the bone and where it was found? (Accept all responses. Questions that will advance the intentions of the unit include: How did it get there? Why was it in the ground? What animal did it come from? Is it an old bone? Did we have dinosaurs around here? Did this area always look this way? Is it a fossil? Why are fossils found in the ground?)
- Do you notice any **patterns** in the questions? (Have the students indicate which questions are similar to each other such as questions about the type of animal or questions about how it became buried in the ground, etc.)



Lesson 1 - Bones in Our Neighborhood

This is the mystery bone.

3

Lesson 1 - Bones in Our Neighborhood *(cont.)*

1. What do you notice or observe about the bone and where it was found?

Students may note the characteristics of the bone, i.e. size, shape, color as well as that it was found below the surface of the ground. Accept all responses.

2. What questions do you have about the bone and where it was found?

Accept all responses.

4

SEP: Science and Engineering Practice(s):

Planning and Carrying Out Investigations:

Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Part B

3. Have the students gather where they can see the record of **observations** and **questions** from the last science session. Ask a student to review the information from the last class including the bone and the observations and questions generated.
4. Discuss students' prior knowledge about **a "model" in science** and how it can be used to explain something. Depending on students' past experiences, they may have made models that were very simple and did not include an explanation. As the students make progress in their understanding of models, they should begin to use a **model** to explain a phenomenon, such as why an animal bone might be found in the ground.

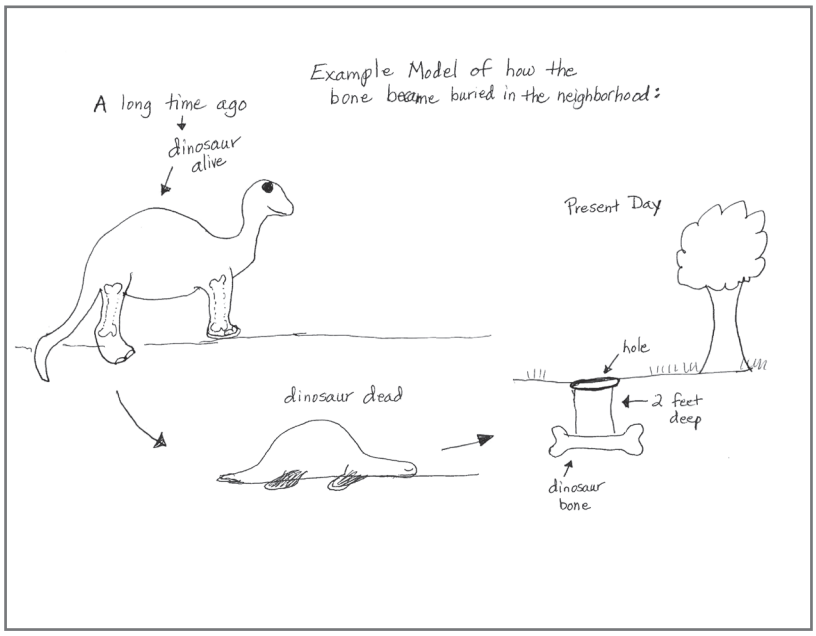
Discuss characteristics that students may remember about **what makes an effective model**. Specifically, discuss:

- The model should be understandable to other people
- It should include labels of the objects pictured
- Arrows can show the order in which events happen
- This model is supposed to explain where the bone came from and how it became buried in the ground.

The students will work independently in their Science Journals on page 5 to make a model of their preliminary explanation for the type of animal the bone is from and how the bone became buried in the ground.

5. As scientists, it is always a good idea to find out what other people are thinking. Have the students leave their journals open to the page they have been working on, then move to another desk and try to understand the model there. Altogether, the students should look at approximately 3 different classmates' models.

   The Example Model of how the bone became buried in the neighborhood can be used just for teacher reference or to compare with the models that the students draw. A copy of the Example Model can be projected from the image on the BOCES 4 Science website.



6. Ask the students to discuss with a partner the similarities and differences in the models that they saw.

   Discussion Questions:

   - What **similarities** did you find in the models you saw? (Answers will vary.)
   - What **differences** did you find in the models that you saw? (Answers will vary.)

SEP: Science and Engineering Practice(s):

Developing and Using Models:

Develop and/or use models to describe and/or predict phenomena.

CCC: Crosscutting Concept(s):

Patterns:
Similarities and differences in patterns can be used to sort, classify, and communicate.

CCC: Crosscutting Concept(s):

Cause and Effect:
Cause and effect relationships are routinely identified, tested, and used to explain change.

SEP: Science and Engineering Practice(s):

Developing and Using Models:
Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.

- Are there parts of the models you saw (or the Example Model) that are not explained? (Answers will vary. The Example Model does not show how the dinosaur bone came to be buried in a yard. It also doesn't explain what happened to the rest of the **dinosaur** bones.)
- Do any of the models show a **cause and an effect**? (If a model shows HOW the bone was buried, it probably shows a cause and effect.)
- Is there anything about this situation that everyone can agree on? (Answers will vary, for instance, did the students agree on the type of animal they think the bone was from?)

7. Use responses to the last question to create a **classroom model** (based on the consensus of the group) **showing an explanation** for how the bone came to be buried in the ground.) The model can be created on a whiteboard or on chart paper.

Part C

8. As this session begins, display the current classroom **model explaining how the bone came to be buried in the ground**. After review, have the students think about and discuss as a large group, "What do we want to know?" Hopefully the students will conclude that they are trying to find out what type of bone is buried in the ground and how it got there.
9. Write the main questions on the chart paper that was labelled, "What do we want to know?" Have the students discuss what they think they need to find out in order to answer the main questions: what type of bone is buried in the ground? and how did it get there?
10. Distribute 4 sticky notes for each pair of students and a dark marker that is easily seen. Tell the students to each write two different **questions** that need to be answered in order to solve this puzzle. If students do not ask "Is it a dinosaur bone?" and "Is it a fossil?" be sure to include those questions.
11. In the Scientist Circle, ask the students to use their protocols to share their **questions**. The teacher should continue to focus the students on the things they need to find out (i.e. questions they have) in order to know what type of bone was buried in the ground and how it got there. As students take turns asking questions, the teacher and the students should arrange

What do we want to know:

- What type of bone is buried?
  - Is it from a dinosaur?
  - Is it a fossil?
  - What type of animal is it from?
  - What part of the animal is the bone from?
  - Did the animal die recently or long ago?
- How did it get there?
  - Was the bone put there or did the animal die nearby?
  - How could it have become covered over with soil?
  - How do bones end up as fossils?
  - Did the place it was found always look the same?
  - How has the land changed?

the sticky note questions on poster paper in groups based on similarities. It will be helpful to label the groups of sticky notes, for example, "Type of Animal" questions. Once the students' questions are sorted, use the "What do we want to know?" chart paper to record those questions. See the sample above.

12. On another sheet of chart paper, write the heading, "What we are figuring out". Tell the students that this will be the place that they will record the answers to their questions.

Closing the Lesson

Tell the students that, as part of the science unit, we can investigate these questions to figure out how the bone got into the ground and what type of animal it is from.

To close the lesson, have the students **think about and discuss one specific question and how it could be investigated.**

At the end of class, reflect with the students on what they think they know about dinosaurs and fossils in preparation for the next lesson.

SEP: Science and Engineering Practice(s):

Asking Questions and Defining Problems:

Identify scientific (testable) and non-scientific (non-testable) questions.

Connections

Differentiation:

Depending on individual student needs, an alternate task for students could be to discuss their thinking with a partner before or instead of completing the writing on the Student Science Journal pages.

Instead of individual models in the Student Science Journal, the students could all contribute to a whole class model.

Pre-Assessment for the Unit:

The teacher should listen and look for misconceptions that may be uncovered in this lesson as well as throughout the unit. Keep anecdotal records about the misconceptions held by specific students by using the Science Misconceptions Anecdotal Record sheet. A blank record sheet can be found on the BOCES 4 Science website.

Cross-Discipline Extension:

ELA: There are a number of articles about "real life" experiences of individuals who have dug up dinosaur and other ancient fossils. Age appropriate articles are listed on the links page for this lesson on the BOCES 4 Science website.

Student Science Misconceptions Anecdotal Records

Next Lesson Preparation

Prepare for the unit by attempting to align the lessons in this guide with student questions and investigation suggestions. It may be necessary to teach the lessons out of order or to add additional lessons.

For Lesson 2: Find a place to hang the Geologic Time Scale poster in the classroom.

Print the page of the illustrations for the Geologic Time Scale. A student group will cut them out. They will be taped to the poster during the lesson.