Deer, Deer Everywhere!

Teacher's Guide

Matter and Energy in Organisms and Ecosystems

BOCES 4 Science

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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1/18

Foreword

BOCES 4 Science is a collaboration between four New York State BOCES (Board of Cooperative Educational Services). 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 NRC publication, A Framework for K-12 Science Education is the basis for the NYSSLS.

We believe that the future health and well-being of our world depends on scientifically literate people making informed decisions. The development of literacy in science 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

Deer, Deer Everywhere! is a unit designed for grade five.

In this unit, Matter and Energy in Organisms and Ecosystems are explored through the lens of deer overpopulation. Students take on the role of NYS Department of Environmental Conservation researchers charged with the task of creating a public service announcement on this issue. During the unit, the students will focus on the Science and Engineering Practices of Developing and Using Models, Engaging in Argument from Evidence, Obtaining, Evaluating and Communicating Information, and Construction Explanations and Designing Solutions. The unit addresses the Cross Cutting Concepts of Systems and System Models, and Energy and Matter.

Scheduling

This unit is scheduled to be in the classroom for eight weeks. There are approximately 15 science instructional sessions in this unit, based on 30-40 minutes each. Adjust your schedule accordingly. Please return the unit promptly or to request an extension, call 585-352-1140.

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:

- Chart paper (L1, L9)
- Tape (L1, L5, L7, L9, L10)
- Markers (L1, L3, L9, L12)
- Rulers (L2, L3, L12)
- 2-liter bottles with caps (L3)
- Water (L3, L6, L7, L9)
- Scissors (L3, L7)
- Dead plant material (L3, L9)
- Bottle holder crate (optional) (L3)
- Deer food examples (optional) (L4)
- Microscopes (optional) (L5)
- Smooth leaves (L6)
- Balloons (optional) (L7)
- Colored pencils/crayons (L8, L9, L13)
- Computers (L8, L13)
- Earthworms (optional) (L9)
- Refrigerator (optional) (L9)
- Hula hoop (optional) (L10)
- Construction paper (L13)

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.

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 embedded formative assessments and a final summative assessment of learning. The teacher is encouraged to use a variety of informal or anecdotal assessment strategies as well, such as: portfolios of artifacts, "thumbs up" & "thumbs down", "ticket out the door", regular perusal of student science journals or having students keep an additional notebook to contain their reflections.

Additional Features of this Unit

The Deer, Deer Everywhere! unit also includes Student Science Journals and Deer Diaries that are included in the unit or available online at the BOCES 4 Science website. (A web address and password are located within the science kit.)

Additional resources for the teacher, such as the specific assessments, ELA and/or ELL supports, 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:

K-2-ETS1-2 – Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Science and Engineering Practices

Developing and Using Models

- Develop a simple model based on evidence to represent a proposed object or tool.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

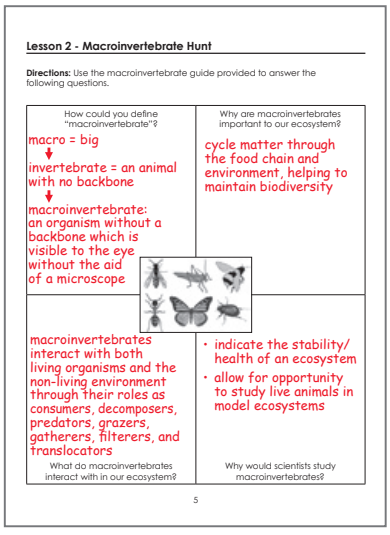
ELA/Math/Social Studies Connections:

ELA: 2R1

Math: NY-2.MD

Social Studies:

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)** and/or the **Crosscutting Concepts (CCCs)**. In addition, small boxes on the right hand side of the Procedure pages (see box in the green column to the right) serve as a visual reminder, as well.



Lesson 2 - Macroinvertebrate Hunt

Directions: Use the macroinvertebrate guide provided to answer the following questions.

How could you define "macroinvertebrate"?

macro = big
↓
invertebrate = an animal with no backbone
↓
macroinvertebrate: an organism without a backbone which is visible to the eye without the aid of a microscope

Why are macroinvertebrates important to our ecosystem?

cycle matter through the food chain and environment, helping to maintain biodiversity

macroinvertebrates interact with both living organisms and the non-living environment through their roles as consumers, decomposers, predators, grazers, gatherers, filterers, and translocators

What do macroinvertebrates interact with in our ecosystem?

- indicate the stability/ health of an ecosystem
- allow for opportunity to study live animals in model ecosystems

Why would scientists study macroinvertebrates?

5

In addition, 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.

CCC: Crosscutting Concept(s):

Cause and Effect:

Events have causes that generate observable patterns.

New York State P-12 Science Learning Standards

Matter and Energy in Organisms and Ecosystems

Students who demonstrate understanding can:

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun. [Clarification Statement: Emphasis should be on plants converting light energy by photosynthesis into usable energy. Examples of models could include diagrams and flow charts.]

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

5-LS2-1. Develop a model to describe the movement of matter among plants (producers), animals (consumers), decomposers, and the environment. [Clarification Statement: Emphasis is on the flow of energy and cycling of matter in systems such as organisms, ecosystems, and/or Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

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

Developing and Using Models

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Use models to describe phenomena. (5-PS3-1)
- Develop a model to describe phenomena. (5-LS2-1)

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Support an argument with evidence, data, or a model. (5-LS1-1)

Disciplinary Core Ideas

PS3.D: Energy in Chemical Processes and Everyday Life

- The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)

LS1.C: Organization for Matter and Energy Flow in Organisms

- Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)
- Plants acquire their material for growth chiefly from air and water. (5-LS1-1)

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-LS2-1)

New York State P-12 Science Learning Standards

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

Energy and Matter

- Matter is transported into, out of, and within systems. (5-LS1-1)
- Energy can be transferred in various ways and between objects. (5-PS3-1)

Connections to other DCIs in fifth grade: **5.PS1.A** *(5-LS1-1),(5-LS2-1);* **5.ESS2.A** *(5-LS2-1)*

Articulation of DCIs across grade-levels: **K.LS1.C** (5-PS3-1),(5-LS1-1); **2.PS1.A** (5-LS2-1); **2.LS2.A** (5-PS3-1),(5-LS1-1); **2.LS4.D** (5-LS2-1); **4.PS3.A** (5-PS3-1); **4.PS3.B** (5-PS3-1); **4.PS3.D** (5-PS3-1); **4.ESS2.E** (5-LS2-1); MS.PS3.D (5-PS3-1),(5-LS2-1); **MS.PS4.B** (5-PS3-1); **MS.LS1.C** (5-PS3-1),(5-LS1-1),(5-LS2-1); **MS.LS2.A** (5-LS2-1); **MS.LS2.B** (5-PS31),(5-LS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS31),(5-LS2-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)

W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5PS3-1),(5-LS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-LS1-1),(5-LS2-1)

MP.4 Model with mathematics. (5-LS1-1),(5-LS2-1)

MP.5 Use appropriate tools strategically. (5-LS1-1)

5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1)

* 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 3

Eco-columns

Focus Question:
How does matter move among plants, animals, decomposers, and the environment?

Vocabulary:
eco-column

Safety:
The box cutter should be used only by the teacher. Carefully monitor student use of scissors to cut the plastic bottles so they do not incur any injuries.

Lesson Synopsis

Learning Target(s):

I can develop a model (eco-column) to describe the cycling of matter within an ecosystem.

I can use a model (eco-column) to describe how interactions in the ecosystem allow multiple species to meet their needs.

Lesson Description:

In this lesson, students will construct an eco-column, a model ecosystem that connects a terrarium and an aquarium. Throughout the remainder of the unit, students will observe changes in the eco-columns and may use them for further experimentation. The eco-columns will help students understand the relationships that link organisms in an ecosystem to one another and their non-living environment. Students will get to draw parallels between the events occurring inside their model eco-columns and those that occur in the ecosystem in which they live.

(Lesson 3 must be split up over 2 to 3 days, with the final day falling 5 to 8 days after the first.)

Management

Materials

For the class:

- 2 buckets
- 2 nets
- 2 spoons
- Safety-blade box-cutter (for teacher's use only)
- Eco-column video (link found in this unit's Teacher Resources on the BOCES 4 Science website)

For each group of 4 students:

- 6 plastic cups
- 2 cups gravel
- 2 cups soil
- 2 droppers (pipettes)
- 20-30 alfalfa seeds
- 20-30 grass seeds
- 20-30 mustard seeds
- 1-2 sprigs elodea
- 10-15 duckweed plants
- 3 dropperfuls algae
- 1-2 snails
- 1-2 fish
- 1-2 isopods (to be used in 5-8 days)
- 1-2 crickets (to be used in 5-8 days)
- 2 toothpicks
- Rock
- Wax pencil
- Screen
- Rubber band
- Index card
- Paper towel
- 3 2-liter bottles with caps*
- 1½-liter water*
- 4 pieces tape*
- Ruler*
- Scissors*
- Dead plant material: fallen leaves, twigs, pine needles, grass clippings*
- Bottle holder crate (optional)*

For each student:

- Student Science Journal p. 7-15
- Deer Diary p. 6

* provided by teacher/student

Preparation:

Students will build their **eco-columns**, or mini models of our ecosystem, in this lesson. To prepare, you will need to collect 3 clear (not colored) 2-liter bottles with caps for each group of 4 students, possibly by asking students and colleagues to begin bringing these in at the beginning of the unit. Bottles should be rinsed with water and the labels should be removed (a hairdryer can be used to soften the glue). You may also wish to visit a local grocery store and ask for large bottle holder crates to store your students' eco-columns in for the remainder of the unit. Any donated crates can be kept for use from year to year. Be sure you have an area that is out of direct sunlight and extreme temperature change for storing the eco-columns.

It is highly recommended that you preview the video instructions for building an eco-column provided in this unit's Teacher Resources section of the BOCES 4 Science website, read the Eco-column Written Instructions (on pages 7-10 of the Student Science Journal), and build your own sample eco-column. Not only will it provide a model for students, but it will also provide you with the experience of trying this once yourself so that you may anticipate any difficulties students may encounter.

There are a lot of materials required for students to use in this lesson, so it may help to set them up buffet style. At least 4-5 gallons of water should be set aside 24 hours before the lesson so that chlorine can dissipate. There are some initial cuts that will need to be made using a safety-blade box cutter. These should be done by the teacher and may be completed ahead of time or done during the lesson. Gather dead plant material (fallen leaves, twigs, pine needles, grass clippings).

Example of Buffet for Eco-column Written Instructions Part B. Setting Up the Terrarium

Rocks Take 1	Mustard Seed Take 20 - 30	Wax Pencils Take 1	Droppers Take 1	Rubber Bands Take 1	Gravel Take 1 cup	Water
Dead Plant Material	Grass Seed Take 20 - 30	Alfalfa Seed Take 20 - 30	Soil Take 2 cups	Toothpicks Take 2	Screen Take 1	Cups Take 3

Example of Buffets for Eco-column Written Instructions
Part C. Setting Up and Stocking the Aquarium

Gravel Take 1 cup	Droppers Take 1	Wax Pencils Take 1	Wet Paper Towels Take 2

Elodea Put 1-2 sprigs on a towel	Duckweed Put 10-15 pieces on a towel	Algae Put 3 dropperfulls into a cup

Snails Take 1 - 2	Mosquito Fish Take 1 - 2	Water	Droppers Take 1	Rulers Take 1	Cups Take 2

Some of the live materials for this lesson will be obtained directly from a vendor. A coupon with directions will arrive separately for each kit ordered. It is the teacher's responsibility to notify the vendor 7-14 days before you intend to use the live organisms. Please note that because this lesson is split into two sessions, 5-8 days apart, you will need to place 2 separate orders for your live specimen (order 1 fills the aquarium and order 2 will fill the terrarium; a live plant will also be included in order 1 for use in Lesson 5). Any instructions that come directly from the vendor should be followed. In addition, upon receiving your aquatic plants, be sure to remove them from their packaging. Until they are put into their eco-columns, place near a window and add water if necessary. Before fish and snails are placed into the eco-column, change half the water every other day to ensure a fresh oxygen supply – water should be left out to allow chlorine to dissipate before using. Finally, crickets and isopods may stay in the containers they came in for 1 to 2 days prior to use – please be sure to get them into the eco-columns before the weekend comes. When it comes time to add crickets to the eco-columns, it may help to cool them in the refrigerator for 20 minutes beforehand. Brief refrigeration will cause no harm, but a decrease in temperature will temporarily slow their activity level and aid in distribution.

In order to protect our ecosystem, it is advised that organisms used in the eco-columns are not released into the environment upon completion of the unit. Once the unit is complete, you may wish to continue maintaining the eco-columns within your classroom, donate them for use in another classroom, allow students to take them home with parental permission, or place the organisms in a sealed container, freeze them, and bury them. Please be aware that students often become attached to their eco-columns, so what to do with the organisms when the unit is finished may present a great opportunity for discussion.

Teacher Background:

No organism on earth lives isolated and independent from all others. Every organism, including humans, exists within an ecosystem of living and nonliving things. The model ecosystems students construct in their **eco-columns** will show obvious signs of change over time – for example, the crickets will eat some of the plants and seeds, and newborn mosquito fish or small snail eggs may appear. Such natural disturbances may disrupt the stability of the model ecosystems, which in turn can be connected to the problem we are studying that is facing our ecosystems in NYS, deer overpopulation.

Fifth grade students are often quite curious about environmental issues and ways they can help save the environment and the organisms in it. There are many ways to use the eco-columns to further investigate these issues if you wish to do so, and some of these opportunities will present themselves throughout the remainder of the unit. Don't be surprised if some of the questions students would like to explore go beyond what you know or can find out. In this case, your goal will be to help students learn how they can continue to find out for themselves.

Standards

Performance Expectations:

1 5-LS2-1 – Develop a model to describe the movement of matter among plants (producers), animals (consumers), decomposers, and the environment. (Clarification Statement: Emphasis is on the flow of energy and cycling of matter in systems such as organisms, ecosystems, and/or Earth.) [Assessment Boundary: Assessment does not include molecular explanations.]

Science and Engineering Practices

Developing and Using Models

- Use a model to test interactions concerning the functioning of a system.
- Identify limitations of models.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms break down dead organisms and therefore operate as "decomposers." A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.

Crosscutting Concepts

Cause and Effect

- A system can be described in terms of its components and their interactions.

Stability and Change

- Change is measured in terms of differences over time and may occur at different rates.
- Some systems appear stable, but over long periods of time will eventually change.

ELA/Math/Social Studies Connections:

Math: MP.5

SS: 5.4

Vocabulary:
eco-column - a model ecosystem that connects a terrarium and an aquarium.

Procedure

Problem: How can we construct a **model** of an ecosystem to better understand a deer's ecosystem?

1. Explain to students that one way to study something is to make a **model** of it (which they have been doing on paper up to this point). Tell them you have a video about making a mini-version of our ecosystem in a bottle, but before you show it, ask what we should and should not include and why.

   Discussion Questions:
   - What should we include in our **model** ecosystem? (both living organisms and the non-living environment with which they **interact** should be represented; students may look to the chart paper **models** from Lesson 1 for ideas; focus discussion on potential **interactions**)
   - What shouldn't we include? (can't include deer – too large; point out that while this **model** provides an easy way for our class to study a deer's ecosystem, it does have **limitations**)

2. Show Eco-column video from online Teacher Resources so students have a reference for what they are about to do. Allow students to point out what they noticed and ask questions after the video. Please note that the written instructions will vary slightly from the example in the video. If you created your own eco-column in preparation for this lesson, it can best serve as a **model** for students to refer to.
3. Form groups of 4, and instruct each student in the group to turn to the Eco-column Written Instructions on pages 7 - 10 of their Student Science Journals. Because all students in the group have this, each student will be responsible for following the instructions as the group builds their eco-column together. Encourage students to check off steps as they go throughout the entire unit.
4. As students follow the Eco-column Written Instructions, direct them to begin working on pages 11-15 of their Student Science Journals along the way. This will include drawing labeled **models** that can be referred back to throughout the unit in order to note **change** that occurs within the eco-column over time. If possible, you may wish to allow students to take photographs rather than or in addition to drawing.

SEP: Science and Engineering Practice(s):

Developing and Using Models:

Use a model to test interactions concerning the functioning of a system.

Identify limitations of models.

CCC: Crosscutting Concept(s):

Systems and System Models:

A system can be described in terms of its components and their interactions.

CCC: Crosscutting Concept(s):

Stability and Change:

Change is measured in terms of differences over time and may occur at different rates.

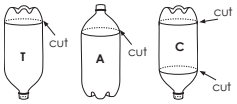
Some systems appear stable, but over long periods of time will eventually change.

Lesson 3 - Eco-columns

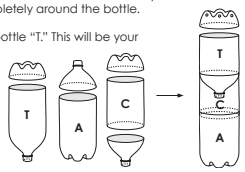
Eco-column Written Instructions

A. Preparing the Bottles

Materials: 3, 2-liter bottles with caps
Wax pencil
Ruler
Scissors



1. Your eco-column will be made up of 3 different bottles. Use your wax pencil to mark one bottle "T" for terrarium, another bottle "A" for aquarium, and the last bottle "C" for connector. Take the caps off the bottles.
2. Using a ruler, measure 23.5 cm from the top of the "T" bottle, and draw a line around the bottle with your wax pencil (it may help to stabilize your bottle on your tray). Your mark should be just above the "hip" of the bottle.
3. Using a ruler, measure 11.0 cm from the top of the "A" bottle, and draw a line around the bottle with your wax pencil. Your mark should be just below the "shoulder" of the bottle.
4. Using a ruler, measure 9.5 cm from the top of the "C" bottle, and draw a line around the bottle with your wax pencil. Your mark should be just above the "shoulder" of the bottle. Next, use a ruler to measure 23.5 cm from the top of the "C" bottle, and draw a line around the bottle with your wax pencil. Your mark should be just above the "hip" of the bottle.
5. Raise your hand for your teacher to make your initial cuts for you. Then, for each of your 3 bottles, place your scissors into the initial cuts your teacher made. Follow the line to cut completely around the bottle.
6. Save the base that you cut from bottle "T." This will be your terrarium lid, and your teacher will help you cut 3-4 holes in it.
7. Assemble the bottles as shown in the model. If bottles don't fit well, make adjustments, possibly by exchanging bottles with another group.



Lesson 3 - Eco-columns *(cont.)*

B. Setting Up the Terrarium

Materials: Screen
Rubber band
3 plastic cups
1 cup gravel
2 cups soil
Wax pencil
2 toothpicks
20-30 alfalfa seeds
20-30 grass seeds
20-30 mustard seeds
Water
Water dropper
Bottle cap
Dead plant material
Rock

8. Using part "T", place a square of screen over the mouth of the bottle and secure it with a rubber band around the neck of the bottle.
9. Stand part "T", neck down, in a plastic cup.
10. Add one plastic cupful of gravel to the terrarium.
11. Add 2 plastic cupfuls of soil on top of the gravel. Try not to muddy the sides of the terrarium.

12. Using 2 toothpicks, make dividing lines in the soil to create 4 equal parts. Use a wax pencil to label the outside of the bottle with what you are putting into each of the 4 sections.
13. In 3 of the parts you will plant seeds. First, sprinkle alfalfa seeds evenly on the soil's surface in their section. Use your toothpick to spread them out if necessary. Press them down gently with your fingers, being careful not to plant them too deeply.
14. Plant the grass and mustard seeds the same way in their own sections.
15. Using a water dropper, wet the soil thoroughly until water begins to drip out of the bottom. Then, replace the bottle cap to prevent leaks. You will repeat this process twice a week.
16. In the 4th section, add some dead plant material and a rock.

Lesson 3 - Eco-columns *(cont.)*

C. Setting Up and Stocking the Aquarium

Materials: 1 cup gravel
2 plastic cups
Water
Ruler
Wax pencil
1-2 sprigs elodea
10-15 duckweed
Dropper
3 dropperfuls algae
1-2 snails
1-2 fish
Paper towel

17. Using part "A", put one cupful of gravel in the bottom of the aquarium.
18. Fill your aquarium with water until it is no higher than 3.0 to 4.0 cm from the top. Mark the water line on the bottle with a wax pencil.
19. Place 1 or 2 sprigs of elodea onto a wet paper towel, then transfer into the aquarium. You may plant it in the gravel or let it float freely.
20. Use a spoon to scoop up 10 to 15 tiny duckweed plants and place them onto a wet paper towel, then transfer into the aquarium.
21. Place 3 dropperfuls of algae into the aquarium.
22. Dip your plastic cup in the holding tank to fill it with an inch or two of water. Then, use a net to scoop 1-2 snails out of the holding tank into your cup.
23. Using a net, catch 1-2 fish. Turn the net inside out and touch it to the water in order to put the fish into your cup.
24. Pour the animals gently into your aquarium.

Lesson 3 - Eco-columns *(cont.)*

D. Joining the Terrarium and Aquarium

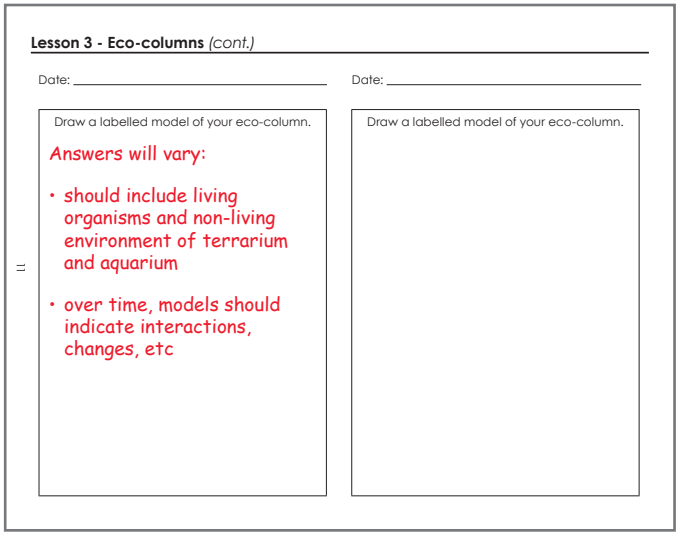
Materials: 4 pieces tape

25. Remove the bottle cap from the base of the terrarium. Then, stack your bottles as shown in the model.
26. Use 2 pieces of tape to attach part A (the aquarium) to part C (the connector). Use 2 pieces of tape to hold part T (the terrarium) to part C. (Hint: Turning under one corner of each piece of tape will make it easier to remove the tape later.)

E. Stocking the Terrarium
(to be completed once plants have started to grow, 5-8 days after planting)

Materials: Plastic cup
1-2 isopods
1-2 crickets
Index card
Lid

27. Use a spoon to scoop 1-2 isopods into your plastic cup. Then, place your isopods gently into the terrarium.
28. Gently capture 1-2 crickets and cover your cup with an index card. Then, place your crickets into the terrarium. Cover the terrarium with the lid (cut off base with holes in it) to keep the crickets from hopping out.



Lesson 3 - Eco-columns *(cont.)*

Date: _____ Date: _____

Draw a labelled model of your eco-column.

Answers will vary:

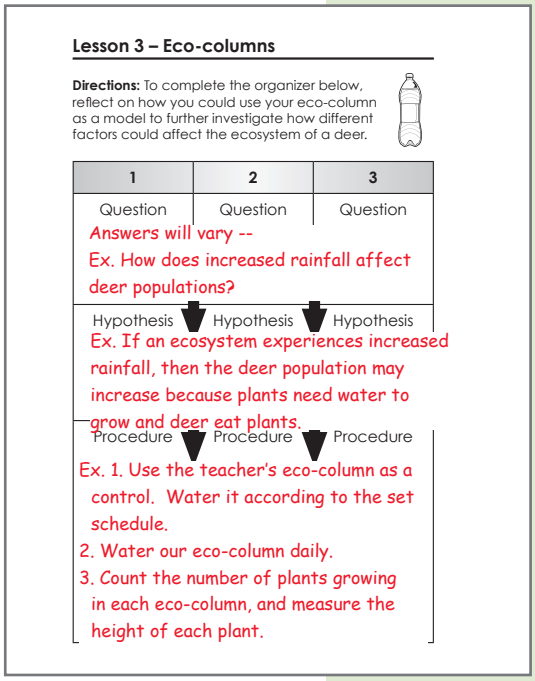
- should include living organisms and non-living environment of terrarium and aquarium
- over time, models should indicate interactions, changes, etc

Draw a labelled model of your eco-column.

5. You may choose to complete parts A–D in one day, or break these parts up over 2 days if necessary. Part E of the written instructions must be carried out 5-8 days from now.
6. While students are completing Part A, they will need your assistance to make initial cuts in their bottles using the safety-razor box-cutter provided. (Box-cutter is for teacher use only.)
7. If so desired, macroinvertebrates that were collected during Lesson 2 can be added to eco-columns, but please note this may not be constant across all groups.
8. If you obtained bottle storage crates, place eco-columns there. You will need to revisit the eco-columns a number of times throughout the remainder of the unit. In addition to instances a future lesson explicitly calls for working with the eco-columns, students will initially need to check to see if their terrariums need to be watered twice a week (eventually, the water cycle within the eco-column should make it self-sustaining). This check-in schedule will allow students to regularly observe and document other **changes** to their eco-columns as well.
9. You may move on to subsequent lessons during the 5 to 8 day period in which you are waiting to revisit Lesson 3.

Closing the Lesson

On page 6 of their Deer Diaries, have students reflect on how they could use their eco-columns as **models** to further investigate how different factors could affect the eco**system** of a deer. For example, students may wonder about the impact of increased rain on deer.



Lesson 3 – Eco-columns

Directions: To complete the organizer below, reflect on how you could use your eco-column as a model to further investigate how different factors could affect the ecosystem of a deer.

1	2	3
Question	Question	Question
Answers will vary -- Ex. How does increased rainfall affect deer populations?		
Hypothesis	Hypothesis	Hypothesis
Ex. If an ecosystem experiences increased rainfall, then the deer population may increase because plants need water to grow and deer eat plants.		
Procedure	Procedure	Procedure
Ex. 1. Use the teacher's eco-column as a control. Water it according to the set schedule. 2. Water our eco-column daily. 3. Count the number of plants growing in each eco-column, and measure the height of each plant.		

Assessment

Throughout this unit, you may choose to assess each Student Science Journal and Deer Diary entry informally so that you may follow up with individuals if necessary, or you may wish to grade entries based on effort and/or accuracy.

Connections

Differentiation:

The diagrams provided within the Eco-column Written Instructions, as well as the check-list strategy and chunking of the instructions, will help support all students' understanding, particularly English Language Learners and students with special needs. Expecting students to use active reading strategies and to check off steps as they go will be beneficial throughout the school year. In addition, while students are working in groups, you will be able to provide small group instruction to students who need more support, while allowing students who are able to follow the instructions on their own to do so. If you have not already established group norms to be followed throughout the school year, the following roles are suggested for this and future lessons: task master, materials manager, recorder, and time keeper.

Next Lesson Preparation

Lesson 4 focuses in on a specific aspect of a deer's ecosystem, plants. If possible, collect any deer food from in and around your house that you can bring in to display to supplement the Power Point available on the BOCES 4 Science website in the Teacher Resources for this unit. (Use the Power Point as a guide for what to bring in – fruit, nuts, etc.)

Each student will need to work with a partner who has been assigned a different photosynthesis diagram (differentiated diagrams have been included in the kit based on ability level). It may be beneficial to plan student pairings prior to the lesson. It is also helpful to set up expectations for working with partners at the beginning of the school year.

To demonstrate the process of photosynthesis in this lesson, students will read and act out the Photosynthesis Factory play. Please preview the play on pages 18 - 19 of the Student Science Journal, then hang the 5 signs (printed from the Teacher Resources online) in appropriate areas around your classroom based on the reading. It may be necessary to clear a space in the front of your classroom for the performance. A roll of adding machine tape has been provided to assemble headbands for performers to wear, along with pictures to attach to each of the headbands.

Cue up the time-lapse video clip of sunflower growth from the Teacher Resources section of this unit on the BOCES 4 Science website.