Got Water?

Teacher's Guide

Earth's Systems

BOCES 4 Science

Teacher's Guide

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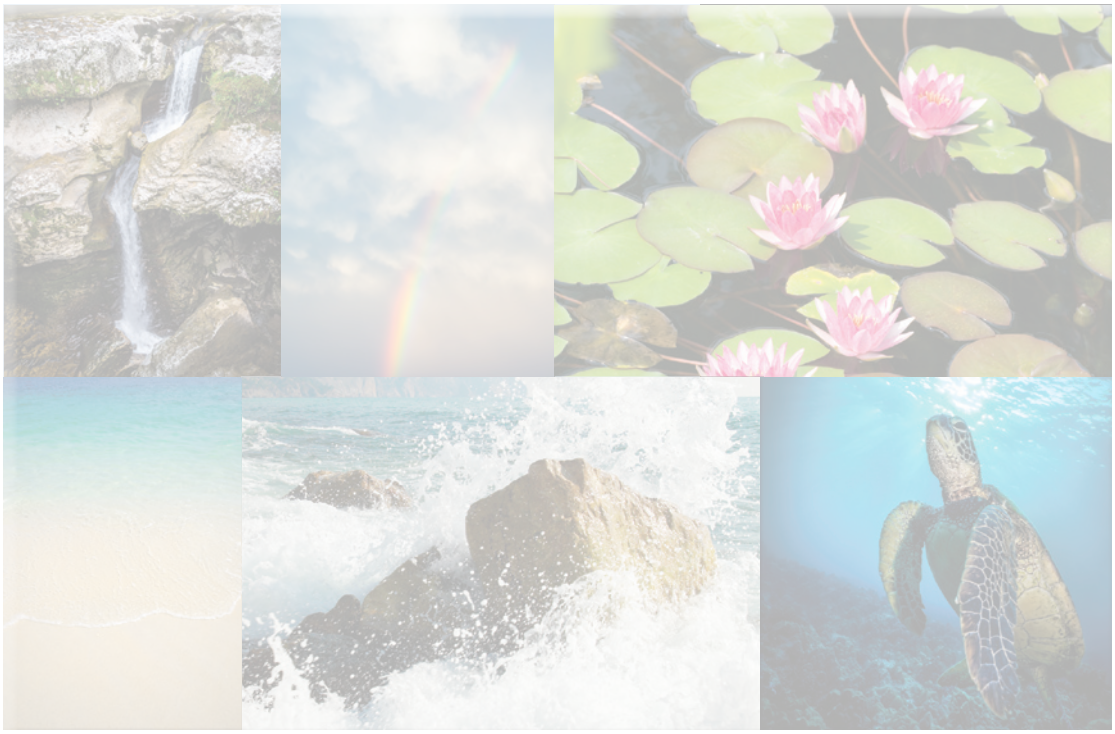
12/18

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

Got Water? is a unit designed for **5th** grade.

In this unit, students investigate Earth's Systems by taking on the role of interns at their local Got Water? facility. Students will develop and use system models to explore interactions among Earth's atmosphere, biosphere, geosphere, and hydrosphere. As a final performance assessment, students will obtain, evaluate, and communicate information on environmental conservation issues, then use this information to clean up a water source that has been polluted with various contaminants.

Scheduling

This unit is scheduled to be in the classroom for 7 weeks. There are approximately 14 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:

- Aquarium (optional) (L1)
- Bottled water (optional) (L1)
- Water bill (optional) (L1)
- Water filter (optional) (L1)
- Advertisements for clean water charities (optional) (L1)
- Pool water test kit (optional) (L1)
- Pond water sample (optional) (L1)
- Personal photo by the water (optional) (L1)
- Chart paper (L1, L3, L8, L9)
- Copy paper (small and large) (L2, L4, L8)
- Coloring tools (markers, crayons, and/or colored pencils) (L3, L4, L6, L8, L9)
- Scissors (class set) (L3)
- Local weather forecast (L5)
- Calculators (class set) (L5, L7)
- Computers (class set) (L5, L6, L8)
- Water (hot) (L6, L9)
- Ice cubes (L6)
- Construction paper (small and large) (L8)
- Leaves (L9)

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 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 **Got Water?** unit also includes Science Journal pages that are 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).

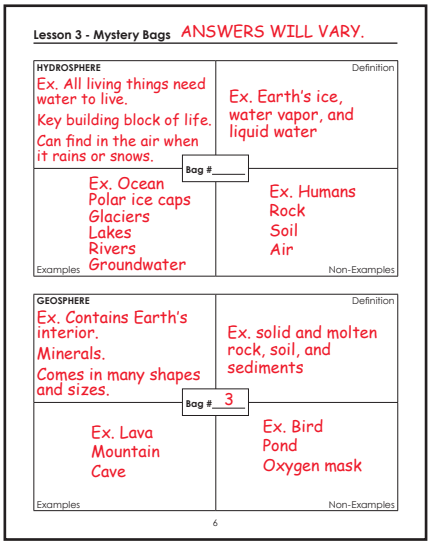
ELA/Math/Social Studies Connections:

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)** or the **Crosscutting Concepts (CCCs)**. In addition, small boxes in the margin of the Procedure pages (see box in the blue column to the right) serve as a visual reminder, as well.


Lesson 3 - Mystery Bags ANSWERS WILL VARY.

HYDROSPHERE — Definition

Ex. All living things need water to live.
Key building block of life.
Can find in the air when it rains or snows.

Ex. Earth's ice, water vapor, and liquid water

Bag #_____

Examples: Ex. Ocean, Polar ice caps, Glaciers, Lakes, Rivers, Groundwater

Non-Examples: Ex. Humans, Rock, Soil, Air

GEOSPHERE — Definition

Ex. Contains Earth's interior.
Minerals.
Comes in many shapes and sizes.

Ex. solid and molten rock, soil, and sediments

Bag # 3

Examples: Ex. Lava, Mountain, Cave

Non-Examples: Ex. Bird, Pond, Oxygen mask

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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

Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment. [Clarification Statement: Emphasis should be on how communities use information to sustain resources and the environment locally, regionally, nationally, and/or internationally.]

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.

- Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

ESS2.C: The Roles of Water in Earth's Surface Processes

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5ESS2-2)

Crosscutting Concepts

Scale, Proportion, and Quantity

- Standard units are used to measure and describe physical quantities such as weight, and volume. (5-ESS2-2)

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS21), (5-ESS3-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

- Science findings are limited to questions that can be answered with empirical evidence. (5ESS3-1)

New York State P-12 Science Learning Standards

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3– 5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS2.A** (5-ESS2-1); **2.ESS2.C** (5-ESS2-2); **3.ESS2.D** (5-ESS2-1); **4.ESS2.A** (5-ESS2-1); **MS.ESS2.A** (5-ESS2-1); **MS.ESS2.C** (5-ESS21),(5-ESS2-2); **MS.ESS2.D** (5-ESS2-1); **MS.ESS3.A** (5-ESS2-2),(5-ESS3-1); **MS.ESS3.C** (5-ESS3-1); **MS.ESS3.D** (5-ESS3-1)

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-ESS3-1)

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-ESS21),(5-ESS2-2),(5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2),(5-ESS3-1)

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

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. (5ESS2-1),(5-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

*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 4

System Centers

Focus Question:
How do Earth's 4 systems interact?

Lesson Synopsis

Learning Target(s):

I can develop a model to describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

I can identify and describe interactions within and between parts of the Earth's systems identified in the model.

I can use the model to describe a variety of ways in which the parts of two major Earth systems interact to affect the Earth's surface materials and processes.

Lesson Description:

In this lesson, students will develop a working model to describe the interactions between Earth's systems. In addition, students will be challenged to identify positive and negative impacts and develop solutions. Students will work either on their own or with a partner to visit centers, then create their own examples.

Management

Materials

For the class:

System center cards
Modeling slideshow (Teacher Resources online)
Ticket to Leave slide (Teacher Resources online)
Current event photo or video clip (ex. local weather report)*
Coloring tools (markers, crayons, and/or colored pencils)*
Magazines* (optional)
Scissors* (optional)

For each pair of students:

Glue stick

For each student:

Student Science Journal p. 8-10
11"x17" paper
Ticket to Leave (Teacher Resources online)
Copy paper*

*provided by teacher/student

Preparation:

1. Prepare a photo or video clip of a current event that shows 2 or more of Earth's systems interacting (ex. local weather report of a hurricane, snowstorm, tornado, volcanic eruption, etc.).
2. Obtain a class set of copy paper and coloring tools. You may also wish to have magazines and scissors available.
3. Set up system centers cards around your classroom.
4. Prepare the Ticket to Leave slide and print a class set of Tickets to Leave from the Teacher Resources online.
5. For more information on the science and engineering practice of developing and using models, view the Modeling slideshow in the Teacher Resources online.

Teacher Background:

Students identified the 4 systems of the Earth in the previous lesson, and here they are evaluating how the systems interact with one another. A current event, such as a local hurricane, snowstorm, tornado, or volcanic eruption, can illustrate this relationship. For example, as air in the atmosphere cools, moisture that has evaporated into it condenses and forms clouds. The snow that falls is part of the hydrosphere. It impacts the geosphere, making the ground slippery, creating potholes, etc. The biosphere is also affected by the snow – covering, freezing, and killing plants, for example, which in turn affects the animals that rely on these plants for food and shelter.

In the lesson that follows, students will investigate how interactions of Earth's systems impact weather and climate, so using a weather report as an example in this lesson will provide a good jumping off point for Lesson 5.

Students are challenged to create models showing the interaction of Earth's systems in this lesson. It is okay for students to grapple with this, especially if you have established a classroom environment where it is okay to take risks! Students should be encouraged to make their best guesses, and reassured that they will learn more and can then see how their understanding has grown. Scientific models are meant to illustrate how student thinking changes over time. The more students are asked to engage in the Science and Engineering Practice of Developing and Using Models, they will become equipped with more tools to do so, and their comfort level will grow. Some components that models may include are zoom out boxes, time sequences, arrows, labels, and definitions. A slideshow on Modeling has been included in the online Teacher's Resources for more information on this practice.

Standards

Performance Expectations:

5-ESS2-1 – Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.) [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

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

ESS2.A: Earth Materials and Systems

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

Crosscutting Concepts

Cause and Effect

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

Systems and System Models

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

ELA/Math/Social Studies Connections:

ELA: 5W1, 5SL1

SS: B3, F6

Misconceptions:

Students tend to want to compartmentalize Earth's systems, perhaps based on their experience in Lesson 3. Be sure they understand the definition of "interact": to affect one another.

Procedure

Phenomenon:

Current events show that Earth's systems **interact**.

CCC: Crosscutting Concept(s):

Cause and Effect:

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

Lesson 4 System Centers *cont.*

SEP: Science and Engineering Practice(s):

Obtaining, Evaluating, and Communicating Information:

Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

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.

CCC: Crosscutting Concept(s):

Systems and System Models:

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

1. Begin by showing a **photo** or **video clip** of a current event that involves Earth's systems **interacting** (**affecting** one another). A weather report would work well, showing a hurricane, snowstorm, tornado, volcanic eruption, etc. – the more local, the better! Ask students which of Earth's systems they observed **interacting** in the photo/video clip.
2. Provide each student with a piece of copy paper. Challenge them to create a **model** that not only shows each of Earth's 4 systems, but also how they **interact** with one another. Direct students that they should **combine** the systems into one scene in their **models**, rather than keeping them separate as in the prior lesson. (If necessary, first create an example **model** as a class of the current **event** you observed in Step 1.)
3. Allow students to "Window Shop," which means they may wander around to look at their **classmates' models** without touching them! Then, provide time for students to go back to their own **models** to make **additions** and/or **changes** based on what they observed. (Some students may feel more comfortable starting a new **model** from scratch. In order for the teacher to be able to use the **models** as a tool to evaluate how students' thinking changes over time, encourage students to keep working with their original **models**, or at least save them to refer back to.)
4. Set up various centers around your classroom, each with a photo that shows at least 2 or more of Earth's systems **interacting**. Provide students with the choice to travel to the centers individually or with a partner as they complete pages 8-10 of their Student Science Journals. In their Journals, students will need to explain how at least 2 systems are **interacting** at each center, then provide 1 possible positive **impact** and 1 possible negative **impact** of the **interaction**. Finally, students should suggest a solution to the negative **impact** that the **interaction** is **causing**. Students may wander amongst the centers at their own pace, with your direction to visit centers that are less crowded. (Alternatively, you could set a timer for rotation.) They may or may not visit all centers, and you may wish to require a minimum of centers that individual students must visit in the time allotted. (Again, you may wish to begin by doing an example together as a class based on the current event you have chosen.)

Lesson 4 - System Centers ANSWERS WILL VARY.

Center #	Explain how at least 2 systems are interacting	Describe 1 possible positive impact of the interaction	Describe 1 possible negative impact of the interaction	Suggest 1 solution to the negative impact of the interaction
Ex.	In the waterfall photo, water from the hydrosphere is interacting with rock from the geosphere.	It is beautiful -- could be a tourist attraction.	Rock could keep wearing away more and more, possibly leading to flooding.	May be necessary to dam or divert the water flow to prevent flooding.

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Lesson 4 - System Centers *(cont.)* ANSWERS WILL VARY.

Center #	Explain how at least 2 systems are interacting	Describe 1 possible positive impact of the interaction	Describe 1 possible negative impact of the interaction	Suggest 1 solution to the negative impact of the interaction

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Lesson 4 - System Centers *(cont.)* ANSWERS WILL VARY.

Center #	Explain how at least 2 systems are interacting	Describe 1 possible positive impact of the interaction	Describe 1 possible negative impact of the interaction	Suggest 1 solution to the negative impact of the interaction

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5. Provide 11"x17" paper and glue sticks in order for students to mount their **models** from the beginning of class on. Taking advantage of the added space provided, ask students to **revisit** their **models** to make **additions** and/or **changes** based on what they learned from visiting the centers during today's lesson.

Closing the Lesson

In order to check for understanding, challenge individuals to choose 2 numbers, 1 through 4. Then, reveal the following list using the Ticket to Leave slide in the online Teacher Resources:

1 = atmosphere 2 = biosphere 3 = geosphere 4 = hydrosphere

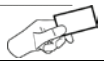
For their Ticket to Leave (print from Teacher Resources online), each student must come up with their own example of how their two chosen systems **interact**, again identifying a possible positive **impact**, negative **impact**, and solution.

You may also wish to ask students to draw a happy, neutral, or sad face on their Ticket to Leave to indicate their comfort level at this point in the unit. Use this feedback to follow up with individual students, perhaps using an Extension piece to supplement their learning if necessary.

Lesson 4 – System Centers **Name** _____

TICKET TO LEAVE

Choose TWO numbers (circle): 1 2 3 4



Your 2 systems	
Your own example of how they interact	
Describe at least 1 possible positive impact of their interaction	
Describe at least 1 possible negative impact of their interaction	
Suggest at least 1 solution to the negative impact of their interaction	

Don't forget to remind students that they can add and remove questions to and from Tweet Board 2 (from Lesson 1) throughout the unit.

Assessment

The models that students create in this lesson provide an opportunity to assess how student thinking changes over time. Not only should you focus on students' understanding of the DCI; this assessment piece also provides the opportunity to evaluate students' ability to develop and use models. The Ticket to Leave provides an opportunity for a quick spot check for understanding rather than (or in addition to) evaluating some students' work on the centers in their Journals. Again, this assessment piece allows you to go beyond evaluating students' understanding of Earth materials and systems – you may also assess their grasp of cause and effect relationships.

Connections

Differentiation: In order to provide hurdle help to students who are having trouble getting started with their models, it may be beneficial to have some magazines on hand from which students could cut out pictures of the environment. You may wish to differentiate the minimum number of centers each student must visit during this lesson. The centers can also be modified by allowing students to choose either a positive or a negative impact for each interaction, rather than both. In addition, you could also allow students to choose just one interaction to create a solution for after they have visited the centers.

Cross-Discipline Extensions:

Social Studies: This lesson provides an opportunity to focus on another area of the world you may be studying in your 5th grade curriculum. Rather than a local weather forecast, you could bring in a current or historic event from the area of the world you are studying. You could also challenge students to focus on this region when creating their models and/or completing their Ticket to Leave.

Next Lesson Preparation

1. Arrange for students to use computers and calculators during the lesson.
2. Make the Climate website link found in the Teacher Resources online available to students.
3. Find a local weather forecast to show the class (preferably a current video clip).
4. If you'd like, baggies of M&Ms or Skittles may be used in this lesson in place of the bags of beads provided in the kit.
5. Pull up the Climate and Weather video clip and the Averages slide from the online Teacher Resources.
6. Print a class set of Tickets to Leave from the Teacher Resources online, or post for discussion.