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Matter and Energy in Ecosystems: A Unit Plan for 5th Grade Based on NGSS

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Lesson 1 - Asking Questions

Performance Expectations

5-LS2-d. Ask questions about what organisms obtain from the environment and what they release back as waste matter into the environment.

Objectives

1. Ask questions about what organisms obtain in terms of *matter* from their environment.
2. Ask questions about what organisms obtain in terms of *energy* from their environment.
3. Ask questions about what organisms release as waste matter into their environment.

Background Information

Because this is more of a diagnostic lesson, there really isn't all that much background information that needs to be covered, so that it can be transferred to the students. With that being said, the teacher's primary goal of this lesson is to get the students to begin asking themselves where energy or matter that they see being used around them all the time comes from or goes to. The teacher is in position to be the facilitator for the students to begin asking these questions.

Though there isn't much background information to cover for the students' sake, the teacher should be aware of these basic concepts so that he or she can diagnose how much the students have remembered from studying ecosystems, matter and energy in the past.

- Matter - anything that has mass and takes up space
    - plants obtain air, water, and minerals from their environment. The carbon (air) that they obtain, is the primary building block for plant matter.
    - When animals eat the plants they break down the plant matter into smaller pieces, so that they can use them to add to their structure.
    - Plants and animals need to consume matter so that they are able to repair old body structures.
    - The matter that does not get used, that is obtained by plants and animals is excreted back into the environment as waste.

- Energy - the ability to do work; usually involves moving matter
    - Plants obtain their energy from the sun, and convert it into chemical energy that they either store for later, or use to move matter.
    - Animals obtain energy when they consume plants or another animal that has consumed a plant.

Having a good understanding of these points will also make it easier for the teacher to ask good probing questions to the class to incite wonder and curiosity in the students' minds as well.

Materials and Setup

The only materials needed for this lesson are student's individual science notebooks, and a writing utensil.

Procedure

Engage

Show the class a photo of my favorite animal, a killer whale, and then ask the class where they think it gets its energy from.

Explore

Have the class write in their science notebooks everything they know about the answer to the question. Then have them discuss their understandings in their science groups (people sitting near them). The groups should be no larger than 4 students each.

After the groups have had time to discuss, the students will be directed to go back to their notebooks for a little bit and write down everything they still want to know, or think would help them understand the answer to the question.

Explain

After they have spent time writing what they want to learn in their notebooks. have the students get back into their groups and discuss the things they still want to learn.

Following that discussion, have the class come together to share all of their theories that they came up with either individually or in their group discussions. This activity will serve a couple of purposes in that it will continue to keep the students thinking about where animals get their energy, as well as help the teacher assess how much understanding the students already have on the topic of energy flow through ecosystems.

Elaborate

Now, assign half the class to do repeat the same process in order to answer this question: Where does the killer whale get the matter it needs in order to grow and maintain it's body mass? To the rest of the class ask: What do you think happens to all the mass that the killer whale doesn't use to grow or maintain it's body?

Both groups should now repeat the same process as above for their respective question, but this time when it comes to be time for the class discussion, include both groups in on the discussion, so that the whole class is exposed at least in some way to the other question.

Evaluate

As mentioned above, the teacher should be evaluating in a few different ways for this lesson. First of all, they should be looking to see if the students achieve the objectives for this lesson. More details on what to look for, can be seen in the chart below.

Secondly, teachers should be assessing where the students are at in terms of understanding the concepts of energy and matter conservation within systems.

Assessment Plan

Learning Objective	Instructional Activity	Assessment
Ask questions about what organisms obtain in terms of *matter* from their environment.	Elaborate portion of the lesson that follows the same procedure as the explore and explain parts.	Formative. Students will have achieved this objective if they participate in the activity by writing their thoughts in their science journals, and by contributing to the class discussion.
2. Ask questions about what organisms obtain in terms of *energy* from their environment.	Explore and explain portions of the lesson.	Formative. Students will have achieved this objective if they participate in the activity by writing their thoughts in their science journals, and by contributing to the class discussion.
Ask questions about what organisms release as waste matter into their environment.	Elaborate portion of the lesson that follows the same procedure as the explore and explain parts.	Formative. Students will have achieved this objective if they participate in the activity by writing their thoughts in their science journals, and by contributing to the class discussion.

Sources

http://www.eia.gov/kids/energy.cfm?page=kids_glossary#E.

Next Generation Science Standards (January 2013) Draft

Brooker, R. J., Widmaier, E. P., Graham, L. E., & Stiling, P. D. (2011). *Biology* (2nd ed., pp. 1244-1248). New York, NY: McGraw-Hill.

Lesson 2 - Conservation of Energy

Performance Expectations

5-LS2-d. Ask questions about what organisms obtain from the environment and what they release back as waste matter into the environment.

5-PS3-a. Use models to describe that energy animals use to maintain body warmth, body repair, and for motion was once energy from the sun.

Objectives

4. Describe what organisms obtain from their environment in terms of energy.
5. Describe the flow of energy throughout an ecosystem.
6. Explain the law of conservation of energy and how it relates to energy flow within an ecosystem.

Background Information

This lesson covers quite a lot of scientific content. Students will need to know about the Gulf of Mexico ecosystem that will the the context for the game in the Explore section of the lesson. Included with that would be, the names of all of the producers in that ecosystem (phytoplankton, brown algae). They will also need to have a good grasp on the the terms producer, consumer, and decomposer. This information they will already have had experience with from studying ecosystems in previous grades. More specific background information is included in the instructions for the activity as provided by Rice University's Professional Development Program website is in an attached document below.

Teachers should also be aware of the topic of energy transformation. This lesson deals primarily with energy being transferred from light to chemical energy, and chemical energy to heat or movement. Students may need a refresher on this subject, but should have heard it before in fourth grade (NGSS, 2013 Draft). In case students ask, teachers should be aware that there are many different ways energy can be transferred other than what will be discussed in this lesson.

The next major concept that will be covered in this lesson is the Law of Conservation of Energy that states that within a closed system - which in our case is an ecosystem - energy cannot be created or destroyed. Instead it is transferred into different forms. In an ecological sense, the energy that we will be dealing with in this lesson comes from the sun, and is transferred into chemical energy that animals can use. When this chemical energy is

used to move matter either within the plant, or an animal further down the food chain, a large portion (90%) of it ends up as heat, which is released back into the environment. When this energy is transferred into heat, it becomes unusable in the sense that chemical energy is usable to plants and animals. Thus, we see many more organisms that are lower on the food chain than those higher, because those higher on the food chain need to consume more in order to receive the same amount of energy that a first level consumer gets by just eating plants.

Materials and Setup

- Engage
    - Science notebook for each student
    - Writing utensil for each student
    - Gulf Coast Restaurant menu for each student
- Explore - details on games setup are included in the Activity document below.
    - hula hoop
    - playing chips - 10 per student
    - large playing area
    - food web cards
- Explain
    - Science notebook for each student to record notes
    - Projector screen to show diagrams and key concepts
- Elaborate
    - One quiz for each student
- Evaluate
    - Same quiz with first round of corrections

Procedure

Procedural Note: The engage and explore portions of this lessons were taken from Rice University's Professional Development Program website. See Sources section for link.

Engage

Give each student in the class a copy of the menu (see below for menu) from the restaurant near the coast of the Gulf of Mexico. Ask the class to pick something off the menu that they "want to eat" for lunch. Be quick to remind them that there is no right or wrong answer, so they can pick whatever they want.

After everybody has picked something, ask them to draw a food chain in their science notebooks that explains where the energy comes from that they will soon be

consuming. I know the students won't have any background information in this, and this will probably upset some of them. In that case, ensure them that this exercise is not for a grade. In fact, this exercise is designed to get them thinking about energy flow between organisms. This way their schemas will be activated, so that they will be more excited to learn the content that will follow this exercise.

Explore

Play the Gulf of Mexico Food Web game with the students in the gym. The documents needed for this activity are below.

http://rescu.rice.edu/system/files/10127/original/5.9%20B%20Changing%20Webs%20Explore.pdf?1326732596

Explain

After playing the game, bring the students back into the classroom and explain to them these concepts:

1. Teach them that energy at any level of the food chain was once energy from the sun that plants converted into chemical energy that they can store easily.
2. When animals consume this chemical energy they break it down into useable packages, that can either be stored or used to move matter.
3. When energy is used to move an object, some of it transferred into heat, while the rest becomes energy of movement.
4. Make sure that you stress more than one time during this lesson that energy cannot be created or destroyed, but rather it is transformed into other forms of energy.
5. Due to this transformation of energy, most (90%) of the energy consumed by an animal is not available to other animals that might consume it further down the food chain.
6. Where does the energy go? Much of it is used to keep the animal warm, if it is warm-blooded, while the rest of it gets transferred into heat that is released back into the environment.
7. Nature's way of transferring energy is not geared for recycling heat energy, so when heat is released to the environment, it is considered not usable energy, but is still energy.
8. This is why there are many more producers and first level consumers in an ecosystem than top level predators.

Elaborate

Have the students take the end of lesson quiz. After they have taken it, collect them, and grade them without giving students the correct answers. Then pass them back out with grades on them, giving the students the chance to improve their score by correcting what they got wrong the first time they took the quiz.

Evaluate

After the students have been able to make their quiz corrections, go over all the answers as a class, and have them turn it in again for a final grade. This will be the summative grade for this lesson, and it will serve to help the students when they begin working on their final project.

Assessment Plan

Learning Objective	Instructional Activity	Assessment
4. Describe what organisms obtain from their environment in terms of energy.	Elaborate section. Use information learned during explain section to take and do corrections on quiz.	Formative. End of lesson quiz.
4. Describe what organisms obtain from their environment in terms of energy.	Evaluate section. Turn quiz in for final grade.	Summative. End of lesson quiz corrections.
5. Describe the flow of energy throughout an ecosystem.	Game played during Explore section.	Formative. Gulf of Mexico food web game worksheet.
6. Explain the law of conservation of energy and how it relates to energy flow within an ecosystem.	Elaborate section. Use information learned during explain section to take and do corrections on quiz.	Formative. End of lesson quiz.
6. Explain the law of conservation of energy and how it relates to energy flow within an ecosystem.	Evaluate section. Turn quiz in for final grade.	Summative. End of lesson quiz corrections.

Gulf Coast Café

Appetizers

OYSTERS ON THE HALF SHELL ½ dz. 7.25 dz. 10.50

BAKED OYSTERS 16.95
Six oysters baked in butter to perfection.

CRAB CAKES 11.95
Two patties of blue crab meat. Served with sweet corn.

PEEL & EAT SHRIMP ½ dz. 6.25 dz. 9.95

BBQ SHRIMP 11.95
Peel and eat gulf shrimp sautéed in BBQ sauce.

CAMPECHANA 11.95
A Mexican style dish filled with shrimp. Served with tortilla chips.

Soup

OYSTER STEW cup 6.95 bowl 10.50
Oyster broth, heavy cream, celery and spices.

ALGAE STEW cup 6.95 bowl 10.50
A creamy soup with brown algae and sweet red peppers.

CORN & CRAB BISQUE cup 6.95 bowl 10.95
Sweet corn and jumbo crab meat in a creamy soup.

SEAFOOD GUMBO cup 6.95 bowl 10.50
A rich soup filled with shrimp, crab and oysters. Served with a side of white rice.

TEXAS CHOWDER cup 6.95 bowl 10.50
A hearty, creamy soup filled with gulf clams.

Gulf Coast Classics

Served with salad, rice and beans.

JUMBO CRAB CAKES 25.95
Jumbo crab meat and sautéed in garlic butter.

STUFFED SHRIMP 18.95
Large gulf shrimp stuffed with crab meat and fried.

SHRIMP DIABLO 18.95
Large gulf shrimp smothered in a spicy tomato sauce.

SAUTEED ALGAE 18.95
Brown algae sautéed in olive oil with zucchini, squash and red peppers.

Explore

60 mins.

Materials

For the Class
- hula hoop
- playing chips (about 10 per student)
- large playing area

For Each Student
- Food Web Card

To Do: You may wish to attach string to make necklaces of the cards.

FYI. To simplify the game, eliminate the algae and red snapper. Phytoplankton and zooplankton are "floaters."

Set a playing boundary. Make sure students are tagging safely.

Given a variety of organisms and playing chips, students will demonstrate the flow of energy through the Gulf of Mexico marine food web.

1. Tell students that they will play a tagging game to show the ***energy flow*** in the Gulf of Mexico. Each student will get a card with the role of a ***population*** of organisms in the ***community***. Organisms can move around quickly except phytoplankton and zooplankton. They are "floaters" carried by the currents.

2. The organism's energy source can be found on the card. The energy will be represented by playing chips. To get energy, a student must tag another student who is an energy source. When tagged, that student gives up **ONE** energy chip. Students cannot be tagged twice in a row. The object of the game is to continue the flow of energy as long as possible. When an organism has lost all energy chips, they are done with the game.

3. At least half of the students should be phytoplankton and zooplankton. You may wish to color code the cards to indicate the role of the organism. A green dot on the card could indicate a producer, for example.

4. Take students to their playing area. Lay down the hula hoop and say that it is the Sun. Drop the playing chips in the hoop. Tell the students that they will enter the playing area according to the ***niche*** their organism plays in the community. Explain that each niche will get a 30 second head start. ***Producers*** will collect energy first. Then ***consumers*** and ***decomposers*** enter.

5. Place a cone with the **detritus** card taped to it on the field or tape it to a table if playing indoors. Explain that sometimes organisms die of old age, disease, or natural disaster. Explain that the teacher may point to students and say, "You died of old age," for example. Students then become dead organic material--detritus. They go to the detritus area. Even though they have died, they still have stored energy. Only bacteria, shrimp, and crabs may collect one chip from them at that point. When the detritus runs out of chips, they are finished with the game.

6. Play a round (you decide how long). For the next round, announce that the Gulf of Mexico is getting warmer, and this will decrease the number of phytoplankton by half. (Those students may play other roles). You may announce a hurricane has wrecked the shrimping boats in Galveston, so the humans are taken out that round. You may also announce that warmer temperatures have led to bacteria breeding at twice their normal rate. What are the effects of these events on the rest of the community?

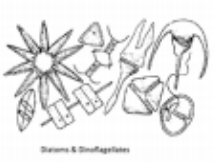
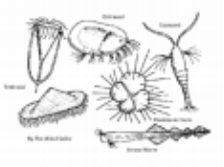
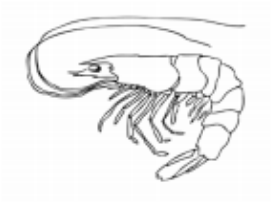
Producers	Consumers
Phytoplankton	Zooplankton
Brown algae	Eastern Oyster
	Shrimp
Decomposers	Stone crab
Bacteria	Red snapper
Shrimp	Human
Stone crab	

7. After the game is played for several rounds, use the student's organism cards to construct a large food web.

Vocabulary

food chain
food web
energy flow
population
community
niche
predator
prey
consumer
producer
competition
interdependency

Gulf of Mexico Food Web Game

Phytoplankton  Length: .1 mm Energy Source: The Sun (for photosynthesis)	**Zooplankton**  Length: 1 cm Energy Source: phytoplankton and bacteria
White Shrimp  Length: 20 cm Energy Source: zooplankton and detritus	**Detritus**  Detritus is non-living organic material

Gulf of Mexico Food Web Game

Stone Crab  Width: 15 cm Length: 10 cm Energy Source: oysters, shrimp, algae, detritus	**Eastern Oyster**  Length: 15 cm-30 cm long Energy Source: phytoplankton, zooplankton, algae
Humans  Energy Source: oysters, shrimp, crabs, red snapper, algae	**Bacteria**  Length: .5-5 micrometers Energy Source: detritus and all other organisms

Gulf of Mexico Food Web Game

Red Snapper	Brown Algae
	
Length: 24-36 cm	Length: 30cm-10m
Energy Source: crab and shrimp	Energy Source: The Sun (for photosynthesis)

Gulf of Mexico Food Web Game Student Guide

You are an organism living in the Gulf of Mexico. You will try to get energy in order to survive. If you are a producer, then you will get energy from the sun. If you are a consumer, then you will get your energy from other consumers.

1. Receive a role card from your teacher. Look on the card to see where you get your energy.

2. Your teacher will show you to a playing area. There will be a hula hoop laid out with playing chips in it. The hula hoop represents the sun. The playing chips represent energy.

3. Your teacher will send producers into the playing area first. The producers will collect as many playing chips as they can from the sun in 30 seconds.

4. Next, the teacher will send in the consumers and the decomposers. A consumer must catch and tag a producer in order to get energy. If a consumer is tagged, the producer must give up one playing chip to the consumer.

5. Decomposers must catch and tag a consumer in order to get energy. If a consumer is tagged, a playing chip must be given up.

6. There will be a separate area labeled "detritus". Detritus is the decaying matter of once living organisms. An organism may die of old age, disease, or environmental factors. If your teacher says you are detritus, take your chips to the detritus area. There, shrimp, crabs, or bacteria may collect a chip from you until you are out of chips.

7. On your student journal record your role, niche, and draw a sketch of your organism. Describe where you got your energy from and where your energy went.

8. The teacher may signal a new round. In this new round, roles may change. Pay attention to how the new roles change the game.

Gulf of Mexico Food Web Game Student Journal

My organism _____ My niche_____

My sketch

Energy collected from:

1.

2.

3.

4.

5.

Energy given to:

1.

2.

3.

4.

5.

During this round, did something in the environment change? How did this affect the food web?

How could climate change affect the food web in the future?

Gulf of Mexico Food Web Game Student Journal

My organism _____ My niche_____

My sketch

Energy collected from:

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Energy given to:

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2.

3.

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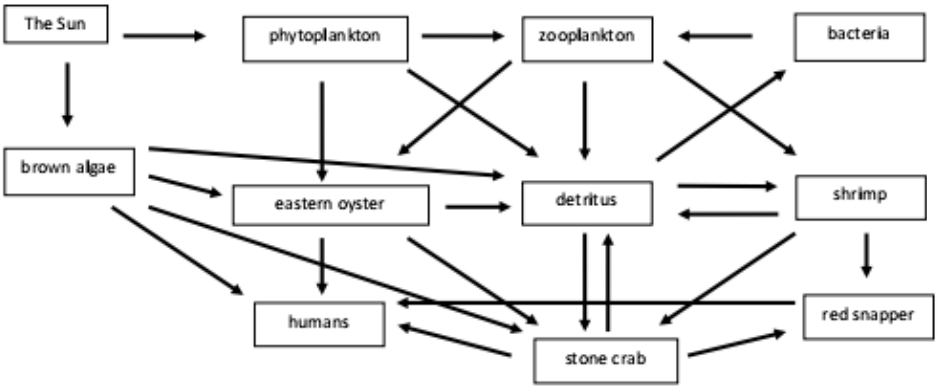
During this round, did something in the environment change? How did this affect the food web?

How could climate change affect the food web in the future?

Gulf Of Mexico Food Web



Discussion Questions:

- During the food web game, what was the effect of decreasing phytoplankton? How else might climate change the food web? (Decreasing phytoplankton means less energy for all other populations in the web. Climate change might also cause phytoplankton blooms, which are short bursts of phytoplankton that create oxygen-starved areas as they decompose.)
- Which predators were in competition for prey? How could a predator adapt its behavior to survive? (Humans tend to compete for prey against crabs and red snappers. A predator such as a red snapper could eat another prey organism.)
- If shrimp populations decreased, what would be the effect on humans? What are some other ways that humans depend on the food web of the Gulf of Mexico? (Humans rely on shrimp and seafood for nourishment and for economic reasons. The shrimping industry employs shrimpers, and restaurants employ people who rely on fresh seafood being served.)
- Since humans are so interdependent on this food web, how could people protect the health of the Gulf food web?

Discussion Questions:

• During the food web game, what was the effect of decreasing phytoplankton? How else might climate change the food web? (Decreasing phytoplankton means less energy for all other populations in the web. Climate change might also cause phytoplankton blooms, which are short bursts of phytoplankton that create oxygen-starved areas as they decompose.)

• Which predators were in competition for prey? How could a predator adapt its behavior to survive? (Humans tend to compete for prey against crabs and red snappers. A predator such as a red snapper could eat another prey organism.)

• If shrimp populations decreased, what would be the effect on humans? What are some other ways that humans depend on the food web of the Gulf of Mexico? (Humans rely on shrimp and seafood for nourishment and for economic reasons. The shrimping industry employs shrimpers, and restaurants employ people who rely on fresh seafood being served.)

• Since humans are so interdependent on this food web, how could people protect the health of the Gulf food web?

Name:_____

Energy Quiz

Directions: Use the space on the rest of this page to answer the following questions as completely as you can. Feel free to draw pictures, as well as write out your answer.

Question: A giraffe eats leaves from a tree. What is it gaining in terms of energy by doing this? Where does the tree get the energy to grow and produce leaves and fruit? Where does the energy go after the giraffe eats it?

Name:_____

Energy Quiz KEY

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Question: A giraffe eats leaves from a tree. What is it gaining in terms of energy by doing this? Where does the tree get the energy to grow and produce leaves and fruit? Where does the energy go after the giraffe eats it?

Rubric

	Satisfactory	Fair	Needs Improvement
Question 1: *What is it gaining in terms of energy by doing this?* 4 points possible	Answer includes: The giraffe gains the chemical energy stored in the leaves, that it can now use to move and maintain its body heat.	Includes only one of the two answers listed in the satisfactory section.	Doesn't include any of the answers listed in the satisfactory section.
Question 2: *Where does the tree get the energy to grow and produce leaves and fruit?* 4 points possible	Answer includes: Trees get energy from the sun, and converts it into usable chemical energy.	Includes only one of the two answers listed in the satisfactory section.	Doesn't include any of the answers listed in the satisfactory section.
Question 3: *Where does the energy go after the giraffe eats it?* 8 points possible	Answer includes: Some energy is used to move, repair body, and stay warm. The rest of the energy is released back to the environment as heat.	Includes information about giraffe using energy to move, but disregards energy released as heat to the environment.	Doesn't include any of the answers listed in the satisfactory section.
SCORE			/16

Sources

Next Generation Science Standards (January 2013) Draft

http://rescu.rice.edu/system/files/10127/original/5.9%20B%20Changing%20Webs%20Explore.pdf?1326732596

Brooker, R. J., Widmaier, E. P., Graham, L. E., & Stiling, P. D. (2011). Biology (2nd ed., pp. 1244-1248). New York, NY: McGraw-Hill.

Lesson 3 - Conservation of Mass

Performance Expectations

5-LS2-a. Construct and use models of food webs to describe the transfer of matter among plants, animals, decomposers and the environment, and discuss the limitations of these models.

Objectives

7. Describe what organisms obtain from their environment in terms of matter.
8. Describe what organisms release back as waste matter to the environment.
9. Explain the law of conservation of matter and how it relates to the flow of matter within an ecosystem.

Background Information

Similarly to the previous lesson, this lesson is pretty heavy on the scientific content. The main point here the Law of Conservation of Energy, which states that in a closed system, matter cannot be created or destroyed.

The baking soda and vinegar demonstration is used to illustrate this point for the students. Because the balloon covers the opening of the pop bottle, none of the gas is allowed to escape, resulting in the mass being the same before the reaction and after the reaction.

This concept applies to ecosystems, in the sense that matter that begins as carbon in the air, gets transformed and added to many times, as it is taken in by plants, used structural material for the plant, then consumed by an animal and used in different ways then. That matter will eventually find itself being broken down by decomposers, only to have the cycle begin again.

Students will also be asked to understand that matter that is not incorporated into the body structure of the organism is eventually released as waste back into the ecosystem. This occurs in plants primarily as plants release oxygen back to the environment through small pores on the bottom of their leaves. In animals, this occurs as they release both solid and liquid waste.

Materials and Setup

- Engage
    - Old disassembled phone
    - Photo of same phone before it was disassembled
    - Scale
- Explore
    - For each group of 4 students.
        - Conservation of Matter Worksheet (One per student)
        - 1 clean plastic 2 liter pop bottle
        - Tablespoon of baking soda
        - Two tablespoons vinegar
        - Funnel
        - Scale
        - Balloon
- Explain
    - Science notebook for each student to record notes
    - Projector screen to show diagrams and key concepts
- Elaborate
    - End of lesson quiz
- Evaluate
    - Same quiz with first round of corrections made.

Procedure

Engage

In order to engage the students in this lesson, show the class a picture of an old phone and the mass of that old phone. Then reveal in front of the whole class that same old phone all disassembled. Ask the class to predict what the mass of the phone is now, and why? After they have had time to think about their answer, have them share their thoughts with the class. Hopefully there will be some students who think it will be more or less than the original mass, as well as some who believe it will be the same mass.

Now take out a scale and weigh the dismantled phone. The mass should be the same as it was before it was dismantled. Explain to the class that this happens because, matter cannot be created or destroyed, therefore the phone has the same mass regardless of its "state."

Explore

At this time, pass out the supplies listed in the materials section. These will be used for a demonstration of the Law of Conservation of Matter. Allow the students time to follow the instructions on the worksheet, and complete the exercise. When they are done, gather the class together, and discuss their results as a class. Be sure to encourage students to think about the reason why they got the results they got, if students' masses didn't come out like they were expected to.

Explain

After discussing this activity with the class explain to them the following concepts. Also, make sure to stress the connection between the conservation of matter in the previous demonstration and the conservation of matter in ecosystems.

1. Tell the students that matter flows throughout an ecosystem in a similar manner as energy.
2. Producers take in matter from the air (carbon), and water and minerals from the soil. They recombine this matter into its body structures, so that they can grow to maturity, and fix structures that have worn out.
3. Consumers, then come along and eat this matter. They break it down into smaller parts in order to build them back up into its own body structure for growth, and repair.
4. The matter that is not incorporated into the plant's or animal's structure, is released back into the environment as waste.
    a. In plants this takes the form of oxygen being released on the underside of the leaves. In animals this takes the form of solid and liquid fecal matter.

Elaborate

Have the students take an end of the lesson quiz. This will follow the same format as the quiz for the previous lesson, where it will be graded and returned, so that the students will have the opportunity to see where their understanding is lacking, and then correct it for a grade.

Evaluate

After the students have made their corrections, go over the correct answers with the class as a whole, so they will be able to once again hear what is important for them to learn. Then they will turn in their quizzes for a grade.

Assessment Plan

Learning Objective	Instructional Activity	Assessment
7. Describe what organisms obtain from their environment in terms of matter.	Elaborate section. Use information learned during explain section to take and do corrections on quiz.	Formative. End of lesson quiz.
7. Describe what organisms obtain from their environment in terms of matter.	Evaluate section. Turn quiz in for final grade.	Summative. End of lesson quiz corrections.
8. Describe what organisms release back as waste matter to the environment.	Elaborate section. Use information learned during explain section to take and do corrections on quiz.	Formative. End of lesson quiz.
8. Describe what organisms release back as waste matter to the environment.	Elaborate section. Use information learned during explain section to take and do corrections on quiz.	Summative. End of lesson quiz corrections.
9. Explain the law of conservation of matter and how it relates to the flow of matter within an ecosystem.	Demonstration during the explore part of the lesson.	Formative. Completed worksheet and participation during class discussion of activity.

Name:_____

Conservation of Matter Activity Worksheet

Directions:

1. Using the scale, find and record the mass of the pop bottle, baking soda, vinegar, and balloon.
    a. Record the mass here:_____
2. Now, using the funnel, pour the vinegar into the pop bottle.
3. Now very carefully and quickly, pour the baking soda into the pop bottle and put the balloon over the opening of the bottle. This needs to be done quickly or else the mass measurements we take later will be skewed.
4. Ok, now wait for about 2-3 minutes and record your observations.
    a. Record your observations here:

    _____

    _____

    _____
5. Predict what you think the mass of the pop bottle, baking soda, vinegar, and balloon will be after the experiment is done.
    a. Record your prediction here: _____
6. Why do you think this will be the mass you observe?
    a. Record your reasoning here:

    _____

    _____

    _____
7. Lastly, using the scale, find and record the mass of the pop bottle, baking soda, vinegar, and balloon. Make sure not to forget the container that were originally holding the vinegar and baking soda.
    a. Record the mass here: _____

Answer the following questions:

1. Was the mass the higher, lower, or the same, after the experiment compared your prediction? Why do you think this occurred?
    a. _____

    _____

    _____

2. The Law of Conservation of Mass states that mass cannot be created or destroyed. Therefore, if no mass was allowed to escape the system, we should see the before

and after masses be close to being exactly the same. Did you have these results? If so, explain why this occurred. If not, explain, why this didn't occur.

a _____
_____
_____

Name:_____

Matter Quiz

Directions: Use the space on the rest of this page to answer the following questions as completely as you can. Feel free to draw pictures, as well as write out your answer.

Question: A giraffe eats leaves from a tree. What is it gaining in terms of matter by doing this? Where does the tree get material to grow and produce leaves and fruit? Where does the matter go after the giraffe takes it in?

Name:_____

Matter Quiz KEY

Directions: Use the space on the rest of this page to answer the following questions as completely as you can. Feel free to draw pictures, as well as write out your answer.

Question: A giraffe eats leaves from a tree. What is it gaining in terms of matter by doing this? Where does the tree get the material to grow and produce leaves and fruit? Where does the matter go after the giraffe takes it in?

Rubric

	Satisfactory	Fair	Needs Improvement
Question 1: *What is it gaining in terms of matter by doing this?* 4 points possible	Answer includes: The giraffe is gaining material that can be used to grow its body, or repair its body.	Includes only one of the two answers listed in the satisfactory section.	Doesn't include any of the answers listed in the satisfactory section.
Question 2: *Where does the tree get the material to grow and produce leaves and fruit?* 4 points possible	Answer includes: The tree gets the material from the air, and soil.	Includes only one of the two answers listed in the satisfactory section.	Doesn't include any of the answers listed in the satisfactory section.
Question 3: *Where does the matter go after the giraffe takes it in?* 8 points possible	Answer includes: Some of the matter is used to help the animal grow, while some of it goes to repairing worn out parts of its body, and still more is released as waste back into the environment.	Includes information about giraffe using matter for body repair and growth, but disregards anything about waste matter that is released or vice versa.	Doesn't include any of the answers listed in the satisfactory section.
SCORE			/16

Sources

Changes in matter, not in weight; A lesson plan created by Kristin Reed. Aug. 8, 2002. Accessed online at: http://www.uen.org/Lessonplan/preview?LPid=631

Next Generation Science Standards (January 2013) Draft

Brooker, R. J., Widmaier, E. P., Graham, L. E., & Stiling, P. D. (2011). *Biology* (2nd ed., pp. 1244-1248). New York, NY: McGraw-Hill.

Lesson 4 - Procedure for Final Project

Performance Expectations

5-LS2-a. Construct and use models of food webs to describe the transfer of matter among plants, animals, decomposers and the environment, and discuss the limitations of these models.

5-LS2-d. Ask questions about what organisms obtain from the environment and what they release back as waste matter into the environment.

5-LS2-c. Use models to test the functioning of a designed process that mitigates a factor upsetting the stability of an ecosystem.

Objectives

10. Construct a model to describe that the energy animals use to maintain body warmth, body repair, and motion was once energy from the sun.
11. Construct a model that describes the transfer of matter among plants, animals, decomposers and the environment.
12. Use models to test the function of a designed process that mitigates a factor upsetting the stability of an ecosystem.

Procedure

Here is the time schedule for this project:

Day 1: Explain project, answer questions about project, and decide scenario.

Day 2 - Day 5: 30-45 minutes of class time to do research, and ask teacher questions.

Day 6 - Day 9: 30-45 minutes of class time to build models, and come to a conclusion.

Day 10: Presentation practice for 30-45 minutes

Day 11 - Day 12: Presentations and grading

Name:_____

Jr. DNR Project

Instructions

For this project you will be working in your science groups to study a scenario (you get to decide from the list below) where an ecosystem has been upset by something, and people are beginning to try to fix the problem. You and your group mates are the Department of Natural Resources officers assigned to determine if these people have designed a process that will eliminate the factor from upsetting the ecosystem. Then you will need to explain to the State Congressional Environmental Committee (the rest of the class), and the Governor (Mr. Hintz) why the designed process is or is not eliminating the ecosystem's upsetting factor.

Possible Scenarios

- Oil Spill in the Gulf of Mexico
- Fighting forest fires
- Flooding of any major U.S. River
- Combating invasive species
    - wild parsnip
    - asian carp
    - purple loosestrife
- Grand Valley rain water drainage plan
- Drought - unusual lack of rain on an ecosystem of your choice
- Diverting the Colorado River for drinking water and irrigation
- Removal of predator from an ecosystem
- Another of your choice that is approved by Mr. Hintz

Expectations for Congressional and Gubernatorial Presentation

- Understand the ecosystem's upsetting factor.
- Use models to explain what the upsetting factor is doing to upset the ecosystem.
- Understand the designed solution.
- Determine if the designed solution is or is not eliminating the effects of the upsetting factor in the ecosystem and explain why you came to that conclusion.

Things to think about:

- Designing some sort of food web or food chain model that tracks the energy and/or matter flow through the ecosystem you study will not only help you to determine the effectiveness of the designed process, but it will also be a great tool to use in your presentation.
- This project is designed for you to show me what you know from our Energy and Ecosystems Unit, so use what you learned to help you.
- As always, if you have any questions don't be afraid to ask me right away!

Background Information

This project does not cover any more scientific content other than what is specific to each group's' own research, but is heavy on modeling. Therefore, here is what the teacher should know about modeling, and how it relates to this project. Models are simply ways for people to represent or show what they are thinking. For example, a group of students can model a food chain by acting in front of the class. Another group of students can choose to model something by drawing it out on a piece of paper.

For this project the students will be asked to model energy and matter flow throughout an ecosystem in the style of a food chain or a food web. This model is also going to be the primary tool they will use to test to see if the designed process they studied is actually helping stabilize the ecosystem. By mapping out where the energy and matter is going, the students will be able to see how the upsetting factor is affecting the ecosystem as a whole. It will also show them whether or not the designed factor is going to actually eliminate the upsetting factor.

The models the students come up with will not only serve as a tool with which to make their own conclusions, but they will also help them to communicate their conclusion and reasoning to the class.

Name:_____

Peer Evaluation Form

Group Member's name:_____

Describe this member's effort level during the research phase of the project.

Describe this member's effort level during the model development phase of the project.

Describe this member's effort level in perparing and presenting the project.

Group Member's name:_____

Describe this member's effort level during the research phase of the project.

Describe this member's effort level during the model development phase of the project.

Describe this member's effort level in perparing and presenting the project.

Group Member's name:_____

Describe this member's effort level during the research phase of the project.

Describe this member's effort level during the model development phase of the project.

Describe this member's effort level in perparing and presenting the project.

Sources

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