Investigation 5: Finding the Energy
Content Enhancement 5.1: Where does food come from?

To support students as they: Discern critical information from text and/or class work; Understand information; Apply knowledge

Page 155, use with #7 in class or as homework

Materials:
- Copies of the content enhancement Student Sheet, *Where Does Food Come From?*, one per student.

Instructions to Teacher
1. Distribute copies of the content enhancement Student Sheet, *Where Does Food Come From?* for students to complete as they read *Where Does Food Come From?*.

2. Explain that this sheet will help students to focus on and record the main ideas in the reading as well as help them to make sense of what they have read.

3. Use whatever procedures you normally use to ensure that all students have completed the Student Sheet correctly. The *Sample Completed Sheet* is provided for your reference.

4. Tell students to keep the corrected sheet to use as a reference and as a study guide.

Name_____

Period_____ Date_____

WHERE DOES FOOD COME FROM?

Fill in the blank	Word bank
1. _____ is the source of two essential elements of life – _____ and chemical _____. Building blocks are _____ made out of atoms. They are the carbon based chemicals used to make body tissues. They come from the fats, proteins and carbohydrates in _____.	energy food building blocks matter food
2. Energy is _____. It is _____ of atoms. It is needed to _____ all the things that living organisms do – talk, digest food, think, grow.	not matter do not made
3. Plants (known as _____) get energy and building blocks through the process of _____. With the help of _____ from sunshine, they bond _____ together to make _____ molecules. Sugar molecules provide _____ and also the _____ to build plant _____.	photosynthesis energy tissues autotrophs carbon atoms building blocks sugar energy
4. _____ get the energy and building blocks they need by _____ other _____. The crust in your pizza contains a bit of _____ that wheat captured from the _____.	sun animals eating organisms energy

Making sense

1. Explain why plants never have to eat ham sandwiches.

_____

2. Explain how sugar molecules are created by plants.

_____

Fig. 4: Cloze Sheet 2

Name_____

Period_____ Date_____

WHERE DOES FOOD COME FROM?

Fill in the blank	Word bank
1. *Food* is the source of two essential elements of life – *energy* and chemical *building blocks*. Building blocks are *matter* made out of atoms. They are the carbon based chemicals used to make body tissues. They come from the fats, proteins and carbohydrates in *food*.	energy food building blocks matter food
2. Energy is *not matter*. It is *not made* of atoms. It is needed to *do* all the things that living organisms do – talk, digest food, think, grow.	not matter do not made
3. Plants (known as *autotrophs*) get energy and building blocks through the process of *photosynthesis*. With the help of *energy* from sunshine, they bond *carbon atoms* together to make *sugar* molecules. Sugar molecules provide *energy* and also the *building blocks* to build plant *tissues*.	photosynthesis energy tissues autotrophs carbon atoms building blocks sugar energy
4. *Animals* get the energy and building blocks they need by *eating* other *organisms*. The crust in your pizza contains a bit of *energy* that wheat captured from the *sun*.	sun animals eating organisms energy

Making sense

1. Explain why plants never have to eat ham sandwiches.

Plants do not have to eat ham sandwiches because they create their own "food."

2. Explain how sugar molecules are created by plants.

Plants use energy from sunshine during photosynthesis to link carbon atoms together to make sugar molecules.

Fig. 4: Cloze Sheet 3

Investigation 5: Finding the Energy
Content Enhancement 5.5: Levels of Biomass/Energy Diagram

To support students as they: Understand information; See relationships and connect ideas

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Materials:
- Copies of content enhancement Student Sheet, *Levels of Biomass/Energy Diagram*, one per student.
- Ribbon, one set per student.

Instructions to Teacher

1. Tell students, *"You saw a biomass energy pyramid in the Trophic Levels reading (page 19 in the Resources), and modeled energy transfer using beads. Today, we will use a different kind of diagram to model energy flow and understand what happens to the energy at different trophic levels."*

2. On the board, draw the first level of the biomass/energy diagram, and walk students though it as you draw (see Sample of Completed Diagram as a reference).

- Ask students, *"This block represents algae biomass; where does the biomass come from?"*
  Elicit from students that, through photosynthesis, plants captured the Sun's energy.

- Ask, *"How much of the energy made by photosynthesis creates algae biomass?"*
  Elicit from students that 10% of the sugars are used as building blocks to create algae biomass, and point to the Algae Biomass section of the diagram.

- Ask, *"What happens to the rest?"*
  Elicit from students that the rest of the energy is used by the algae to run the processes of life and then is lost to the environment as heat energy.

3. Distribute Student Sheet, *Levels of Biomass/Energy Diagram*, one per student, and ribbon.

4. Have students tape the ribbon to the first level diagram to represent the amount of algae biomass and the energy consumed by algae through their life activities.

5. Ask students to work with a partner to complete the diagram.

6. Use whatever procedures you normally use to ensure that all students have completed the diagram correctly. The sample completed sheet is provided for your reference.

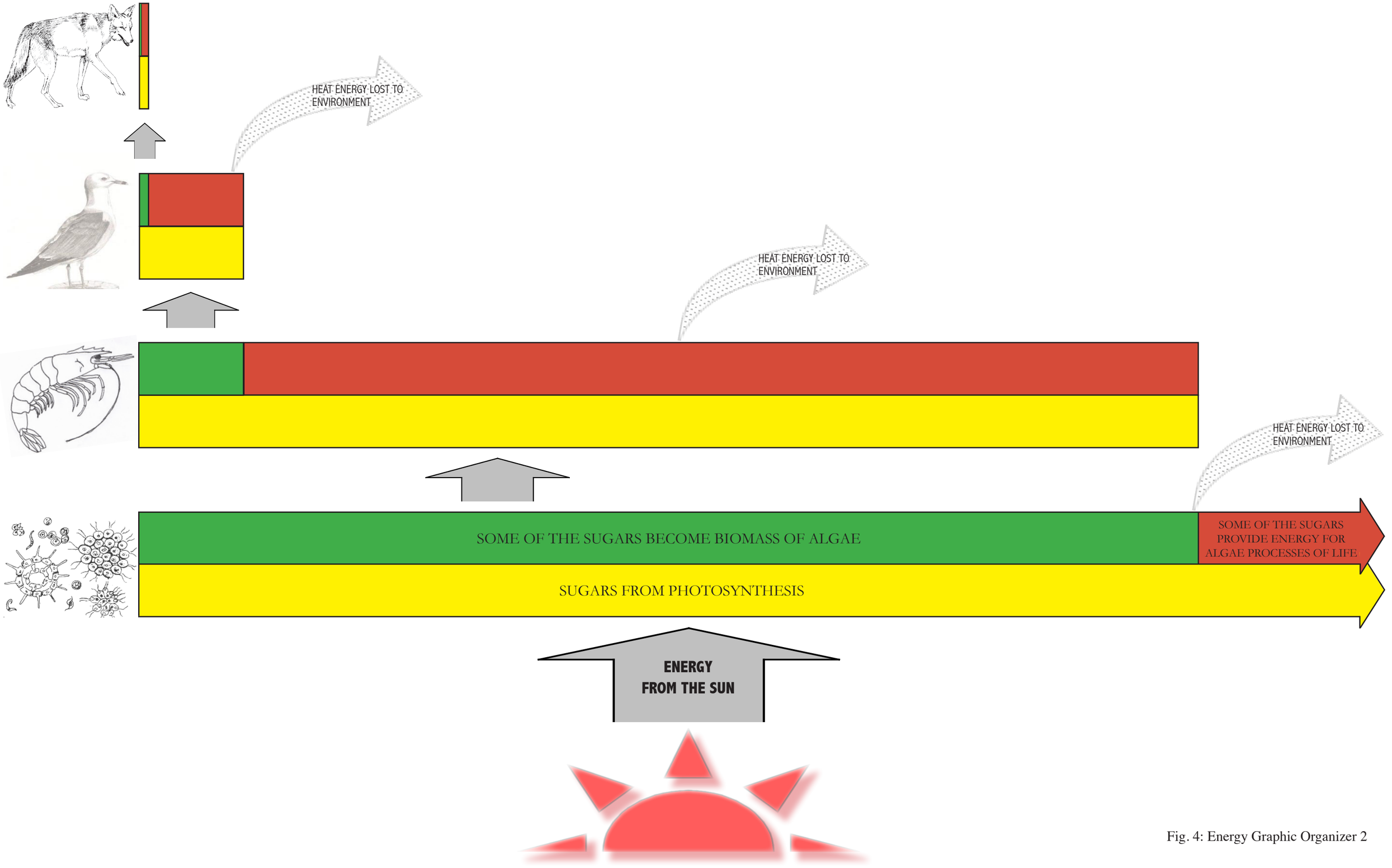
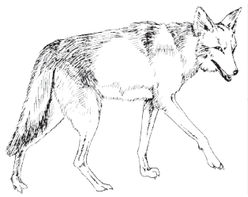


Fig. 4: Energy Graphic Organizer 2



HEAT ENERGY LOST TO ENVIRONMENT

BIOMASS

ENERGY FOR GULL PROCESSES OF LIFE

BIOMASS OF SHRIMP EATEN BY GULL

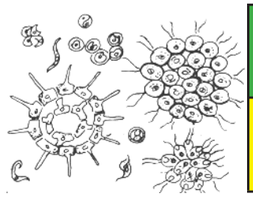
HEAT ENERGY LOST TO ENVIRONMENT

SOME OF THE FOOD BECOMES BRINE SHRIMP BIOMASS

SOME OF THE FOOD PROVIDES ENERGY FOR BRINE SHRIMP PROCESSES OF LIFE

BIOMASS OF ALGAE (FOOD) EATEN BY BRINE SHRIMP

HEAT ENERGY LOST TO ENVIRONMENT



SOME OF THE SUGARS BECOME BIOMASS OF ALGAE

SOME OF THE SUGARS PROVIDE ENERGY FOR ALGAE PROCESSES OF LIFE

SUGARS FROM PHOTOSYNTHESIS

ENERGY FROM THE SUN

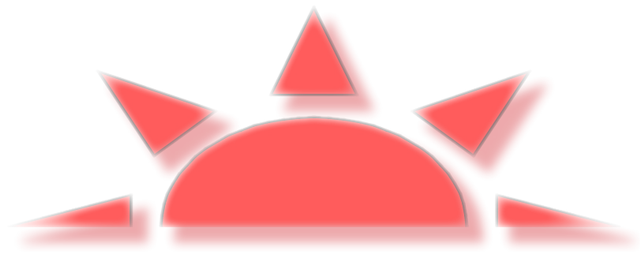


Fig. 4: Energy Graphic Organizer 3

Investigation 5: Finding the Energy
Content Enhancement 5.6: Tell the Energy Story

To support students as they: Organize information, Understand information; See relationships and connect ideas

Page 168, at the end of #16

Materials:
- The coyote bead model should be displayed in a prominent place in the classroom so students can easily refer to it.

- Students should have easy access to their completed content enhancement 5.5 *Levels of Biomass/Energy Diagram*.

- The following student materials, one per student:
  - Student Sheet, *Guidelines for Developing and Telling the Energy Story*
  - Student Sheet, *Tell the Energy Story* (with *Word Bank* section and *Starting Sentences* on it)

- Paper on which to write story, one (or more as needed) per group.

Instructions to Teacher
1. Explain to students that they will work in groups to write a science story that explains their coyote bead model.

2. Ask students to take out their completed *Levels of Biomass/Energy Diagram* while you distribute copies of the Student Sheets, *Guidelines for Developing and Telling the Energy Story* and *Tell the Energy Story*, one per student. Distribute paper for the entire group.

3. As a whole class, go over the guidelines emphasizing:
   - In a group of three, they will put into words what the coyote bead model shows us.
   - They will decide who will be Student 1, Student 2, and Student 3, and switch roles for telling different parts of the story.
   - The coyote bead model, their Biomass/Energy Diagrams, and a Word Bank will remind them of the important ideas that are part of the story.
   - They should start each part of the story with the sentence given.

4. After their group finishes a draft of the story, they should read the whole story together and ask themselves: Does it tell what happens to the energy represented in the coyote bead model and biomass/energy diagram? Were we able to use most of the words in the word bank? Are there any edits we wish to make?

5. Students can share what they wrote and edited with the rest of the class or with another group as time permits.

6. Wrap up by reviewing, as a class, the energy transfer represented in the coyote model. Use the information from the *Sample Completed Story* as a reference.

Guidelines for Developing and Telling the Energy Story

1. Work in a group of three and decide who will be student 1, student 2, and student 3.

2. Together your group will put into words what the coyote bead model shows us. Use the Levels of Biomass/ Energy Diagram and the word bank to help you.

- **Beginning of the Story**

  Student 1 (story teller): tell about the activities of the coyote and the movement of energy. Begin with the sentence: *Coyotes eat gulls and other birds*.

  Student 2 (helper): check off words used from the word bank and provide help to the story teller when asked.

  Student 3 (writer): write the opening sentence of the story: *Coyotes eat gulls and other birds*. Then write down the beginning of the story as student 1 tells it.

- **Middle of the Story**

  Student 2 (story teller): tell about the activities of the gull and the movement of energy. Begin with the sentence: *Gulls eat brine shrimps and brine flies*.

  Student 3 (helper): check off words used from the word bank and provide help to the story teller when asked.

  Student 1 (writer): write the first sentence of the next part of the story: *Gulls eat brine shrimps and brine flies*. Then write down the middle of the story as student 2 tells it.

- **End of the Story:**

  Student 3 (story teller): tell about the activities of the brine shrimp/brine fly and the movement of energy. Begin with the sentence: *Both the brine shrimp and the brine fly eat algae*.

  Student 1 (helper): check off words used from the word bank and provide help to the story teller when asked.

  Student 2 (writer): write the first sentence of the next part of the story: *Both the brine shrimp and the brine fly eat algae*. Then write down the end of the story as student 3 tells it.

3. Read your whole story together and ask yourselves: Does it tell what you know about energy flow? Were you able to use most of the words in the word bank? Make any edits you wish.

Name_____

Period_____ Date_____

TELL THE ENERGY STORY

Word bank

Energy
Biomass
Building blocks
Eat
Heat
Algae
Brine shrimp/brine fly
Gull
Coyote
10% rule
Producer
Consumer
Environment
Activities of Life
Sunlight
Lost
Photosynthesis

Starting sentence

Beginning: Coyotes eat gulls.

Middle: Gulls eat brine shrimp and brine flies.

End: Both the brine shrimp and the brine fly eat algae.

Name_____

Period_____ Date_____

TELL THE ENERGY STORY

Sample story for teacher reference

Beginning:

Coyotes eat gulls (and other birds). This food is the source of energy needed to maintain all the functions/processes/activities of life like moving, breathing, etc. These life processes/ activities produce heat energy which is lost to the environment. Coyotes also use some of the bird biomass as building blocks for their own biomass. Because of the loss of energy as heat, it takes about 10 kg of bird to build 1 kg of coyote biomass.

Middle:

Gulls eat brine shrimps and brine flies. This food is the source of energy needed to maintain all the functions/processes/activities of life like moving, breathing, etc. These activities produce heat energy which is lost to the environment. They also use some of the brine shrimp or brine fly biomass as building blocks to build their own biomass. Because of the loss of energy as heat, it takes about10 kg of brine shrimp/fly to build 1 kg of gull biomass.

End:

Both the brine shrimp and the brine fly eat algae. They obtain energy from this food to maintain all the functions of life like moving, breathing, etc. These activities produce heat energy which is lost to the environment. They also use some of the algae biomass as building blocks to build their own biomass. Because of the loss of energy as heat, it takes about 10 kg of algae to build 1 kg of shrimp or fly biomass.

Algae capture energy from the sun during photosynthesis. They obtain energy from the molecules they have made to maintain all the functions/processes/activities of life. These activities produce heat energy which is lost to the environment. They also use some of the molecules they have made as building blocks to build their own biomass. Because of the loss of energy as heat, it takes about 10 kg of sugars to build 1 kg of algae biomass.

Investigation 7: Ecoscenarios
Final Content Enhancement: Ecosystem Discussion

To support students as they: Evaluate information; Apply knowledge

Page 217, end of #17

This CE emphasizes an overarching learning goal of the Populations and Ecosystems unit:
All ecosystems have characteristics in common.

Materials:
- Copies of *Ecosystem Samples*, one per group.

Instructions to Teacher
1. Divide the class into 8 (or fewer) groups. Give each group a savanna **or** a tundra sample ***and*** a coral reef **or** sandy shore sample sheet.

2. Tell students that they will use these samples, as well as their experiences with Ecoscenarios and/or other ecosystems they've studied, to understand that all ecosystems have characteristics in common.

3. Have students discuss the following questions within their groups: (The sample completed sheet is provided for your reference.)

a) What organisms are the producers?

b) What organisms are the consumers?

c) Does the 10% rule seem to apply? Why or why not?

d) In general, how do you think the sizes of the populations differ at the different trophic levels of the ecosystems?

e) Do you think these pictures represent healthy ecosystems? Why or why not?

Note that students will not be able to see all the features in the photographs.

4. Have students share and compare their answers in a whole class discussion to reinforce that ecosystems share common characteristics.

ECOSYSTEM SAMPLES

Coral reef

Savanna

Sandy Shore

Tundra

Fig. 4: Transfer to New Ecosystems 2

ECOSYSTEM DISCUSSION

A. What organisms are the producers?

Coral reef: Seaweed (visible on rocks)
Savanna: Grass
Sandy shore: Algae
Tundra: Grass, moss

B. What organisms are the consumers?

Coral reef: Fish
Savanna: Zebra, hyena, lion, vulture
Sandy shore: Shorebirds
Tundra: Reindeer, eagle

C. Does the 10% rule seem to apply? Why or why not?

Yes in the savanna and tundra, not as obvious in the coral reef and the sandy shore.
There is far more biomass of primary producers (grass, moss) than consumers visible in the tundra picture. There is far more primary producer biomass visible in the savanna than primary consumer (zebra); although, there is more secondary consumer biomass visible (e.g., lion etc.). There appear to be a herd of primary consumers just visible on the horizon .
(In the other two ecosystems, although the 10% rule isn't visible, we see a large number of consumers suggesting there is an adequate biomass of producers.)

D. In general, how do you think the sizes of the populations differ at the different trophic levels of the ecosystems?

Populations of primary consumers are smaller than populations of producers, populations of secondary consumers are smaller than populations of primary consumers.

E. Do you think these pictures represent healthy ecosystems? Why or why not?

Yes, all four look like they are healthy ecosystems because producers and consumers are present, and at least in two of the four pictures they appear to exist in proportional numbers/biomass (to the 10% rule); abiotic factors appear "normal" (i.e., no disturbance present, clean water, etc.).