



Explore: Trophic Trek: Following Energy Through the Food Web

INSTRUCTOR:

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Objective:

In this activity, you will explore how energy flows through ecosystems. You will learn about trophic levels, calculate how energy moves from one organism to another, and understand why energy decreases as it moves up the food web. By the end of this activity, you will be able to explain energy transfer and describe the roles of different organisms in an ecosystem.



Background Information:

In an ecosystem, organisms interact with each other in many ways. Some organisms make their own food, while others rely on other living things for food. These interactions form a **food web**. A food web shows how energy flows from one organism to another. Organisms are organized into different **trophic levels**, which represent their role in the food web.

Producers are organisms that make their own food, usually through a process called **photosynthesis**. They are at the **base** of the food web. Examples include plants, algae, and some bacteria. **Consumers** are organisms that eat other organisms to get their energy. There are several types of consumers:

- **Primary consumers** eat producers. These are usually herbivores, like grasshoppers or deer.
- **Secondary consumers** eat primary consumers. These are typically carnivores, like frogs or snakes.
- **Tertiary consumers** are top predators that eat secondary consumers. These might be animals like hawks or sharks.

Energy flows through the food web in a **linear path**, starting with producers and moving through consumers. However, not all energy is passed on to the next level. Only about **10%** of the energy from

one trophic level is transferred to the next, and the rest is lost as heat or used for other life processes. This is why the energy available to each higher trophic level decreases.

Instructions:

1. Examine the Prepared Food Web Poster:

- The poster shows a food web with different organisms and their trophic levels already labeled. The background also shows a **trophic level pyramid**.

2. Draw Feeding Relationships:

- Use dry-erase markers to draw lines showing which organisms eat each other. For example, if a frog eats a grasshopper, draw a line from the grasshopper to the frog. Be sure to label the lines with the amount of energy transferred.

3. Calculate Energy Transfer:

- Follow the 10% rule of energy transfer. For each relationship, calculate how much energy is transferred. For example, if a grasshopper eats 1000 calories of grass, the frog will receive only 100 calories (10% of 1000). Fill out the energy calculation worksheet.

4. Plot the Energy Pyramid:

- Use the energy transfer calculations to draw the energy pyramid. Label each level with the energy available at each trophic level. Discuss why the pyramid narrows as you go higher in the food web.

5. Answer the Reflection Questions:

- After completing the food web and energy pyramid, reflect on what you've learned about how energy moves through ecosystems.
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Reflection Questions:

1. Why is so much energy lost as it moves up the food web?

Sentence Frame: *Energy is lost because...*

2. How does energy loss affect the number and size of organisms in an ecosystem?

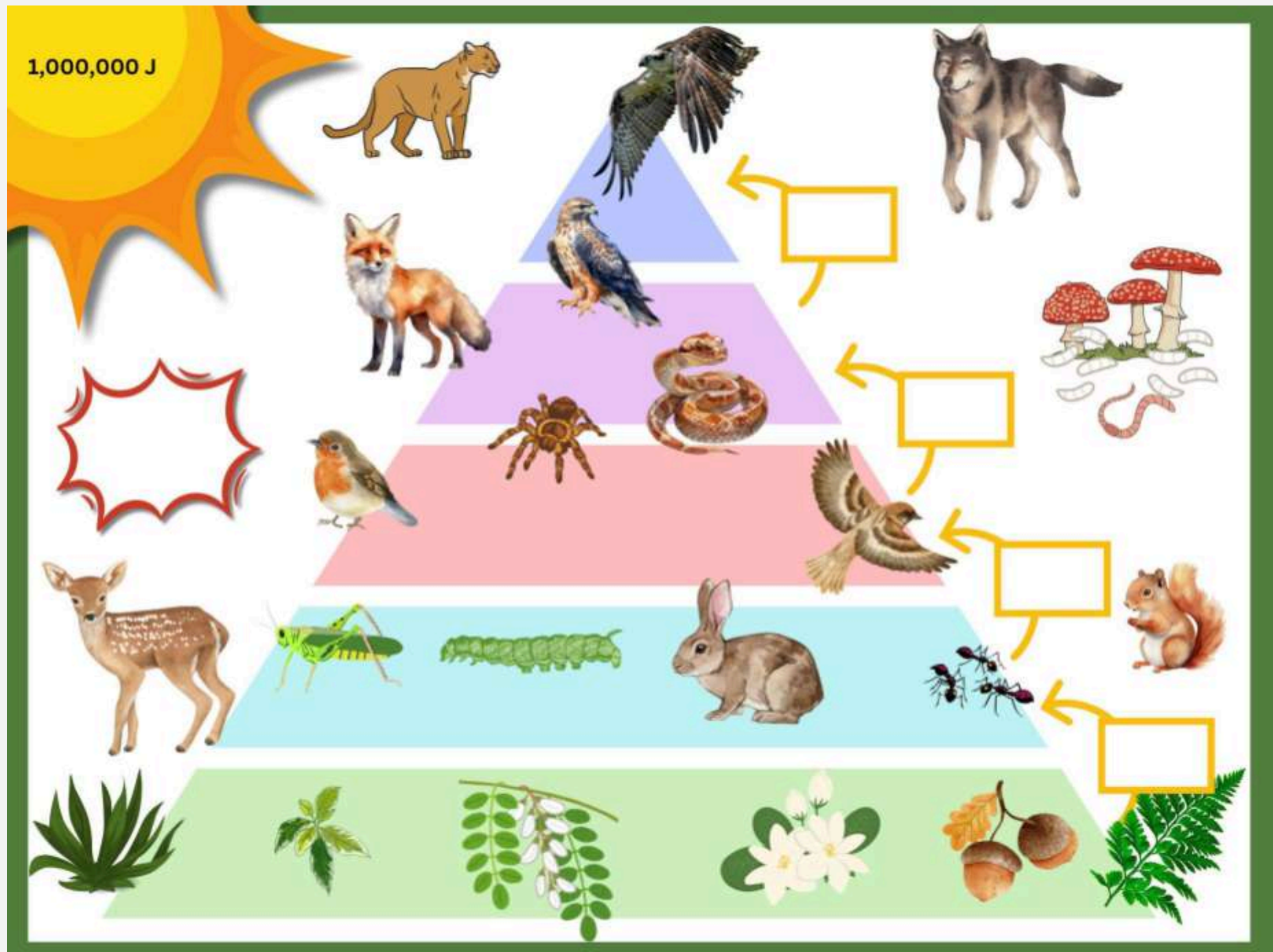
Sentence Frame: *As energy moves up the food web, the number and size of organisms...*

3. What happens if there are too many organisms at the higher trophic levels?

Sentence Frame: *If there are too many organisms at the higher trophic levels, then...*

4. Why are producers so important to an ecosystem?

Sentence Frame: *Producers are important because...*



Teacher Instructions: Following Energy Through the Food Web

Objective:

To guide students in understanding how energy flows through ecosystems via trophic levels, how energy is transferred between organisms, and why energy decreases as it moves up the food web.

Content Background:

Trophic Levels:

- **Producers:** Organisms that produce their own food, typically through photosynthesis. Examples include plants, algae, and some bacteria.
- **Primary Consumers:** Herbivores that eat producers (e.g., grasshoppers, rabbits).
- **Secondary Consumers:** Carnivores that eat primary consumers (e.g., frogs, small birds).
- **Tertiary Consumers:** Top predators that eat secondary consumers (e.g., hawks, sharks).
- **Decomposers:** organisms that break down decaying matter and recycle

Energy Flow: Energy in ecosystems flows from producers to consumers, with a loss of about 90% of energy at each trophic level due to metabolic processes like movement, growth, and heat production. Only about 10% of the energy from one level is passed on to the next. This is often called the "10% rule."

Energy Pyramid: An energy pyramid visually represents how energy decreases as it moves up trophic levels. The largest level (the base) represents producers, while the smallest level (the top) represents tertiary consumers. The width of each level in the pyramid reflects the amount of energy available.

Teacher Preparation:

1. Prepare the Food Web Poster:

- Create a large food web on poster paper. Include a variety of organisms from different trophic levels (plants, herbivores, carnivores, and predators).
- Label each organism with its respective trophic level (e.g., Producer, Primary Consumer, Secondary Consumer, Tertiary Consumer).

- In the background, include a Trophic Level Pyramid, showing the relative energy levels at each trophic level (Producers at the base with the most energy, Tertiary Consumers at the top with the least energy).

2. Organize Materials:

- Dry-erase markers
- Energy Calculation Worksheets (with space for students to track energy transferred at each trophic level)
- Student Reflection Worksheets

3. Familiarize Yourself with the "10% Rule": Ensure you understand the energy transfer principle so you can confidently help students with energy calculations.

Teacher Instructions:**1. Introduction (10–15 minutes):**

- Start with a brief review of energy flow in ecosystems and trophic levels.
- Use visuals and real-world examples (e.g., "A lion eats a zebra, but only a fraction of the zebra's energy is available to the lion. The rest is lost as heat or used by the zebra for its own life processes").
- Introduce the food web concept and explain how energy flows from producers to consumers.
- Highlight the 10% energy transfer rule: "Only about 10% of the energy from one level is passed to the next level. The rest is lost as heat, movement, and growth."

2. Activity Instructions (20–30 minutes):

- Present the prepared food web poster to the class. Explain that the trophic levels are already labeled, and the students' task is to trace the feeding relationships.
- Hand out dry-erase markers and Energy Calculation Worksheets.
- Walk the students through the first few connections, modeling how to draw arrows between organisms and label the energy transferred.
- For example, if grass (producer) is eaten by a grasshopper (primary consumer) that eats 1000 calories of grass, label the arrow with "1000 calories." Then explain that the grasshopper will only pass on 10% of that energy (100 calories) to the next level.
- Have students calculate energy transfer and loss for each relationship on their own.

3. Plotting the Energy Pyramid (15 minutes):

- Ask students to transfer their energy transfer calculations to an energy pyramid template.

- Explain that the size of each level on the pyramid should represent the energy available at that trophic level, with the producer level at the base being the widest, and the tertiary consumer level being the narrowest.

4. Reflection and Discussion (10 minutes):

- Have students complete the reflection questions, either in pairs or independently. Encourage them to use sentence frames to help structure their thinking (e.g., "Energy is lost because...").
 - After completing the reflection, have a class discussion using some of the guiding questions below.
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Guiding Questions to Prompt Student Thinking:

- Why do you think only 10% of energy is passed on to the next trophic level?
This question helps students think about the inefficiencies of energy transfer in ecosystems.
 - What might happen if there were too many animals at the higher trophic levels?
This question encourages students to consider population dynamics and the balance of an ecosystem.
 - How would the removal of a producer (like grass) affect the rest of the food web?
This helps students think about the importance of producers and the consequences of disrupting the base of the food chain.
 - What might happen to the size of the animal populations if energy transfer were more efficient?
This allows students to reflect on the real-world consequences of energy transfer and the structure of food webs.
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Helpful Hints to Ensure a Successful Activity:

- **Be Clear on the 10% Rule:** Ensure students understand the 10% rule before starting calculations. Emphasize that only 10% of the energy at one level is transferred to the next level, and 90% is lost as **HEAT**
- **Model Energy Transfer:** Start by modeling the first few organisms and energy transfers for students. You could use a simplified example like grass → grasshopper → frog.
- **Use Examples Students Can Relate To:** Incorporate real-world examples of food webs, such as a local forest or ocean ecosystem.

- **Encourage Group Work:** If students are stuck, let them discuss the relationships with a partner or in small groups. Collaborative learning can be helpful when tackling complex concepts.
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Differentiation Strategies:

1. For Struggling Learners:

- Provide sentence frames to help structure answers in the reflection questions (e.g., "The energy is lost because...").
- Pair struggling students with peers who can help explain the concepts.
- Offer simplified energy web templates with fewer organisms to reduce cognitive load.

2. For Advanced Learners:

- Challenge students to extend the food web by adding more organisms (e.g., decomposers, scavengers) and calculating the energy flow through those additional trophic levels.
- Ask students to explain the consequences of removing one organism from the food web on energy flow (e.g., how would the absence of a primary consumer affect the energy pyramid?).

3. For English Language Learners (ELLs):

- Provide a glossary of key terms, including trophic levels, producers, consumers, and energy transfer.
- Use visuals, diagrams, and color-coded trophic levels to reinforce vocabulary.
- Pair students with a peer who speaks the same language (if possible) or provide visual support through diagrams.

4. For Students with Special Needs:

- Offer additional time to complete the assignment.
 - Provide a step-by-step guide to help students understand each part of the activity.
 - Use visual aids such as photos of real animals at different trophic levels (e.g., a photo of a rabbit, a hawk) to make abstract concepts more concrete.
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Closing:

After completing the activity, have a final discussion about the energy flow in ecosystems. Emphasize how each level depends on the energy from the level below it, and how the energy pyramid helps us understand the limitations of energy in supporting various populations in an ecosystem.