

Carbon's Round Trip

Build models that distinguish cycling matter from flowing energy.

MS-LS2-3 "Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various..."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Read the model-building notes. Underline transfers of carbon and circle transfers of energy. You will draw two linked models, not just fill process labels.

A simplified meadow ecosystem

- ① A meadow includes plants, plant-eating animals, dead material and decomposers such as fungi and bacteria. Carbon is matter: its atoms can move between living organisms and nonliving air or dead material. Plants take in carbon dioxide from the air to make food during photosynthesis. Animals obtain carbon when they eat plants. Dead plants, dead animals and animal waste supply carbon-containing material to decomposers.
- ② Plants, animals and decomposers all release some carbon dioxide into the air during respiration. Carbon atoms do not disappear when an organism dies or uses food. They move into other materials, so a carbon atom can follow different routes and eventually return to a plant. Our first model will include only these five parts and carbon transfers. It leaves out water, soil nutrients and many other organisms and interactions.
- ③ Energy enters the meadow as sunlight. Plants capture some light energy and store energy in food. Feeding transfers stored energy to animals. Dead material also contains stored energy that decomposers can use. As all these living organisms use energy, some spreads to the surroundings as heat. That heat does not cycle back as usable sunlight for the plants. The energy model will put the Sun and heat in the surroundings outside a boundary around the meadow parts.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 Trace one carbon atom from air through an animal and back to air. Name the processes.

2 Why must the model include a carbon route from plants directly to dead material?

3 Why is it wrong to draw heat returning to plants and label it photosynthesis?

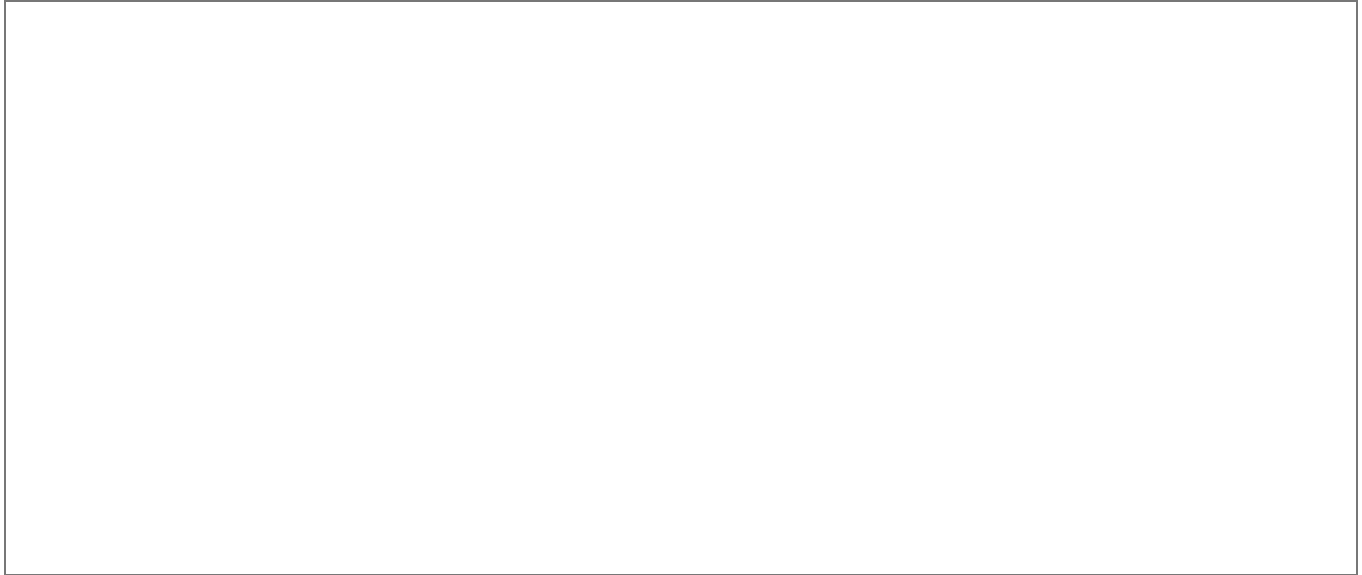
4 If a plant dies, has its carbon been destroyed? Explain where its carbon can go.

3 YOUR TURN _____ Your own words

Draw two models in the blank areas. Arrange and label the parts yourself. Use arrowheads and process labels to show the direction and meaning of every transfer. After drawing, explain the difference between cycling carbon and flowing energy.

1. Model matter: carbon cycling

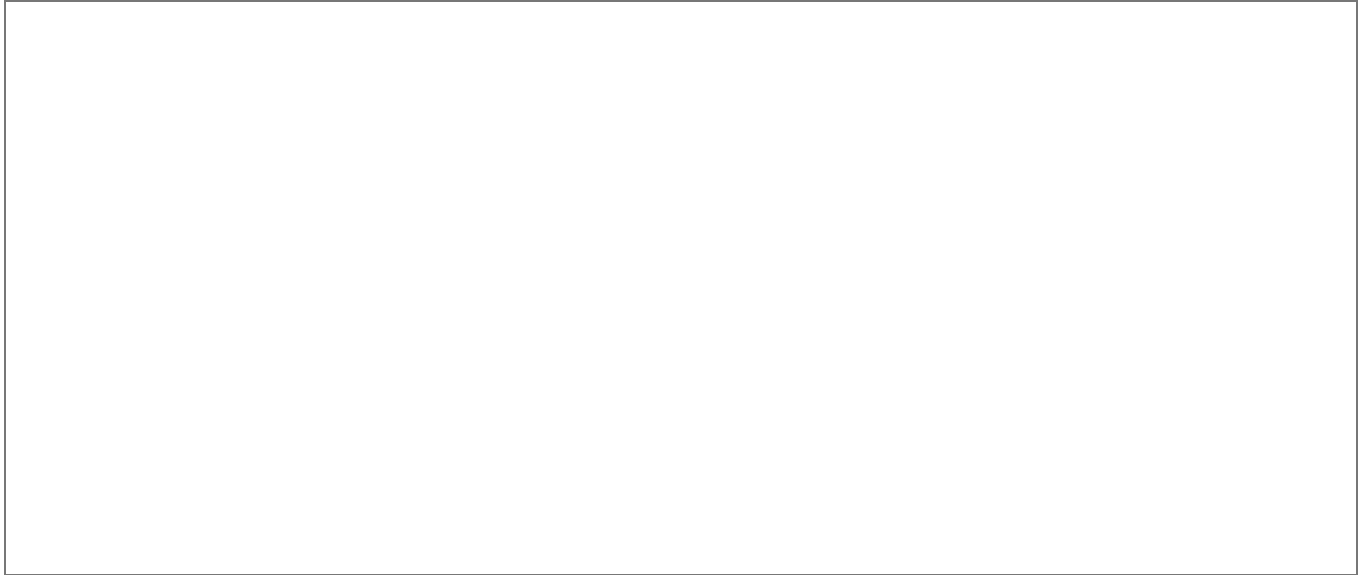
Draw air, plants, animals, dead material and decomposers inside a labeled system boundary. Add carbon arrows for photosynthesis, feeding, death/waste from plants and animals, movement from dead material into decomposers, and respiration from all three living groups. Show at least one complete cycle. Assume no carbon crosses this simplified boundary.



Trace a carbon atom around one cycle. Explain how matter is conserved and name one limit of this model.

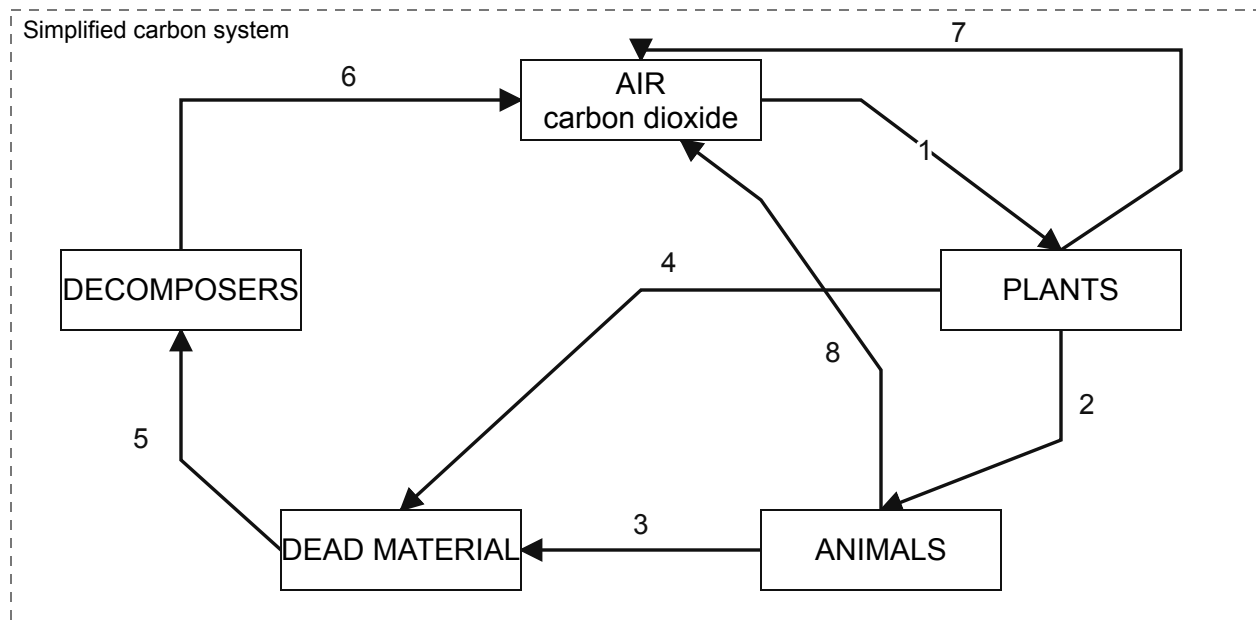
2. Model energy: input, transfers and output

Draw plants, animals, dead material and decomposers inside a labeled meadow boundary. Put the Sun and heat in the surroundings outside. Show sunlight entering plants, stored energy moving through feeding and dead material, and heat leaving plants, animals and decomposers. Do not draw heat returning as usable sunlight.



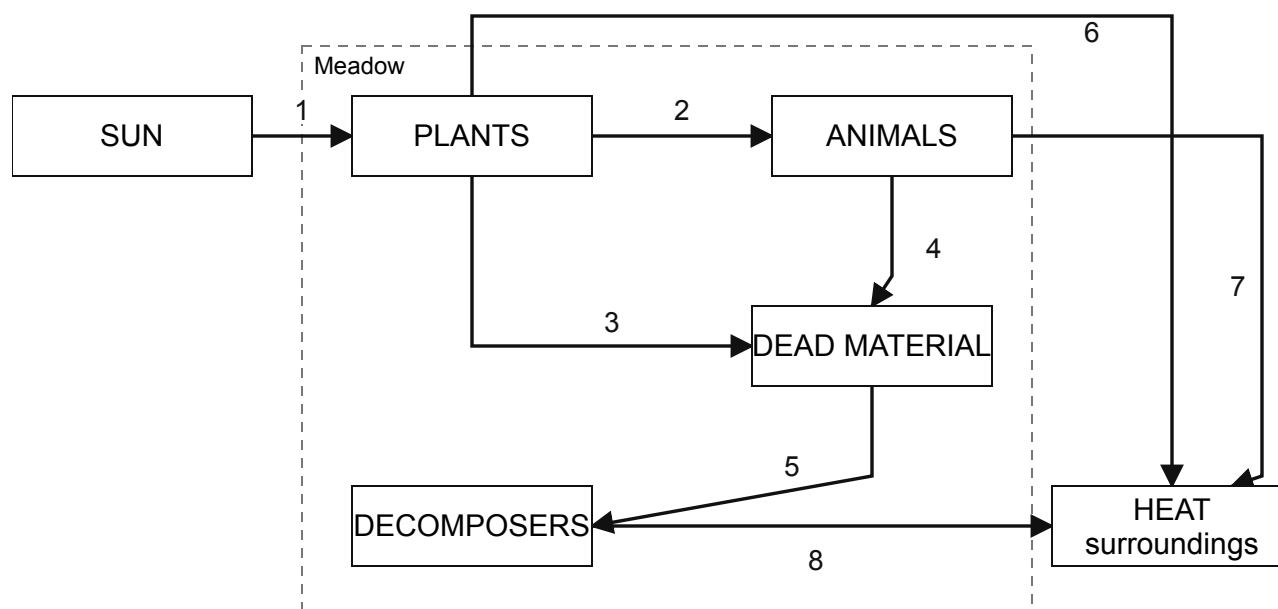
Trace energy from the Sun through an organism to the surroundings. Explain why this is a flow rather than a cycle.

1. Model matter: carbon cycling · example model



Arrows: 1 photosynthesis; 2 feeding; 3 animal death/waste; 4 plant death; 5 carbon entering decomposers from dead material; 6 decomposer respiration; 7 plant respiration; 8 animal respiration. Example cycle: air, plant, animal, air. The boundary includes all five modeled parts; real ecosystems also exchange matter beyond them.

1. Air to plant by photosynthesis, plant to animal by feeding, animal to air by respiration. Also accept a longer route through dead material, decomposers and decomposer respiration.
2. Plants can die without being eaten. Their remains supply carbon to decomposers, so carbon need not always pass through an animal.

2. Model energy: input, transfers and output · example model

Arrows: 1 sunlight; 2 stored energy in food; 3-4 stored energy in plant/animal remains and waste; 5 stored energy reaching decomposers; 6-8 energy spreading as heat from plants, animals and decomposers. The Sun and heat in the surroundings lie outside the meadow boundary. Energy is transferred, not destroyed; it does not cycle back as usable sunlight.

3. Plants capture light energy in photosynthesis; the heat that spreads to the surroundings does not return as usable sunlight. Energy flows through the ecosystem rather than cycling like carbon.

4. No. Its carbon atoms move into dead material, decomposers and the air, and can return to plants. They remain matter even when their location and form change.

PART 3 · YOUR TURN (SAMPLE ANSWER)

Matter example: A carbon atom enters a plant from air, reaches an animal through feeding, and returns to air through respiration. Its atoms are conserved.

Energy example: Sunlight enters a plant; some stored energy reaches an animal through feeding and later spreads to the surroundings as heat. It does not return as usable sunlight. Other correctly labeled layouts and pathways are acceptable.

Assess each learner's constructed model, arrow direction/process labels, explicit boundary and explanation. Numbered teacher arrows are explained in the captions; students may label their arrows directly. This is a simplified carbon model of matter cycling, not every nutrient cycle or a complete food web. The closed carbon boundary is a modeling assumption, not a claim that real meadows never exchange carbon. No chemical equations required. Reference: NGSS MS-LS2-3, including its clarification about conservation, energy into/out of ecosystems and system boundaries.