PATTERNS & PARTNERSHIPS: UTAH MOUNTAIN ECOLOGY

RED BUTTE GARDEN BOTANY BINS

Lesson 6: Fueling the Web
Modeling Matter and Energy

SEEd Alignment: 6.4.3 – *suggestions for acclimating to phenomenon education in italics*		
Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.		
Disciplinary Core Ideas	**Crosscutting Concepts**	**Science and Engineering Practices**
• LS2.B : Cycles of matter and energy transfer in ecosystems	• Energy and Matter	• Develop a Model • Engage in Argument from Evidence
Vocabulary: vocabulary is underlined		
producer, consumer, decomposer, abiotic, biotic, primary consumer, secondary consumer, tertiary consumer.		
Time Commitment: These lessons are designed to provide flexibility in both length and depth. Plain text in black contains the middle-of-the-road option, while text in red contains time-saving options, and text in purple contains options to dive deeper into the subject matter.		
50 - 100 minutes (2 classes) , 35-45 minutes, and 100+ minutes (2-3 classes).		

Lesson Summary

The incredible complexity of any given ecosystem can be hard to conceptualize. There is a dizzying array of interactions, both biotic and abiotic. Even professional ecologists can lose sight of the intricacies of the forest, for a subset of the trees. Creating models of ecosystems, and the flow of energy and matter that drives them, is a wonderful way to give a hint of the complexity that exists. In this lesson you and your students will use the bins specimens to create that model, producing a tangible representation of the flow of energy and connections of the Utah Mountain Ecosystems. Students will create a web between each organism's predators and prey, and see the potential effects of abiotic components on that web. But, the flow of energy and matter isn't just a matter of connections, it's also a matter of quantity and conservation. As energy and matter flows from the sun to plants to primary consumers to secondary consumers, etc., the amount of energy does not stay constant. Your students will explore the reasons that there are fewer organisms as you travel from the bottom to the top of the trophic pyramid. Ecologists and land managers need to understand the balance that exists between those trophic levels to grasp the domino effect that can occur when one of those levels is altered.

Essential Questions

- How does energy and matter move through an ecosystem?
  - Are there any "dead-ends" for energy and matter in an ecosystem?
- Does the amount of energy and matter remain the same as it moves from organism to organism?
  - How does the amount of energy and matter that is transferred from organism to organism effect the ecosystem?

Enduring Understanding

- All organisms need energy to live, and that energy moves through organisms as they produce food, eat, or are eaten.
- If the flow of energy and matter stops, organisms cannot survive.
- Changes in the flow of energy leads to changes in the ecosystem.

Previous Knowledge

Your students likely have felt a pang of hunger and understand that food gives them the energy to grow and function and without it they would not survive. They also likely understand that there is not a 100% use of the matter they consume, as evidenced by the end result of that food passing through their digestive system. As is true for most humans, the foods that your class consumes comes from a variety of sources; plants, animals, fungi, etc. And your class has likely heard horror stories of humans being killed or eaten by a wild animal. All of this background can be called into play when discussing the flow of energy that occurs within the Utah Mountain, and all other, ecosystems.

Background Information

The flow of energy through an ecosystem was once taught as being a chain, then a cycle, and most recently a web. The web is the most accurate analogy as it captures the myriad of nodes, connections, and loops that occur as energy moves through an ecosystem. There are no real beginnings and ends, just steps along the way. That being said there are definitive categories of nodes within that web; namely producers, consumers, and decomposers.

Producers, also called primary producers, are often considered the beginning of the flow of energy, as they harness the power of the sun to create food, seemingly out of thin air. While their contribution is incredible and integral to the rest of the nodes, they still largely rely on the nutrient cycling abilities of the decomposers. Plants, algae, and cyanobacteria all contribute to the flow of energy through photosynthesis; splitting carbon dioxide and water with power harnessed from the sun by chlorophyll and joined into sugars and oxygen within chloroplasts.

Producers bring the energy of the sun into the flow of energy in the ecosystem. Of all the Sun's energy that reaches the Earth, only an estimated 1-6% is harnessed by plants through photosynthesis. This is more than enough, however, to allow for the great diversity of consumers and decomposers that grace the Earth. Producers participate in the cycling of matter in two main ways, the most obvious is when they are eaten and have their matter incorporated into their predators' body. The more hidden being their uptake of minerals from the soil (largely nitrogen, potassium, and phosphorus) and the exchange of carbon dioxide from the air. Plants are well known for taking in carbon dioxide when they perform photosynthesis, but they also release carbon dioxide when they respire, or use the sugars produced in photosynthesis to create energy for plant growth.

Consumers include all the organisms that eat the producers, and those that eat the consumers that ate the plants, and so on. The consumers whose diets are predominantly composed of producers are called primary consumers. The consumers who primarily eat the consumers who ate the plants are called secondary consumers. Tertiary consumers are those whose diets are at least twice removed from the producers (they eat the consumers that eat the consumers that eat the producers.) Tertiary consumers are often (but not always) apex predators, this means that there are no other predators that typically hunt and kill them. Examples of apex predators in the Utah Mountains include: black bears, lynx, wolves, mountain lions, wolverines, golden eagles, great gray owls, and humans. Regardless of the trophic level of the organism, they still rely on the producers as the primary food source. Students may understand that eagles eat weasels, but not see the ultimate dependence on producers. Without the plant that fed the mouse, that fed the weasel, the eagle would have nothing to eat. The flow of energy and matter within consumers is often visualized as a trophic pyramid, which demonstrates not only the path that energy takes (from bottom to top) but the loss of energy and subsequent reduction in number of organisms that exist as one travels up the pyramid. The biological rule of 10 tells us that only around 10% of the energy in an organism is transferred from one trophic level to the next. That means that of 1000 calories or Jules of energy created by a plant, only 100 are able to be utilized by the mouse that eats the plants, only 10 move to the weasel, and only 1 moves to the eagle. The rest of the energy is lost as heat energy, is used for life processes, or is passed on to decomposers as feces. Plants would need to create 1000 units of energy, for the eagle to eventually have just one (see blackline "Trophic Levels, Energy, and Matter".) This reduction in energy and mass is the limiting factor that leads to fewer and fewer organisms as one moves from primary producers to primary consumers to secondary consumers to tertiary consumers. That reduction is also why so much land is required to sustain a single tertiary consumer. Consumers most notably move the flow of energy and the cycle of matter along as they eat producers, and one another, and incorporate their preys' matter and energy into their own bodies. They also contribute to the matter cycle as they release carbon dioxide and their waste, and after their death when they are recycled by decomposers.

Decomposers provide the link in the cycle of matter from the consumers back to plants, breaking down waste and dead organic matter into material that plants can utilize to grow.

Plants require minerals, typically absorbed by their roots from the soil, in order to live and grow. These minerals need to be in a specific form in order for plants to absorb them, and decomposers are masters at transforming minerals into those usable forms. Decomposers, like other organisms, also respire, releasing carbon dioxide into the air, soil, and ultimately the matter cycle. The flow of energy begins with the sun beaming energy to earth, where plants harness around 1% of that energy, the next step is typically primary consumers who utilize only 10% of the energy the plants have harnessed. This reduction in energy often continues through two or more subsequent consumers, and reductions in energy. Decomposers are often the final step in the flow of energy, as energy is released as heat during their life functions. Beyond their role in the energy and matter cycles, decomposers have an incredibly important role in the large-scale removal of detritus from the earth's surface. In a forested area the size of a football field, the plants alone produce around 4.4 tons of dead organic matter a year. Add on the dead organic matter and waste from all the other organisms in the forest, and the forest floor would be not only unpassable, but repulsive, without the decomposers to recycle it into soil. Be they bacteria, fungi, worms, millipedes, snails, slugs, flies, or other: decomposers can at times seem pesky, but are undeniably essential to their ecosystems.

As is true in every aspect of biology, nothing fits perfectly into neat boxes. A bear could be considered a primary, secondary or tertiary consumer (eating berries, chipmunks, or weasels.) A fungus can be a decomposer or a primary consumer (some fungi only eat plants that are already dead, but some will kill living plants for food.) A wasp could be a primary or secondary consumer or a decomposer (eating plants, bugs that eat plants, and dead organisms.) A plant can be a producer or a primary or secondary consumer (spotted coralroot is parasitic on fungi that is fed by plants!) That being said, having even imperfect boxes to sort organisms into is far better than sorting through a giant pile on the floor.

Lesson Plan:
Fueling the Web – Modeling Matter and Energy

Materials	Location
Plant & Organism Rikers	Botany Bin
Fauna Photos	Botany Bin – Fauna Photo Folder
Twine	Botany Bin – Twine Bag
An Open Area	Classroom supplies
Blackline: L6 Fueling the Web – Modeling Matter and Energy	Addendum Folder – Tab L6 or USB – L6 Folder
Pencils or Pens	Classroom supplies
White/Smart Board for group discussion	Classroom supplies
Optional:	
Blackline: L6 Trophic Levels, Energy, and Matter	Addendum Folder – Tab L6 or USB – L6 Folder
Blackline: L6 Blank Trophic Levels, Energy, and Matter	Addendum Folder – Tab L6 or USB – L6 Folder

Preparation

- There are 108 different specimens in the bin, so unless you are planning on combing classes for a super web (which would be awesome!) there will be more specimens than you will need. <u>We recommend taking 5-10 minutes to familiarize yourself with the organisms in the bin before you conduct any of the lessons.</u>
  - This is a great activity to do with multiple classes, or in a larger group. Since there are so many specimens, you could have up to 115 students working together to create a web! This would require more twine than is included in the bin, we recommend around 100 feet per 30 students.
- For this activity, most of your students will have a specimen. You or one of your students will be the web-weaver and will not need a specimen. At the end of the web building, you have the opportunity to have 1-4 of your students become abiotic factors. The exercise can be

done more quickly with more than 1 web-weaver working to link the organisms, but this can detract from the students understanding the individual interactions and overall pathways.

- You will want to select a sampling of organisms that showcase the three main trophic levels: producers, consumers, and decomposers. If you are going to discuss the differing levels of consumers, select examples of primary, secondary, tertiary consumers.
- For a much quicker lesson, you can display and discuss a few preselected organisms as opposed to building the web as a class.

Some suggestions for organism selection for this lesson:	
Producers	Almost all of the plant specimens, and lichens.
Primary Consumers	You can use the spreadsheet on the USB to sort by trophic level, but some of our favorites include: • Plants: elephant head or paintbrush mix (to show plants are not always producers) • Fungi: king bolete (to show fungi are not always decomposers) • Organism Group 3 or 4 • Animals: cow, porcupine, beaver, moose, pika, chickadee, bluehead sucker (to cover all ecosystem zones and broad organism types)
Secondary Consumers	You can use the spreadsheet on the USB to sort by trophic level, but some of our favorites include: • Plants: spotted coralroot (to show plants can be secondary consumers) • Organism Group 2 • Animals: flying squirrel, bat, kingsnake, frog, woodpecker, brewer's sparrow, bobcat, pine marten (to cover all ecosystem zones and broad organism types)
Tertiary Consumers	You can use the spreadsheet on the USB to sort by trophic level, but some of our favorites include: • Wolverine, lynx, bear, human, osprey (to cover all ecosystem zones and broad organism types)
Decomposers	You can use the spreadsheet on the USB to sort by trophic level, but some of our favorites include: • Fungi: oyster, shaggy mane, wolf-fart puffball (to show a variety of fungi diets) • Organism Group 1 • Animal: turkey vulture (to show that not all decomposers are fungi and invertebrates)

Set-up

- To make this activity more phenomenon-based we suggest that you leave the vocabulary to the end of the activity or in the discussion (producer, consumer, decomposer, primary/secondary/tertiary consumer, abiotic, biotic.)
- Explain that the students will be exploring how energy and matter flow through an ecosystem. Your students don't need to have the answers to these questions at this point, the questions are meant to get them thinking about these topics as they engage in the activity. It is ok to simply ask and let the students brainstorm. The exception being a fundamental understanding of energy and matter as terms.
  - Ask the students what they think about when they hear the term "flow of energy".
    - What is energy?
      - We suggest, energy is the ability to do work, change, or grow.
    - What is the source of the energy in the Utah Mountain Ecosystem?
      - Is the source different for different organisms?
    - How does energy move through the ecosystem?
  - What do they think of when they hear the term "cycle of matter"?
    - What is matter?
      - We suggest; matter is the substance that makes up an object and gives it mass and dimension. Examples could include: protons, atoms, molecules, rocks, cats, water, trees, phones.
    - What is the source of the matter in the Utah Mountain Ecosystem?
      - Is the source different in different organisms?
      - Is the source different in living or non-living parts of the ecosystem?
    - How does matter move through the ecosystem?
- Have the students move to an area with an open space, or clear the room to create an open space.
  - If possible, we suggest doing the activity outside or in an open room like a gymnasium.
- Assign roles to the students
  - Web-weaver: This can be played by you or a student. You can have more than one web-weaver to create a web faster, but this does tend to prevent discussion during the weaving.
  - Organisms: This will be the majority of your class.
  - Abiotic Factors: This can either be your web-weaver or if you have a much larger group 2 or 3 students can be assigned this role and act to assist the web-weaver until their role is needed.

- This activity can be done as a class to save time, by preselecting examples of producers, consumers, and decomposers to showcase and discuss as a class as opposed to building the web.
- Give the students a few moments to read the label on their organism (located on the back of each specimen.) Ask them to focus on how their organism might be involved in the flow of energy and matter in the ecosystem.

Activity

- Have the students create a circle. The students should be facing the center and have enough room between themselves for the web-weaver to move between.
- Choose one student to begin the web. We suggest starting with a producer, if you are repeating this activity with other organisms or in different sized groups you can present more of a challenge by having the students start with an organism from a different trophic level.
- Announce the organism that you are beginning with and ask the class where that organisms' energy and matter could flow next. Once the students have come up with an organism that would eat the original organism, have the web weaver give one end a section of the strand/twine to the original organism and then weave it to the next organism and give them a section to hold. Your twine lengths are twelve feet long which will give you enough to create a connection between 2 or 3 organisms per section, add another length as needed. The web stands should be off the ground, but not extremely taut. Work to create a loop from producer to consumer(s) to decomposer and back to producer before stopping for discussion.
  - If needed, when your students get to a tertiary consumer ask them what will happen when that organism dies. Once they've reached the conclusion of a decomposer, continue the web to that organism.
  - If your students get stuck at where matter flows after the decomposer, ask them what lives and grows in the soil, what gets nutrients/minerals from the soil, etc. until they get back to a producer.
- Once one loop has been completed ask the students what they have noticed about how the energy and matter has moved through the ecosystem. Do they think further loops might be different in some way? Ask what they think might happen if one of the components was missing.

- Create another loop, this time moving the other way. Choose a different organism, that hadn't been linked yet, and begin to weave again asking where each organism got its energy and matter. Continue by choosing unused organisms until all have been linked at least once, then begin linking the previously used organisms. Try not to replicate previous links, i.e. don't link a deer mouse to a short-tailed weasel if they had already been linked in a previous loop.
- Your bin includes 5 pieces of 72' long twine, which is typically enough for a minimum of five complete loops.
  - *Teacher Tip: If you are concerned about not having enough twine we suggest using a continuous loop, as opposed to starting with a new organism at the beginning of each loop, and adding new rope as necessary.*

- Once the web is finished, you can move to the discussion or introduce abiotic effects on energy and matter movement.
- Ask your students if they notice any ecosystem components that are missing from the web. If necessary lead the student observations towards abiotic components, namely water, wind, temperature, elevation, soil, or ground surface.
- Tell your students that the web-weaver is now going to represent some of the abiotic components of an ecosystem. There are a few options for this portion, as listed below. These examples focus on the importance of having multiple links (biodiversity) in an ecosystem, more than the cause and effect of abiotic changes in the ecosystem which are covered in detail during the next lesson.
  - Have the web-weaver become the abiotic factor of extreme drought, temperature change, wind, landslides, or floods, etc.
    - Have the abiotic factor student choose some organisms that will die off due to drought. We suggest removing 2 organisms/students for every 10 students participating, so 6 from a class of 30. At least one producer and one consumer, should be removed.
    - Instruct the students who "died" gently lay down their thread(s) and step back slightly.
    - Ask if any of the remaining students are now lacking a food source (i.e. the organisms that "died" was their only food link). If so have those organisms lay down their thread and step back as well. Repeat this step through one trophic loop of organisms, or stop when there are no more organisms without food.

- Discuss the results with the students. How many organisms died off during that drought? How many connections were left? What would happen if there were few organisms to begin with?

- Ask the "dead" students to return to the web and pick up their threads, then explain that you are going to repeat the experiment with fewer organisms.

- Remove 1 to 3 of the lengths of twine from the web, and ask any students who no longer have any links to step back slightly. You want to leave around half the class, so stop removing lengths when you still have a few of each of the trophic levels.

- Have the former web-weaver come back as a different abiotic factor and remove 2 or 3 organisms again (at least one producer and one consumer.) Repeat as above, with organisms "dying" when they are left without a food source.

- Discuss with the class how the results were different with fewer organisms. If they were land managers, would they want to have a larger or smaller variety of organisms? What would happen if there were monocultures, or only one or two of each trophic level of organism ?

- This can be repeated with the abiotic factor only removing organisms from one trophic level, to highlight what happens when the trophic levels become unbalanced.

Discussion

- Ask the students what they noticed during the activity.
  - Did they notice any patterns in the types of organisms in the web?
  - Would they group the organisms in any way based on the activity?
- Reveal the vocabulary of producer, consumer, and decomposer.
  - Ask the students where they think energy entered the web, where do they think it left the web?
  - Ask students where they think matter entered the web, does it leave?

- Have the students record the results of their activity in the worksheet, "Fueling the Web – Modeling Matter and Energy."

- **If you are not doing the next section, we suggest giving the students a copy of the blackline, "Trophic Levels, Energy, and Matter" and reviewing a projection during your discussion.**

Trophic Levels – A Deeper Look

Your students have gotten a good overview of the web of energy and matter that exists in the Utah Mountains Ecosystem, but now they can dive deeper and gain a better understanding of the trophic levels and how energy and matter flows through those levels. In this section students will explore why movement of energy is called a flow, while matter is a cycle, and why there are fewer organisms as you travel towards the top of a trophic pyramid.

- Explain to students that scientists don't include all consumers into one group, but instead break them into three main groups, and that they are going to explore a different representation of the flow of energy and matter.
  - Draw a large blank trophic pyramid on the whiteboard (refer to the blackline, "Blank Trophic Levels, Energy, and Matter" for an example), and distribute copies of the blackline to the students.
- Ask the students to help you to fill out the pyramid using just the terms they know so far; producer, consumer, decomposer.
  - Ask the students to concentrate on the arrows showing the flow of energy and matter if they are struggling.
- Once the basic terms have been assigned to each of the blank shapes, focus on the top three sections of the pyramid that are marked as consumers.
  - Ask the students if they have any ideas on what the three sections represent as far as the consumers.
  - Focus on the bottom consumer shape, and ask the students what kind of consumers might be in this section.
    - If needed, have them focus on the flow of energy and matter again and ask what these consumers might be eating. The goal is to get them to the idea that all of the organisms in this section are directly consuming the producers or plants.
    - Examples of organisms could include: mule deer, sheep, goats, beaver grouse, butterflies, bees, moose, chickadees, etc.
  - Next focus on the middle consumer shape, and ask the students what kind of consumers might be in this section.

- If needed, have them focus on the flow of energy and matter again and ask what these consumers might be eating. The goal is to get them to the idea that all of the organisms in this section are consuming the organisms that were directly consuming the producers or plants.
- Examples of organisms could include: weasels, snakes, frogs, trout, flying squirrels, darners, woodpeckers, etc.

- Lastly focus on the top consumer shape, and ask the students what kind of consumers might be in this section.
  - If needed, have them focus on the flow of energy and matter again and ask what these consumers might be eating. The goal is to get them to the idea that all of the organisms in this section are consuming the organisms that consumed the organisms that were directly consuming the producers or plants.
  - Examples of organisms could include: mountain lions, coyotes, eagles, owls, wolves, wolverines, etc.
- Once the types of consumers have been determined ask the students what terms they think might be applied to the different types of consumers.
- Reveal the terms primary, secondary, and tertiary consumer, and ask the students to make notes in their blank blackline.

- Next ask the students why they think this representation of the flow of energy is in the shape of a pyramid.
  - Discuss the student's ideas for a few minutes, recording them on the whiteboard.
  - Ask the students if they think all of the energy and matter are transferred directly up the pyramid from producer to primary consumer to secondary consumer to tertiary consumer.
    - If necessary, use the concept of matter loss in waste in the form of fecal matter and urine, or energy lost in the creation of heat or movement of an organism's body to illustrate that not all energy and matter moves directly up the pyramid.
  - Have the students hypothesize on the amount of energy that moves from one level to the next. Then reveal that only an average of 10% of energy moves from one section to another.
    - Have the students make notes of the amount of energy that moves from one section to another, for a math portion you can ask them to figure the amounts starting with 1000 units of energy at the producer level.

    - Discuss where the energy goes, that it is not a cycle but a flow, where energy is lost to the ecosystem as organisms' function, largely as heat.
  - Ask the students how and where they think energy enters the ecosystem.
    - If necessary remind students about plants harnessing energy from the sun for photosynthesis, revealing that energy enters the ecosystem from the sun.
    - You can ask the students to add a drawing of the sun and an arrow showing the suns energy entering the ecosystem along with heat waves and energy exiting the ecosystem.
- Lastly discuss why the movement of matter is discussed in terms of a cycle.
  - Explain that matter (and energy) are never really "lost", but can change states and move away. Matter follows the arrows shown in the trophic pyramid, changing as it moves from section to section. It is not reduced in the amount transferred as energy is, it just changes states.
- Finally give the students the blackline, "Trophic Levels, Energy, and Matter."
  - Ask the students to choose two different colors of pen or highlighter, one for energy and one for matter. Have the students draw the flow of energy, including it entering and exiting through the ecosystem and incorporating the units of energy that are notated with one color. Then have the students show the cycle of matter through the ecosystem with the other color.
  - Once the students have filled out the blank trophic pyramid, we suggest giving them a copy of the blackline, "Trophic Levels, Energy, and Matter" or reviewing it as a class through your projector.
- You can also reuse the web exercise from the second page of the blackline, "Fueling the Web – Modeling Matter and Energy" asking the students to make a web with two different colors of pens, one showing matter and the other showing energy moving through the ecosystem.

Assessment

Students should demonstrate an understanding of the way energy and matter move through an ecosystem. Students should also demonstrate an understanding that there are different roles in the transfer of organism within the flow of energy and matter, and that each role is important in their own way. Informal observations can be made as students are completing the web, and during discussion, mostly noting the level of participation and engagement. The worksheets can also be used as either a note of participation, understanding, or critical thinking. The students are unlikely to be able to link organisms in the web worksheet without mistakes as to the exact organisms another organism may gain energy and matter from, but as long as they are getting the general idea they should be given credit.

Extensions

This website includes tutorials and computer games that reinforce the concepts of trophic levels and the flow of energy and matter.
http://www.sheppardsoftware.com/content/animals/kidscorner/foodchain/foodchain.htm

Montana's department of Fish, Wildlife, & Parks website has an interactive game showing a variety of interactions in different ecosystem zones.

http://fwp.mt.gov/education/ecosystem/montane/foodchains/default.html

Arizona State University has a fun lesson plan showcasing the food web that exists in the ocean. This is a good chance to show the repeating of patterns in other ecosystems. PDF on USB.

https://askabiologist.asu.edu/sites/default/files/resources/activities/plankton/plankton_eat_plankton_packet5.pdf

Fueling the Web – Modeling Matter and Energy

Name(s): ______________________________ Date: ____________

What are the three main types (or trophic levels) of organisms found in the Utah Mountain Ecosystem Web? List, define and give an example for each type below.

Organism Type (Trophic Level)	Definition and Example

Do you think you would find the same three main types of organisms (trophic levels) in other ecosystems? Why or why not? ______________________________

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What are some of the non-living (abiotic) components of the ecosystem? List and give examples of their potential effects on the ecosystem below.

Non-Living Ecosystem Component	Examples of Potential Effects

RED BUTTE GARDEN BOTANY BINS

Utah Mountains Ecosystem Web

Create a web between the organisms below with arrows to show how energy and matter are moving through the ecosystem.

Mule Deer

Pika

Sparrow

Fly

Beaver

Yarrow

Darner

Sagebrush

Eagle

Woodlouse

Coyote

Mushroom Oyster

Aspen

Bumble Bee

Black Bear

Spotted Coralroot

Sage Grouse

Mountain Sheep

Grass

Cutthroat Trout

Frog

Mushroom King Bolete

Moose

Pine

King Snake

Paintbrush

Mountain Lion

Earthworm

Flying Squirrel

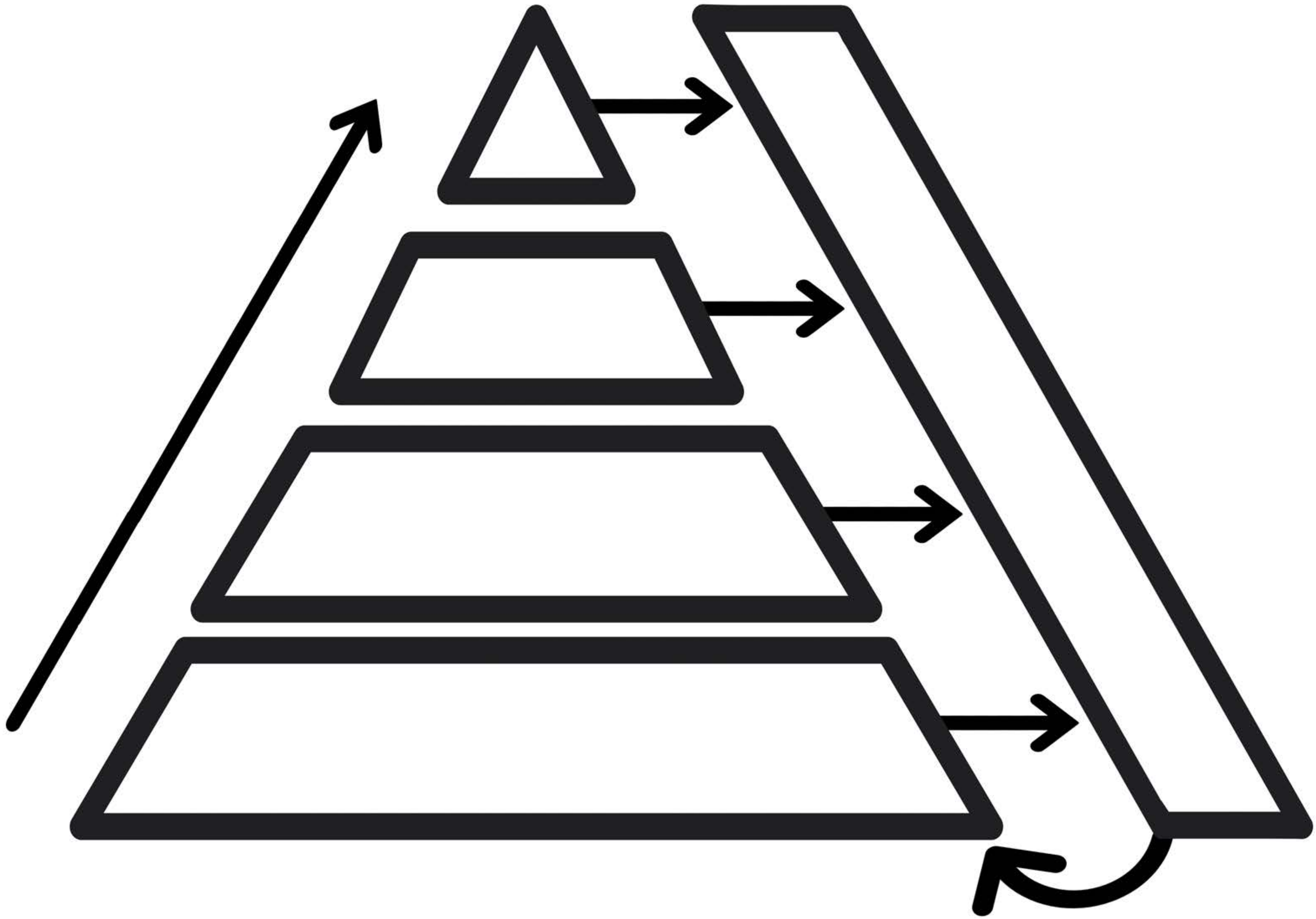
Butterfly

Choke Cherry

Weasel

RED BUTTE GARDEN BOTANY BINS

Trophic Levels, Energy, and Matter



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Trophic Levels, Energy, and Matter

Energy and matter are constantly flowing throught the ecosystem, but not all of that energy, and the matter that energy creates, moves from one level to the next. At each transfer (as one organims eats another), only around 10% of the energy is conserved .