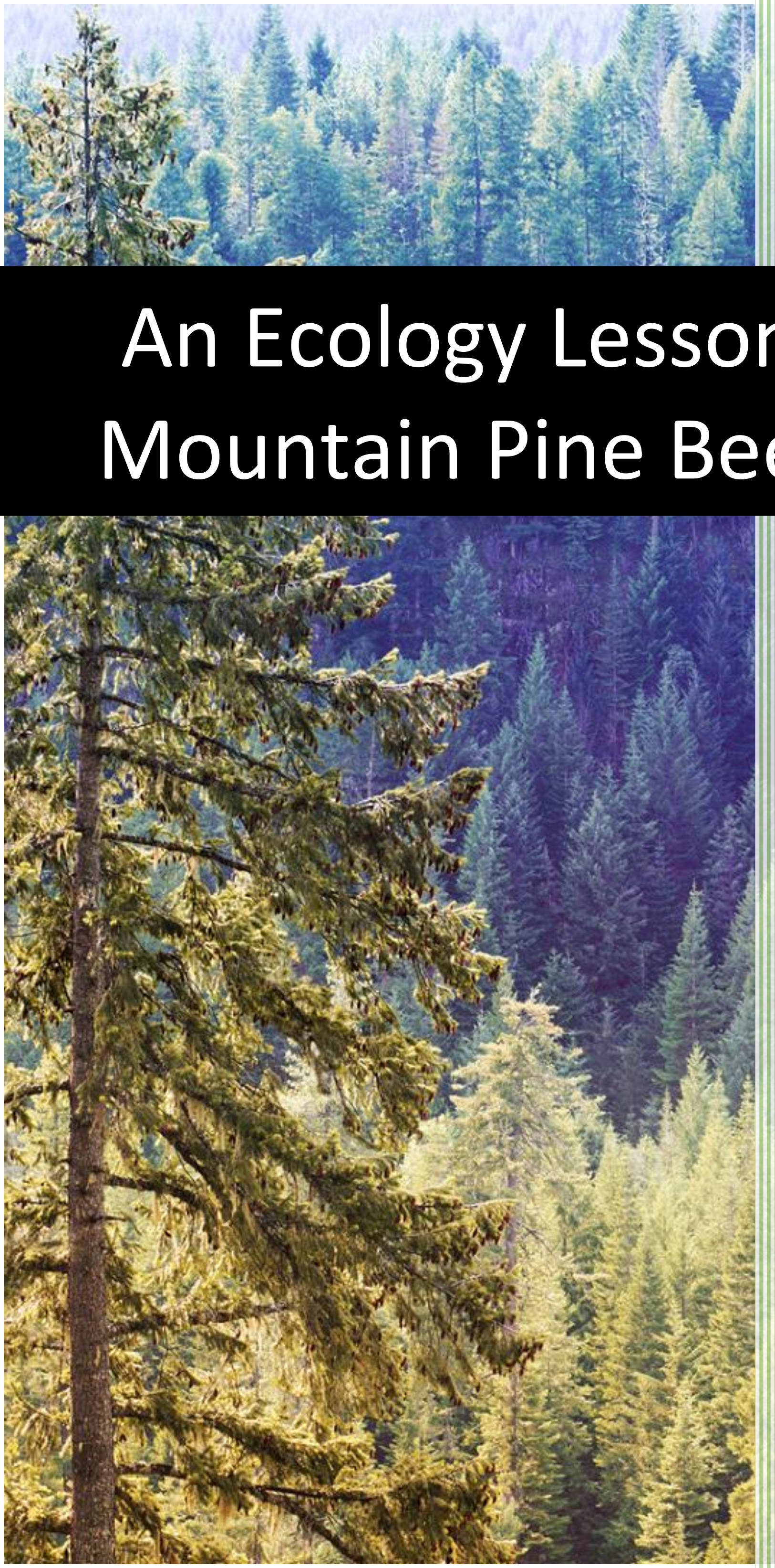

An Ecology Lesson on Mountain Pine Beetles

Intended for elementary and middle school students

Maia Holmes

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AGRICULTURAL BIOLOGY
COLORADO STATE UNIVERSITY

Contents

Objectives

Students who complete this lesson plan will be able to express an understanding of the ecological relationship between the climate and environment, pine forest health, and mountain pine beetles.

Intended outcomes

After completing this lesson, students will be able to explain ways in which bark beetles overwhelm and infest pine trees and predict how this relationship could evolve in the future based on climate change.

Target grade/level

Upper elementary and middle school-aged students (3rd-8th grades)

While this lesson plan was made with these grades in mind, we encourage teachers to modify this to fit any grade level they teach. If you have modified this lesson plan to fit in with a different grade level, please reach out to Maia Holmes at maia.holmes@colostate.edu as she would love to see how to expand this lesson!

Standards met

This lesson plan meets many of the Life Science standards established for elementary, middle and high school students by the Colorado Department of Education. These standards can be found through the CDE website.

Major concepts/standards met: This lesson plan has been developed with the following standards in mind.

Age	Standard Code	Standard
Elementary – 3rd grade	2.1	Organisms have unique and diverse life cycles.
Elementary – 3rd grade	2.2	Being part of a group helps animals obtain food, defend themselves and cope with changes.
Elementary – 4th grade	2.1	Organisms have both internal and external structures that serve various functions.
Middle School	2.5	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
Middle School	2.7	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations.
High School	2.3	Organisms use matter and energy to live and grow.
High School	2.4	Organisms interact with the living and nonliving components of the environment to obtain matter and energy.
High School	2.6	A complex set of interactions determine how ecosystems respond to disturbances.
High School	2.13	Humans have complex interactions with ecosystems and have the ability to influence biodiversity on the planet.

Other concepts/standards: This lesson plan has elements of the following standards and could be altered to include them.

Age	Standard Code	Standard
Elementary – 5th grade	2.1	Plants acquire their material from growth chiefly from air and water.
Middle School	2.10	Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment.
Middle School	2.11	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions.

Middle School	2.12	Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.
High School	2.7	Organisms interact in groups to benefit the species.
High School	2.11	Genetic variation among organisms affects survival and reproduction.

Supplies needed

- 1 Pine Beetle Kit per 2-3 students
- White board and markers (and space for a concept map)
- Presentation on mountain pine beetle (available as a PowerPoint on USB)

Pine Beetle Kits include:

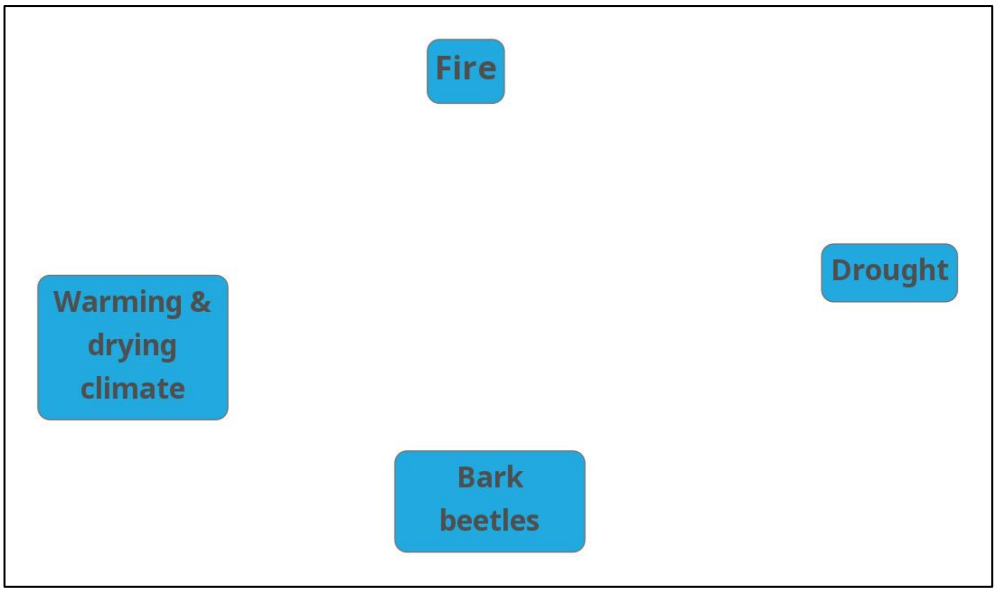
- 1 container
- 1 clear straw
- 2 pipe cleaners
- 10 plastic beads
- 1 100ml plastic wash bottle

One kit should be used for every 2-3 students.

Supplemental materials: samples of pine beetle specimens, examples of wood infected with blue stain fungus, samples of wood that has been bored by pine beetles, images of beetle kill in forests.

Lesson Plan

On a whiteboard or large poster paper, lay out the foundations for a concept map. In the beginning, only include the terms “bark beetles”, “fire”, “drought”, and “warming & drying climate”. The arrangement of the words is up to you, but we recommend the following layout:

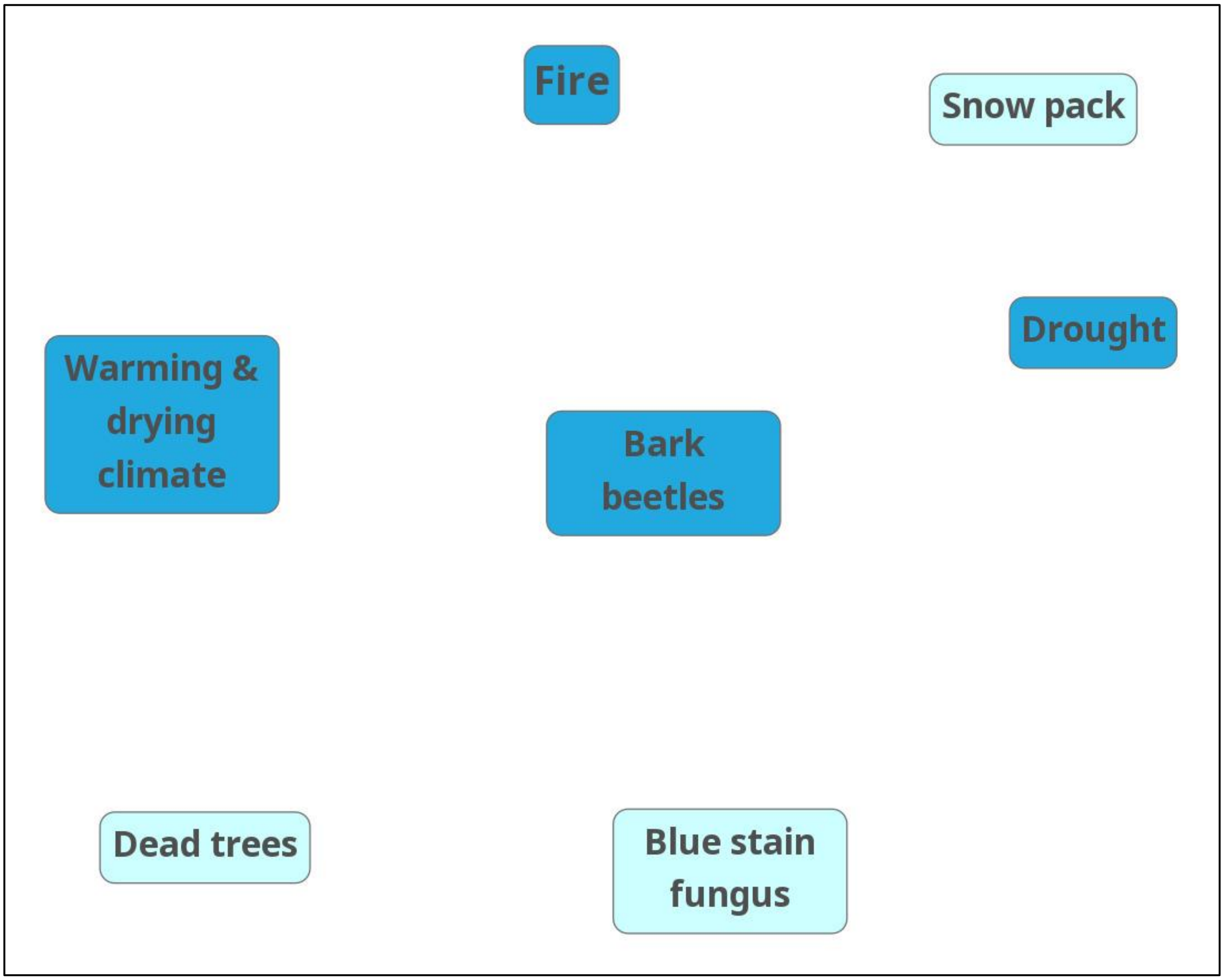


Have the students work as a class to connect these concepts together to the best of their current knowledge. This should be done in a way so that the relationships between the terms can change as students learn more (we recommend doing this on a whiteboard with erasable markers). Examples of completed versions of the concept map are also available in the appendix.

Once students have connected these four terms to the best of their ability, transition into the presentation on Mountain Pine Beetle Life History. A video explaining the relationship between MPB and forest is available as part of this packet, but you may also decide to create your own presentation on the ecology of MPB. This presentation should emphasize:

- What pine beetles are
- How they live (life history)
- How pine beetles use pine trees (including blue stain fungus)
- What happens when a beetle finds a pine tree
- How the overall climate can influence the relationship between beetles and trees

At the end of the presentation, add the terms “snow pack”, “dead trees”, and “blue-stain fungus” to the concept map.



After connecting these new concepts, begin transitioning to the activity.

Directions for activity set up and play

1. Determine that you have the correct number of kits for students, and that each kit has the correct material. One kit has enough material for two (or three) students.
2. Fill wash bottles with 75-90 ml of water.
3. This activity is intended to occur outdoors as there will be water. Set up each kit outside on a flat surface, like a sidewalk or patio. If the activity is occurring indoors, make sure students keep their ‘trees’ (straws) held over the container to limit the amount of mess.

Split the students into groups of two, making sure each group gets a Pine Beetle Kit; if your class has an uneven number, this activity can be done with a group of three. Due to the nature of having an activity that involves water, it is recommended to do this activity outside if possible. If this is not possible, each kit does include a box to minimize the amount of mess.

For this activity, each student in the pair has a different role, and will switch roles halfway through. One student is a pine beetle, and their goal is to use the end of a pipe cleaner to push as many beads up from the bottom of and out the top end of the clear straw as possible. The other student is the pine tree; their job is to use the wash bottle to flush the beetles (beads) out of the straw using water from the bottle.

Begin by explaining the different goal each role has; it is important to clarify here what counts as cheating. Students who are playing as the beetles cannot thread the beads onto their pipe cleaners. Additionally, students who are playing as the trees may not block the exit side of the straw with the wash bottle. Images showing these examples are located in the appendix.

NOTE: Students will run out of water during this activity. You may choose to allow them to refill their bottles, but encouraging them to pour any water collected in the plastic boxes is a great opportunity to emphasize that water is a precious resource that remains in a closed system!

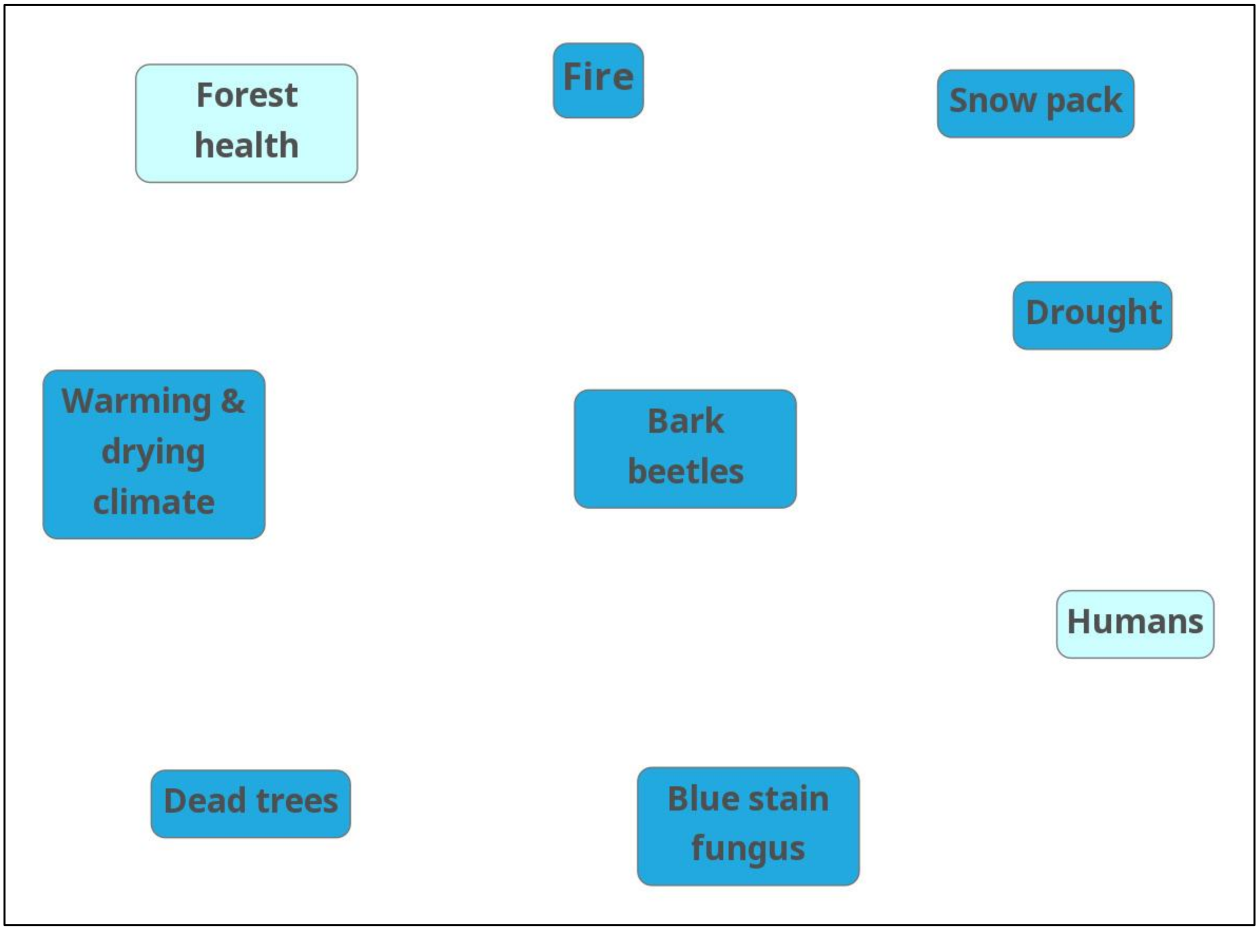
Have students practice the game by playing for 5-10 minutes. After students have had time to play the game in each role (as the beetles and as the tree), introduce new conditions that the forest is experiencing. Have half of the pairs deal with **Condition 1** and the other half with **Condition 2**. This is a good time to encourage students to switch roles again if they would like to.

Condition 1	There was an exceptionally warm winter, and most of the adult beetles survived; the beetle student can now use up to five beads at a time to push through the straw.
Condition 2	A drought hits Colorado! There is now a shortage of water; the tree student can now only use 30ml of water to flush out invading beetles.

After students have role-played these new conditions, begin cleaning up and returning to the classroom.

Lesson Plan, Continued

Once you have returned to the classroom, add the terms “forest health” and “humans to the concept map.



As a class, discuss how all these terms are related and influence each other. Use the experiences they had while playing the game to predict what happens when a warming climate leads to warm winters and less water at the same time. Some discussion questions include:

1. Why do we see an increase in wildfires in forests with pine beetle outbreaks?
2. Where does most of the water in a forest come from?
3. How do the ways humans use forests impact the amount of water in the area?
4. What can humans do to change the number of pine beetles in an area?
5. Are mountain pine beetles bad? Should humans try to get rid of all of them?

Extra information for helping guide students to answer some of these questions:

1. *When there are large outbreaks of mountain pine beetles, there is in an increase in the amount of dead and dying pine trees, which are very flammable. As learned in this lesson, drought and mountain pine beetle outbreaks are often correlated. Droughts allow for conditions that increase the number of wildfires that occur, while mountain pine beetles cause an increase of dead trees that provide more fuel for wildfires.*
2. *In many forests, water comes from precipitation. In the Rocky Mountains, this precipitation is mainly through snow. A forest that has many gaps between the trees is able to build up a larger/deeper layer of snow within the boundaries of the forests, which then slowly melts as the season changes.*
3. *Humans impact the amount of water in a forest in many ways. Forestry management (how many trees are allowed to grow in a certain area), the number and types of roads, and human structures like reservoirs, dams and buildings are all examples of ways humans control and influence the water in a forest.*

Appendix

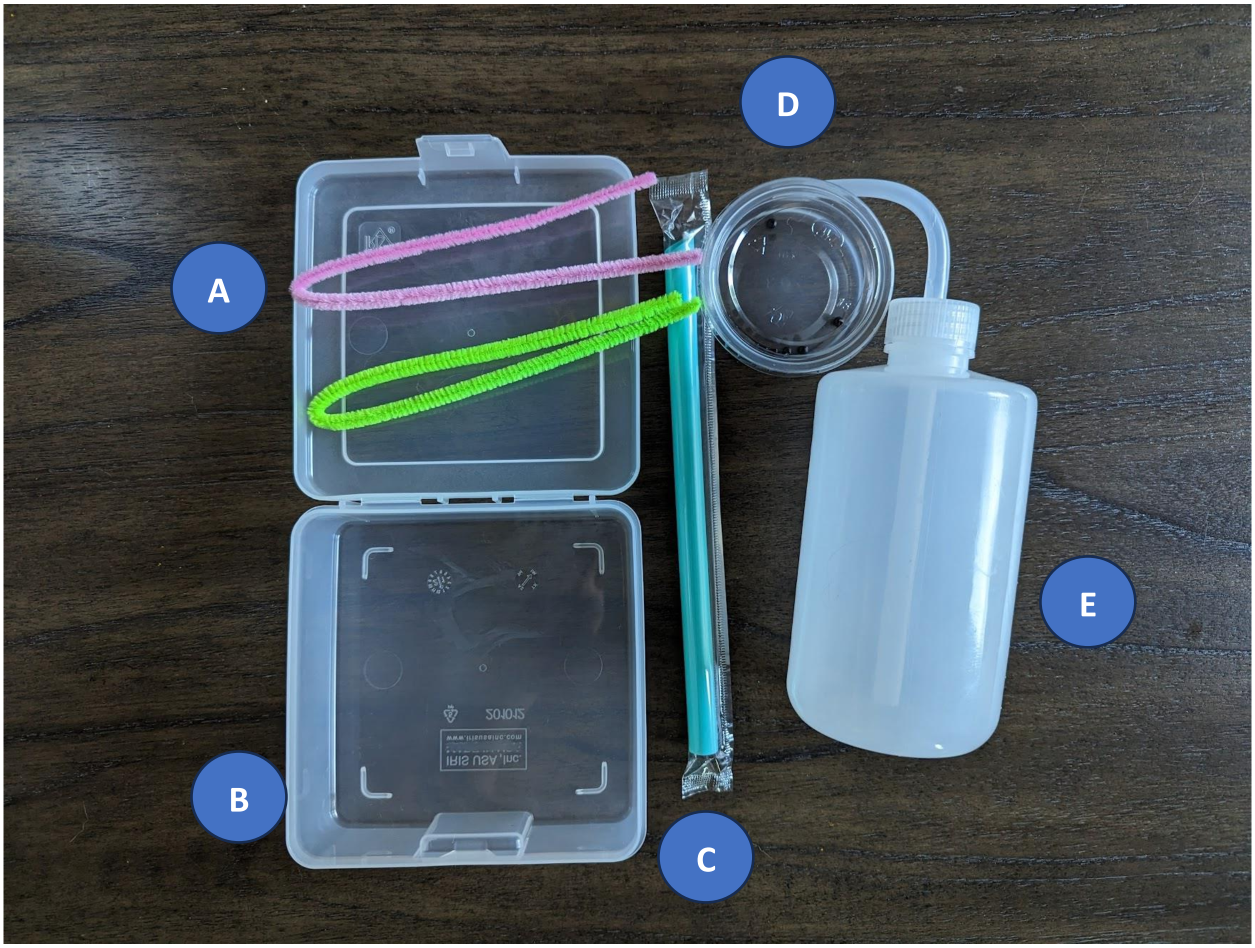
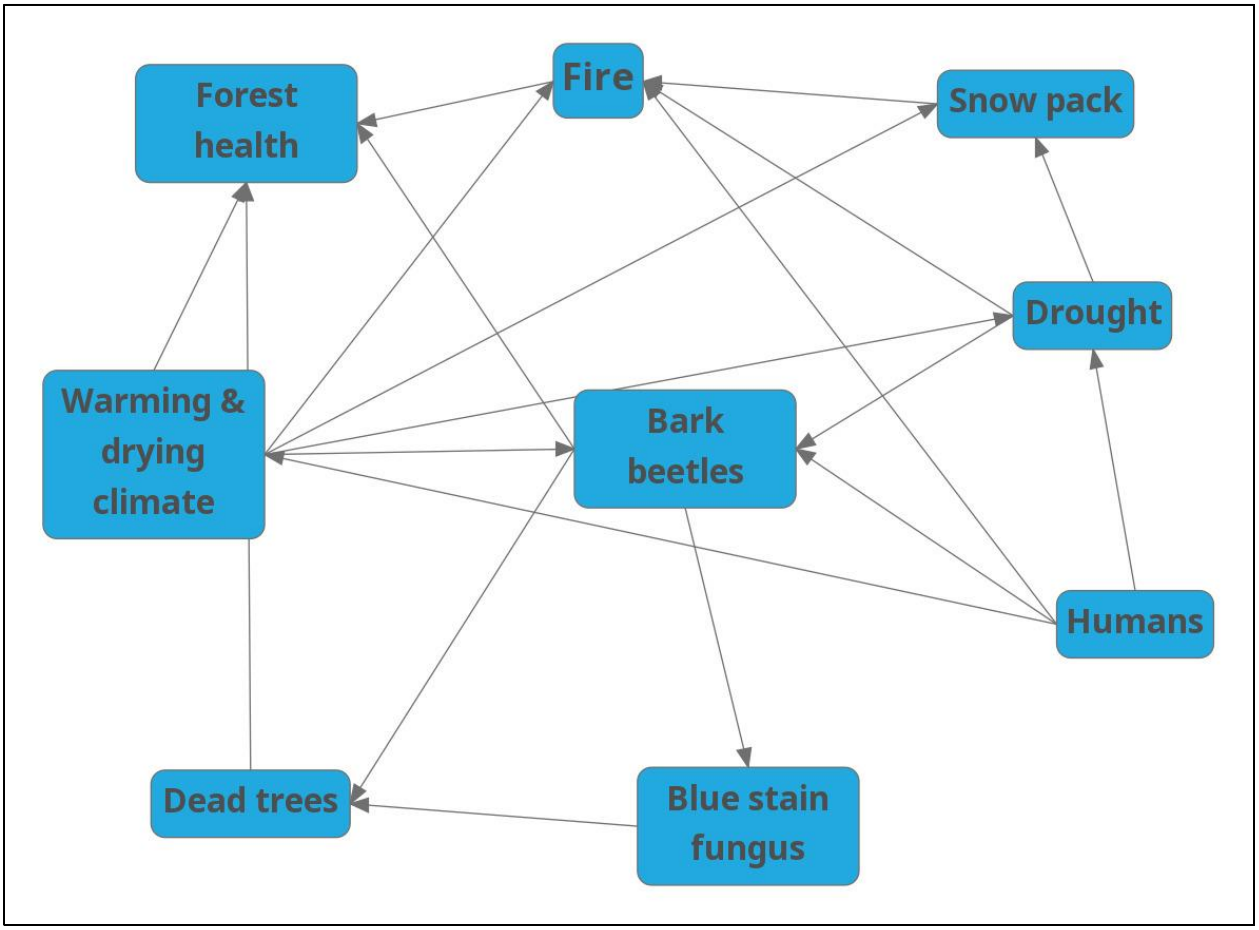


Figure 1– Contents of each beetle kit should include (from left to right): 2 pipe cleaners (A), 1 box container (B), 1 thick straw (C), 1 small container with 10 black beads (D), and 1 wash bottle (E).



Figures 2– Possible connections for the concept map. Allow students to discuss how each of the items within the map may influence each other. Students can either write out their own maps, or one collaborative map can be made for the class on a whiteboard.

IMAGES OF CHEATING CONDITIONS

External Resources

A factsheet that includes more information and images about mountain pine beetles is available through the [Colorado State Forest Service].

A video explaining the relationship between mountain pine beetles and pine trees is available through [Deep Look], an educational channel funded by PBS and KQED.