

8- PLANT & ANIMAL SIGNS: FIRE & HEAT INDICATORS

INTRODUCTION

Students review some climate and fire effects considerations (effects, vulnerabilities and adaptations associated with form and function) along with observable plant and animal signs of the fire environment (heat signs). Students will also learn a little about biophonies and geophonies and how to use those to help enhance fire environment observations.

LESSON OVERVIEW & ESTIMATED TIME (60 MINUTES)

- Student lesson introduction and safety talk (2 minutes)
- Overview and Exercise 1: Cylinder Sound Map (13 minutes)
- Overview and Exercise 2: Effects, Vulnerability & Adaptation (25 minutes)
- Overview and Exercise 3: Climate, Fire & Heat Signs (20 minutes)

MATERIALS & RESOURCES

- Journal or notebook
- Student story zine
- Graphite pencil, eraser, and optional color supplies such as crayons colored pencils and or watercolors.
- Printed illustrations and tables from the lesson.

LOCATION

This lesson can be carried out anywhere with natural plant elements and potential animal observations and signs. The animal observations emphasize insects and birds so most yards, parks, and open areas should work. The more diverse the landscape the better.

BACKGROUND & NATURAL PHENOMENA INVESTIGATED

Using plant and animal observations can be fun but also helpful in showing interconnectedness and deeper ways of knowing the fire environment. The fire environment is strongly influenced by climate and those same climate trends influence plants and animals and can be observed as short-term reactions (heat responses), behavioral changes and shifts distribution. Plant and animal adaptations to the fire environment can also inform us of potential fire effects. Some climate terminology is used to frame observation categories such sensitivity, exposure and adaptive capacity (vulnerability) and build an understanding around effects analysis.

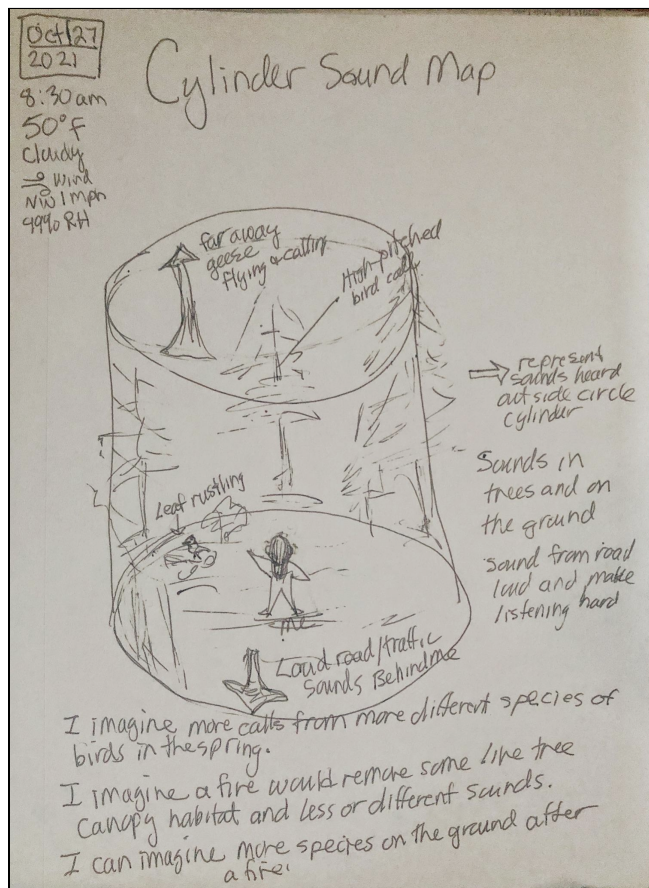
LESSON INTRODUCTION & SAFETY TALK FOR STUDENTS (2 Minutes)

Throughout this guide, you've learned different techniques for making fire environment observations using your senses. In this lesson we are going to use observations of plants and animals and how they respond to the fire environment to inform us. As you've seen, the fire environment is complex and something you can look at close up or

zoomed out, in the moment and over time. In this lesson you'll learn some key information about understanding and analyzing the plant and animal experience within the fire environment and approaches for journaling these observations.

As we go into nature, be aware of your environment and safety considerations. If you are standing under or near a tree, look and listen for wind influences and whether you should move. Be careful where you walk and how you step and point out things you are concerned with.

EXERCISE- CYLINDER SOUND MAP (13 Minutes)



Oftentimes, we narrow our observations to one topic or element like listening to the wind in the leaves. In this exercise, we want to take in all of the things we hear within the area around us. This is helpful for gaining more insight about changing and interactive elements of the fire environment. There is a specialized field in ecology called soundscape ecology, where you study the collective biophony and geophony of sounds in a particular place and time. We know that fire has a strong influence on the structure and function of the environment and thus the soundscape before, during, and after a fire will be different. The soundscape for each ecosystem will be different and each ecosystem will be different in each season and time of day.

- **Biophony**- the collective sound of vocal non-human animals in

a given environment and time.

- **Geophony**- collective earth-related sounds in an area like the sounds of a creek flowing, rain and wind.

It's good to start your field observations with listening observations because as you move and interact in an area, many animals will go quiet or leave.

- Quietly gather students into a group near the edge of the natural area you want to observe as a soundscape. Have students pull out their journals and supplies.

- Demonstrate how to create a cylinder on the page by creating a large circle close to the bottom of the page and the same sized circle near the top of the page with lines connecting both circles along the outside. Keep some space along the top, bottom and edges for possible added elements such as underground or high up. This should resemble a 3-D cylinder and is a modified sound map, which is often a single flat circle. We want to know where in the vertical and horizontal landscape these sounds are occurring since this ties to fuels and fire behavior.
- After creating the sound map cylinder, demonstrate how to add a few habitat elements to give a sense of space and structure. Don't try to fit everything in and do this in a very light pencil mark so sound observations can be overlaid. We just want some vertical and horizontal elements.
- Tell students that they can use words, symbols or sketches within the cylinder to note what they are hearing. It will be quicker to work in pencil or pen and color in after they are done. If they choose to use symbols, they will want to create a legend along the side of the sound map. This can be done after the observations are made or as they go.
- Tell students they have five minutes to silently listen and journal what they hear.
- 1 minute before time is up, tell students they need to wrap things up.
- Over the next five minutes, invite students to share what they heard and how they journaled those observations.
- Ask students what changes in the soundscape they would expect to hear in different habitat types, at different times of year, and over different times of day. Have them write their comments and insights on their journal.

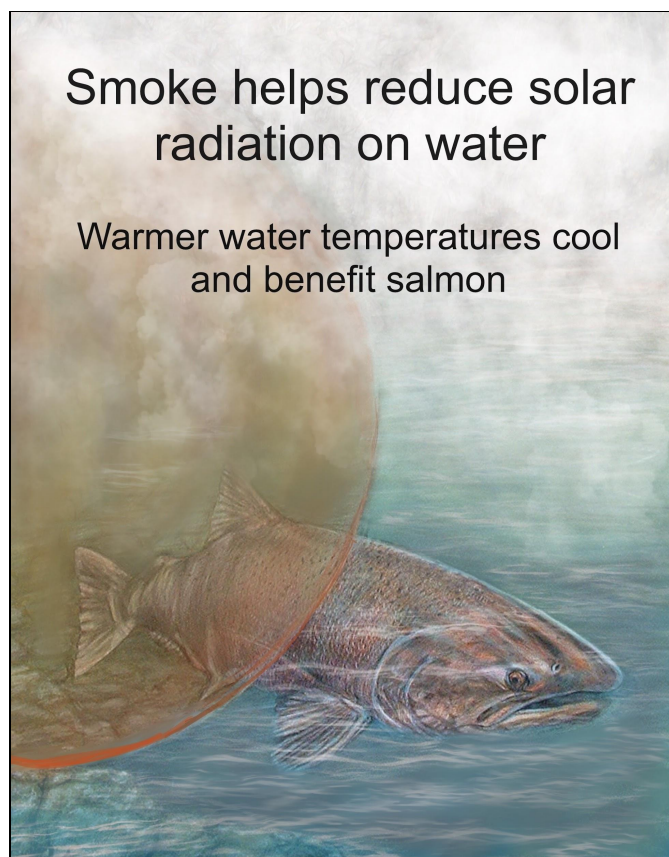
EXERCISE: EFFECTS, VULNERABILITY & ADAPTATION (25 Minutes)

Spend about 10 minutes discussing the following terms and concepts with students and 10 minutes journaling on the story zine.

To connect plant and animal observations to the fire environment, it's important to have some understanding of how fire, weather, and climate can impact them (**effects**). How strongly plants and animals experience effects can be framed around their **vulnerability**. One way to assess vulnerability to the fire, weather, and climate is to look at the level of **exposure** they have, how **sensitive** the plant or animal is, and what abilities they have to **adapt** in response to those effects.

- Gather students together in an area with a variety of natural elements around them. This exercise will start with a discussion and then follow with interactive journaling.
- Ask if they can name or describe what an effect is and what different types or levels of effects that can be experienced. The teacher can point or use natural prompts to help facilitate the discussion.

- Discussion: An effect is a change which is a result or consequence of an action or other cause. There are three types of effects used for environmental analysis: direct, indirect and cumulative.



Direct effects occur in immediate exposure and response such as injury or death from flames.

Indirect effects occur after or as a secondary effect to the plant or animal as a result of the fire. This includes things like impacts to habitat values.

Discussion (Illustration): For example, smoke can have indirect beneficial effects on salmon. In the June 23, 2021 Bay Nature Magazine article, Don Hankins discusses how indigenous burning techniques can be used to create localized smoke with lower intensity burning in mountainous areas to help shade and cool waters for salmon, who require cold water to over summer in streams..

Cumulative effects are those that happen over time and are combined with other disturbances to create a different level of effect. This could include something like drought combined with fire effects having a more significant impact on plants and animals.

Effects can be negative, neutral or beneficial to plants and animals. For example, some hawks, cranes and other carnivorous birds take advantage of fire chasing small animals out of hiding places and hunt around the fire edge. Some Native American tribes used fire near salmon streams to create smoke and help cool water temperatures during hot periods of time. Many insects, birds and mammals are attracted to recently burned areas for easy feeding and hunting. Lizards, birds and deer have been seen rolling in the ash of recently burned areas to help remove parasites from their skin, feathers and fur.

- Ask students if they can describe what makes something more or less vulnerable to different effects. Use natural elements and facilitate discussion around effects and vulnerability to flames and smoke to help describe the terms.

Discussion: In climate science, vulnerability is commonly framed and analyzed around what level of exposure they have to the effects of... how sensitive they

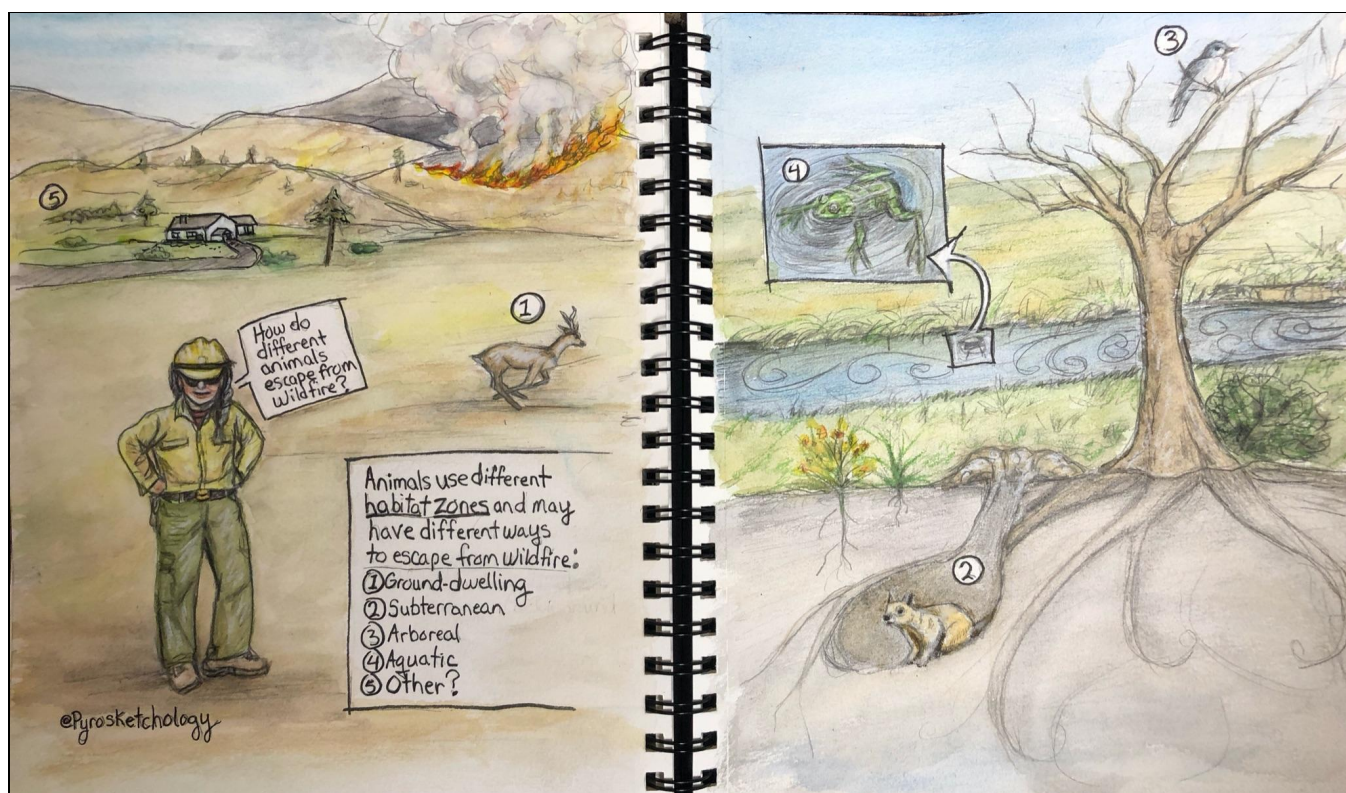
are to effects of... and what adaptation abilities they have in response to the effects of... Note that this lesson will not emphasize memorizing these terms but use them as prompts to observe things in different ways and to ask deeper questions around this subject.



Exposure- It is helpful to frame exposure to fire (when there are not active flames or burned areas to observe) around the fuels conditions as learned in the previous exercises. Thus, lots of continuous dry grass around an individual plant under observation would likely mean more exposure to fire than a small plant in the middle of a large boulder or rocky area. Lots of dry grass leading into ladder fuels around a tree would create more potential exposure for a bird or bird's nest.

Sensitivity- It's helpful to frame sensitivity around form and function and thus a plant may be sensitive to fire or smoke when it is small, thin, and dry and during its growing and reproductive cycle. An animal may be sensitive if it has small and delicate features such as a frog versus a turtle. Additionally, if it is a form that limits movement away from flames and weather. A tortoise would have a form more limiting than a bird to move away from a fire and weather. The more vulnerable functions for an animal can relate to stages of reproduction such as disturbance to breeding, nesting and rearing of young. Birds are more sensitive to fire during nesting season than later in the year when the young have flown away (fledged). Butterflies would be more sensitive when they are in a caterpillar form.

Adaptive Capacity- For this exercise frame adaptive capacity around how well the plant or animal can respond and recover from the effects of fire and smoke. This may be challenging as an observation if fire has not occurred more recently in an area, but there may still be signs and the questions can be asked by looking at the form and thinking about the function.



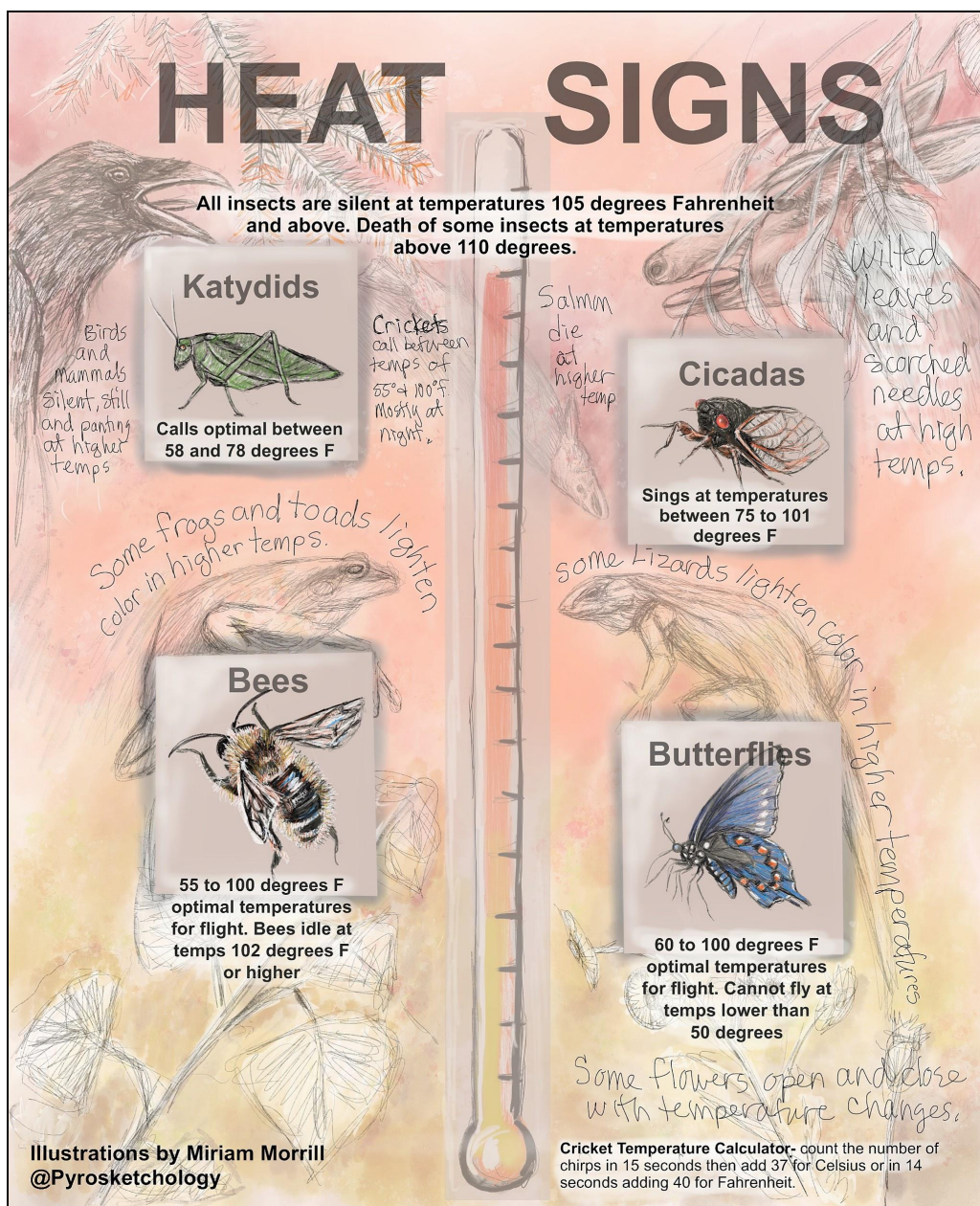
- Start as a group, ask students to look around and say out loud what they see and to discuss the effects and vulnerability of those things for 2 minutes.
- Ask to spend the next 8 minutes looking at a plant and or animal (or animal signs like sounds/calls, spiderwebs, burrows, nests, tracks) and put one or more observations on their story zine. For instance, if they see thick bark on a tree or an animal burrow, sketch the observation and ask questions or make assumptions related to fire effects and vulnerability.

EXERCISE: CLIMATE, FIRE & HEAT SIGNS (20 Minutes)

In this last exercise, we are expanding from fire and smoke effects, vulnerability and adaptive capabilities to considering the broader fire environment and climate influences using plant and animal observations. In the context of weather and climate, we are focusing on temperature (hot) and precipitation (dry) conditions.

- Ask students if they can describe how hot temperatures and dry conditions can affect fire.

Discussion- In previous lessons, we learned how weather (hot, dry, and windy) conditions create what is called fire weather. This is the period when fire behavior can be most extreme. These hot, dry and windy conditions influence fire season and fire weather, but what about ongoing trends over longer periods of time —climate? If hotter temperatures are occurring earlier, later or longer in a year or during nighttime hours when temperatures in the past were cooler, plants and animals can be impacted in many ways.



Discussion- In climate science, the temperature range that different plants and animals have adapted to is called a **climate envelope**. This is not just the comfort zone, but the temperature range needed for long term survivability of individual and sometimes species. We've seen the change in climate envelope happen across many mountain ranges in the United States including the Sierra Nevada. The local climate and environmental conditions are changing and many plants and animals are trying to survive in conditions at the edge of their climate envelope. One approach to help plants and animals adapt during climate changes is called **assisted migration**. This is when specialists bring plants or animals into a different area where they may survive better than the species previously there and survive into future climate conditions. This tool has been used to bring tree seeds from lower elevations into some burned areas on federal lands in the 2018 Camp Fire area. Hopefully this will allow a new generation of trees to survive.

- There are plant and animal signs we can observe that can inform us when the weather and climate are having negative effects. For instance, when trees are too hot, they close their stomata/pores in their leaves and can starve if hot conditions last too long. Sometimes, leaves are scorched and can no longer create food and sometimes, extreme cold and hot temperatures along with drought conditions can cause a stroke (embolism) in a tree's vascular system (xylem and phloem) crippling portions of the tree. When trees are under these stressful conditions, they struggle to fight off insect infestations like the beetle kill we've seen in many forests.
 - Signs of hot and dry conditions can include wilted or scorched leaves and needles and pitch streams coming down a tree trunk. Clear pitch is a sign that a tree might recover from the stress, but when there's dust from beetle larval activity (frass) that can give the pitch a red color, this is typically a sign the tree will die.
- Ask students to spend the next 10 minutes looking at the illustrations in this lesson and journaling their thoughts and memories about plant, animal and human responses to hot and dry conditions. If there is more time and the lesson is being conducted during the summer or early fall season, consider looking for heat signs and journaling observations. This is often more observable along the edge of a forest or open area where the plants and animals are more exposed.
 - Some of these signs may be from normal seasonal phenology changes (drying grass and seeds) and some may be signs from extreme events. Ongoing observations along with weather and climate data can help differentiate or add context, but are not required for this exercise and for becoming aware of the signs to look for.