Fire Ecology Lesson Plan

Adapted from: The United States Forest Service

Time: 60min

Location: Outdoors or Indoors

Materials:

Protractor

Aluminum pans (1 per every 3-4 students)

Boxes of kitchen matches (1 per every 3-4 students)

1 box tin foil

Student worksheet

Stopwatch

Rulers

Fire extinguisher & responsible adults for safety

Clay or Salt Dough (2-3 large handfulls per every 3-4 students)

*Salt Dough Recipe: 1 cup of salt 2 cups of flour 3/4 to 1 cup of lukewarm water Mix salt and flour. Add water a little at a time until a ball forms. Knead for a few minutes.

Next Generation Science Standards:

Cross-cutting concepts: Patterns; Cause & Effect; Stability & Change; Structure & Function

Science & Engineering Practices: Constructing Explanations; Engaging in argument from evidence; Developing and using models

Disciplinary Core Ideas: ESS2: Earth's systems

Background info:

Weather

- Certain weather conditions predict how a fire might behave.
- **Wind** can spread fire by blowing flaming material to new fuel. Wind can dry fuels and prime them for igniting. Wind also brings fresh supplies of oxygen to fire, at the same time feeding it and spreading it.
- The ambient **temperature** will determine how quickly fuels ignite. Hot temperatures indicate a high level of solar radiation, which can heat fuels and prime them for igniting more quickly.
- Knowing whether **precipitation** is in the forecast can help fire monitors decide when to allow burning and when to suppress it.
- Higher air **moisture** levels can dampen fuels. Therefore, a fire on a day with high relative humidity might spread more slowly, because fuels need to dry out to ignite. Likewise, fires may burn less intensely at night: because the sun isn't heating the air, relative humidity is often higher.

Fuel

- Fuel refers to burnable materials. In a forest setting, fuels are anything from duff (partially decomposed organic matter) and surface litter (fallen leaves, needles, pinecones) to full trees.
- Fuels can be classified by size, and also as dead or living.
- Some fuel characteristics that can influence fire behavior are:
    - Fuel loading- the amount of burnable material.
    - Fuel distribution- how fuels are situated on the ground (that is, are they clumped? Are they mostly aerial fuels or ground fuels?)
    - Fuel moisture- how much water is in the fuel (recorded as a percent of the total water a fuel could hold)
    - Fuel size and shape- for example, small, flat fuels dry out faster and ignite more readily than large, round fuels
- Many things can influence how a fuel will burn.
    - Moisture has a big effect, because wetter fuels must first dry out in order to ignite. This is why dead fuels burn faster than live ones.
    - Density also helps determine how fuels will burn. Fuels that are close together will more easily catch fire than those separated by swaths of unburnable material, such as rocks.
- Prompt students to list examples of Types of Fuel:
    - Surface Fuels
    - Needles or leaves

- Grass
- Small dead wood
- Downed logs
- Stumps
- Low shrubs

Topography

- Topography describes land shape. It can include descriptions of:
  - Elevation- height above sea level.
  - Slope- steepness of the land.
  - Aspect- the direction a slope faces (e.g., the south side of canyon has a north-facing slope).
  - Features- such as canyons, valleys, rivers, etc.
- Elevation and aspect can determine how hot and dry a given area will be (for example, higher elevations will be drier but colder than low ones, and a north-facing slope will be slower to heat up or dry out).
- Slope can determine how quickly a fire will move up or down hills. For example, if a fire ignites at the bottom of a steep slope, it will spread much more quickly upwards because it can pre-heat the upcoming fuels with rising hot air, and upward drafts are more likely to create spot fires.

Beginning the Activity:

1. Arrange students into groups. Each group should have no more than 4 people.

- Assign each group a terrain type. Depending on how many groups there are, choices can include:
  - Hilly
  - Flat
  - Canyon
  - Downhill
  - steep Uphill
  - steep Downhill
  - not steep Uphill
  - not steep Downhill Etc.

2. In addition, assign each group a fuel density level:

- dense (20 or more matches per square inch),
- moderate (10-19 matches per square inch),

- sparse (0-9 matches per square inch).

Groups can also experiment with "dead and downed fuels" (broken matches or matches not stuck into the clay). It doesn’t matter how density is assigned as long as there is variety across the groups.

Variation: If desired, assign all groups to one terrain type and vary the density, or assign all groups one density and vary the terrain type.

3. Give students time to create their matchstick forest.

- They will need to first sculpt their clay into the assigned terrain (using tin foil to fill in gaps or create slope if needed). The surface area of the clay should be about 8” x 8”.
- Next, they will need to stick matchsticks into the clay to create the assigned density. Have them use the rulers to check surface area and density.

4. Have students write /sketch descriptions of their forest on their worksheet.

5. Students should now predict how their forest will burn. They can write predictions on their worksheet.

6. Have the stopwatch ready. Each group should light their forests one at a time, so that the rest of the class can see. Time the burn from the ignition of the first match in the forest.

7. Each group should record observations about their own fire on their worksheet.

8. Compare burn times and discuss.

- Why did some forests burn faster than others? What topographical component seemed to make the most difference in burn time? (Slope, aspect, features, etc.)

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Name:_________________________

Student Worksheet: Topography & Fuel Density

1. Terrain: Use a protractor to determine the percent grade of your slope & record it here.

______%

2. Density:

Average trees per square inch? _________________

Dead or downed fuels present? _________________

3. Uniformity of trees? (circle one)

Very uniform Somewhat uniform Random

4. Sketch your forest model here:

5. Make a hypothesis about how your forest will burn (does not have to be time-specific).

6. Where will you light your forest from? Why? Be specific.

7. Observations about your fire:

8. Response to your hypothesis: