TUNDRA AND FOREST FIRE TRIANGLE

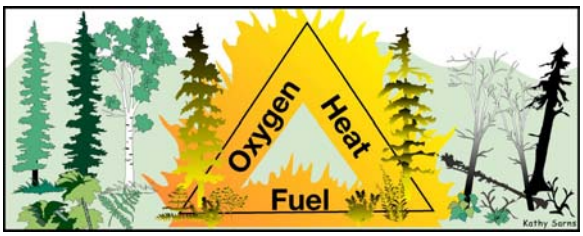
Grade Level: 5-12
Alaska State Content Standards: SA14, SA15
Subject: Science
Skills: Construction, Description
Duration: 30 minutes
Group Size: 4
Setting: indoors
Vocabulary: fire triangle, fuel, surface fuel, ground fuel, duff, canopy fuel, oxygen, heat

OBJECTIVE
Students will describe a fire triangle and its three components.

TEACHING STRATEGY
Students will create fire triangles by playing a card game. They will then use their fire triangles to identify fire fuel types.

MATERIALS
- Tundra or Forest Fire Component Cards, 1 set per 4 students
- Tundra and Boreal Forest Fire Fact Sheet, 1 per student

TEACHER BACKGROUND
Fire is a rapid chemical reaction that combines fuel and oxygen to produce heat and light. An external source of heat is usually required to start the reaction. Once the fire has started, it produces the heat needed to continue burning. There are three components needed to start a fire: **fuel**, **oxygen**, and **heat**. This is called a **fire triangle**. If any one of the components is missing, a fire cannot occur.



A **fuel** is anything that will burn in a fire. **Surface fuels** lie on or right above the ground; surface fuels can be leaves, grass, dead wood, partially decomposed plants, stumps, or brush. **Ground fuels** lie beneath the ground surface. Duff is the organic layer of soil consisting of decaying leaves, roots, or other plant material. This material makes up much of the ground fuel. **Canopy fuels** include tree branches and leaves, dead standing trees, hanging beard lichens, and high brush.

Oxygen is found in the air. The amount of fresh oxygen available to a fire is often influenced by the wind. Compare this to making a campfire. What happens when you blow on the fire? Wind also helps the fire by blowing the heat towards more fuel, moving the fire by carrying sparks, and drying out the fuel through evaporation.

Heat is provided by nature in the form of lightning or volcanoes. In interior Alaska lightning starts many fires. Matches, campfires, and cigarettes are often the sources of heat in many human-caused fires.

To stop a fire the triangle must be broken. To slow down a fire, one of the three components of the triangle must be changed. Think about ways that large and small fires are controlled. A way to remove heat is to throw water onto a fire – the water absorbs heat and also cuts off oxygen. You could stop the flow of oxygen by throwing dirt on the fire, using a fire extinguisher, or dropping fire retardant from planes. The fuel supply could be removed by building a fire line around the fire.

ADVANCED PREPARATION

Copy, cut out, and laminate the **Forest** or **Tundra Fire Component Cards**. Make enough cards so that each student will receive three. Be sure there are equal numbers of fuel, heat, and oxygen cards.

PROCEDURE

1. Discuss a fire triangle with the class as outlined in the Teacher Background section. To begin the discussion the teacher may wish to light a candle and ask the students what it needs to burn. Can you think of other ways fires might be started? Remember that once the fire has been started it produces its own heat. Place a jar over the candle. Students will probably know that the flame will go out. Why? (The oxygen has been eliminated.) How else could we extinguish the flame? (Cutting the wick from the

candle removes the fuel. Wetting the flame removes oxygen and absorbs heat.) Draw a diagram of the fire triangle on the board.

2. Discuss the different types of fuels, again found in the Teacher Background section. Pass out a copy of the "Tundra and Forest Fire Fact Sheet" handout to each student. Write examples for your ecosystem on the board.

3. Shuffle the **Forest** or Tundra Fire Component Cards and give 3 to each student. Each student will try to create a fire by obtaining cards that could be arranged in a fire triangle. Students trade cards with each other until a triangle can be made. When successful, he or she stops and sits down.

4. After all the trading is completed, allow the students to tell the class what components made up their fire. Make sure that each fire has all three components. If an incomplete triangle is formed, point out that no fire would have been started in that situation and discuss why. Ask the student or the class to describe the kind of fuel their fire used (ground, surface, or canopy). Students may be creative in solving this fire activity. If unusual triangles are created, ask the students to explain them to the class.

VARIATIONS

1. Each student is given only one card. Students would then be instructed to locate two other students to form a fire. At the end of the activity, each group of students would discuss the fire they had created.

2. Limit the number of fires by limiting the number of fuel, oxygen, or heat cards distributed. This will create a situation in which not all of the students will be able to form a fire triangle, demonstrating to the students that without all three components no fire can occur.

EVALUATION

Have students write their own Fire Component Cards with fuel from all 3 sources (ground, surface, and canopy).

EXTENSIONS

Students bring in newspaper articles on local fires. Discuss what the three fire components were in each case. If the fire was put out, how did the strategy work within the fire triangle concept? How was it extinguished?

REFERENCES

Used with permission from In Fire, the Story Behind a Force of Nature, “Fire: The Force in With Us” by Jack DeGolia, KC Publications, 1989.

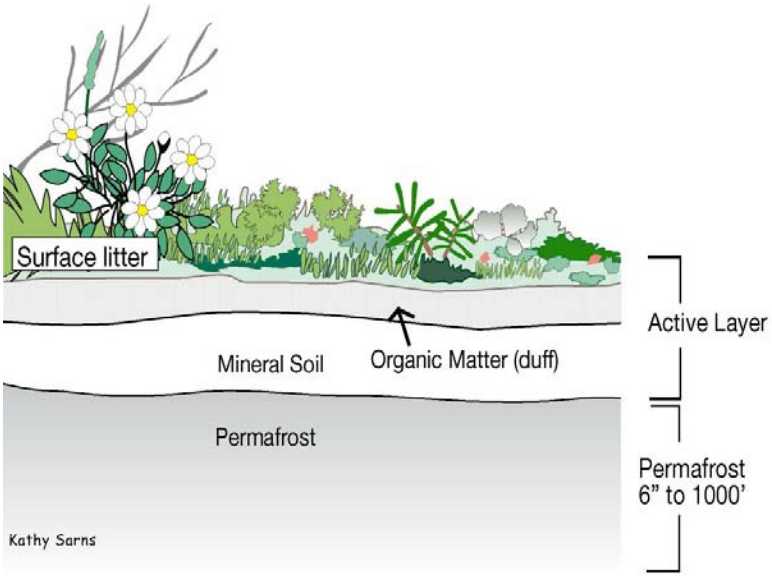
TUNDRA AND FOREST FIRE COMPONENT CARDS

Cut each component card the size of a large mailing label.

Oxygen – Calm	**Heat** – Thunderstorm lightning
Oxygen – Winds 40 MPH	**Heat** – Campfire left
Oxygen – Winds 20 MPH	**Heat** - Lightning on steep slop
Oxygen – Winds 5 MPH	**Heat** – Cigarette thrown into grass
Oxygen – Winds Calm	**Heat** – Lightning 90 F. No rain
Oxygen – Winds 15 MPH	**Heat** – Thunderstorm lightning with heavy showers
Oxygen – Winds 10 MPH	**Heat** – Lightning on flat land
Oxygen – Winds 30 MPH	**Heat** – Fire gets away

Tundra Fuel - Grass	**Boreal Forest Fuel** - Grass
Tundra Fuel – Mosses and lichens	**Boreal Forest Fuel** - Low brush
Tundra Fuel - Shrubs of Dwarf birch, dwarf willow	**Boreal Forest Fuel** - Tops of spruce trees
Tundra Fuel – Very dry, deep organic layer	**Boreal Forest Fuel** - Roots and organic matter in soil
Tundra Fuel - Large amount of dead material	**Boreal Forest Fuel** - Stumps and downed logs
Tundra Fuel - Cottongrass	**Boreal Forest Fuel** - Snags (dead standing trees) and high brush
Tundra Fuel - Shrubs Labrador tea, blueberry	**Boreal Forest Fuel** - Deep duff and decaying material
Tundra Fuel - Wet, sedge-grass tundra	**Boreal Forest Fuel** - Fire burned here 10 years ago leaving very little fuel build-up
Tundra Fuel - Fire burned here last year so there is little fuel build up	

TUNDRA FIRE FACT SHEET



Surface Fires: Burn all materials lying on or immediately above the ground.

Fuels: Include needless or leaves, litter, duff, grass, small dead wood, limbs, and low and high brush.

Ground Fires: Burn all combustible materials lying beneath the soil surface.

Fuels: Include deep duff, roots, and other woody materials.

Fire Intensity describes the amount of heat a fire produces. Fires can be low, moderate, or high in intensity. Factors that influence fire intensity include:

Fuel - Fuels that are small in size and very dry (grass) produce cool, fast fires. The more woody the fuel, the hotter the fire.

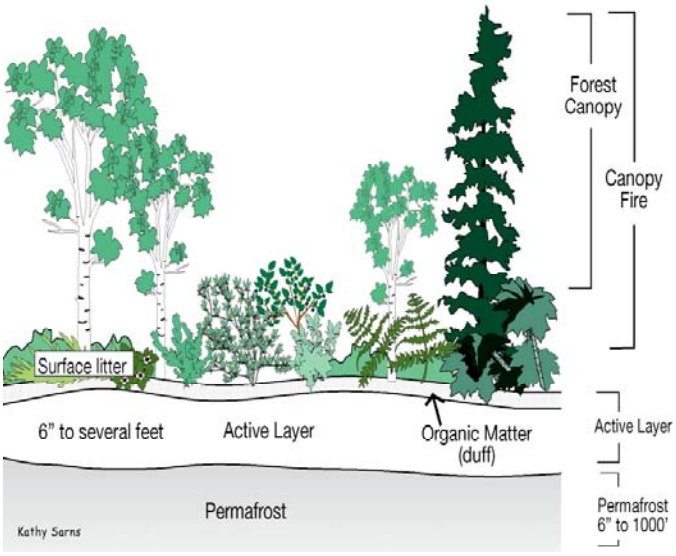
Moisture - The more moisture (or humidity) present the cooler the fire will be. Fires that burn in the spring are less intense than fires that burn during the dry summer months. Rain will lessen the intensity of a fire.

Topography - Slopes that face south, southwest, and west tend to be drier because they receive more sun and will burn more readily than north-facing slopes. Fires burning up a steep slope will burn more rapidly than on level ground. The fire creates its own updraft.

Wind - Wind will fan a fire, causing increased intensity.

Temperature - The higher the air temperature, the drier the fuel and the more intense the fire is likely to be.

FOREST FIRE FACT SHEET



Canopy Fires: Burn all green and dead materials located in the upper forest canopy
Fuels: Include tree branches and crowns, dead standing trees (snags), old mans beard lichen.
Surface Fires: Burn all materials lying on or immediately above the ground.
Fuels: Include needles or leaves, duff, grass, small dead wood, downed logs, stumps, large limbs and low and high brush.
Ground Fires: Burn all fuels lying within and beneath the organic soil layer.
Fuels: Include deep duff, roots, and other woody materials.

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Fuel - Fuels that are small in size and very dry (grass) produce cool, fast fires. The more woody the fuel, the hotter the fire. Spruce burns much hotter and faster than most deciduous trees.

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