Science Process: Observe & Measure, Classify, Experiment, Interpret & Communicate, Inquiry / Physical Science / Life Science / Earth Science / Math: Data Analysis (mean, median, mode, range), Measurement (drawing angles)

The Role of Fire in Healthy Prairie, Brush and Forest Lands

Background

The fires that raced across our state during the winter of 2005-06 were frightening and costly. Although the dry weather conditions and high winds caused them to spread, most would not have started without the carelessness of people. People cause 9 out of 10 fires. Some of the main causes of uncontrolled fires in Oklahoma are arson, untended campfires, lit cigarettes, improper burning of debris and playing with matches or fireworks.

Fire can destroy property and threaten lives, but it does not destroy the land or its wildlife or plant communities. It only causes changes in the vegetational form from one stage of plant succession to another. In the days before people lived on this continent, lightning started fires. All types of vegetation in Oklahoma evolved with fire as a major influence on their development. As a result, indigenous plants and animals are adapted to cope with periodic fire. Some plants need fire to complete their life cycles.

Early explorers such as Washington Irving and Thomas Nuttall found Native Americans using fire in all parts of the area now known as Oklahoma. Native Americans used fire to manage their food source—the herds of bison, elk, and other wildlife that helped make up the diverse prairie ecosystem. They also used fire to maintain prairie openings in forested regions. Early settlers followed this example for awhile but gradually stopped burning. As land use changed, particularly to farming annual crops, the land was broken up into small ownerships, so regular burning was no longer practical.

Today land owners recognize the importance of burning to maintain the health of the land. About 2.5 million acres of native prairie, shrubland and forestland are intentionally burned in Oklahoma each year. That is 6 percent of the total land area in our state.

Prescribed burning is an important means for keeping the ecosystems of Oklahoma's native plant communities healthy. Fire is considered an ecological driver. It gets things going.

P.A.S.S.

GRADE 6

Science Process—1.1,2,3; 2.1,2; 3.1,2,3,4,5,6; 4.1,5; 5.1,2,3,4
Physical Science—2.1
Life Science—4.1
Earth Science—5.1
Math Process—1.1,2,3,4,6; 1.1,2; 3.3; 4.1; 5.1,3,4
Math Content—5.1,3

GRADE 7

Science Process—1.1,2,3; 2.1,2; 3.1,2,3,4,5,6; 4.1,5; 5.1,2,3,4
Life Science—3.1; 4.2
Earth Science—5.1
Math Process—1.1,2,3,4,6; 1.1,2; 3.3; 4.1; 5.1,3,4
Math Content—5.1,3

GRADE 8

Science Process—1.1,2,3; 2.1,2; 3.1,2,3,4,5,6; 4.1,5; 5.1,2,3,4
Physical Science—1.1
Life Science—3.2
Math Process—1.1,2,3,4,6; 1.1,2; 3.3; 4.1; 5.1,3,4
Math Content—5.1,3

Prescribed Fire Associations

Fire can be dangerous and should be used only with caution and proper training. Oklahoma landowners and other concerned citizens form Prescribed Fire Associations to conduct prescribed burns under strictly-controlled conditions. Members of these associations attend burning workshops and participate on fire crews to gain experience with controlling fires. Prescribed burning requires knowledge of weather, fire behavior, fuels and ecology along with good judgment and experience. Most prescribed fires are conducted during the winter or spring.

The most important preparation for a prescribed burn is preparing a fire break. A fire break is an area where no fuel is available for a fire to burn. Most landowners clear a firebreak area by bulldozing or plowing. If an existing road is available, that can also act as a fire break, as can natural barriers such as streams, canyons or rock outcrops.

Weather variables important to planning for a prescribed fire include relative humidity, air temperature and wind speed. Wind speed and direction can change almost instantly, so landowners must be careful not to start a prescribed fire within 12 hours of a weather front or when winds are variable in direction.

The amount of water in dried grass is directly related to relative humidity and can change dramatically within one hour. Changes in relative humidity will drastically change fire behavior and combustibility of fuels. The amount of time since a rain and the amount of tree or shrub cover will also impact fuel moisture and fire behavior. A fire that can be conducted safely at 40 percent relative humidity will pose safety risks at 20 percent relative humidity.

Fire facilitates nutrient cycling, water cycling, and soil health. It helps maintain watershed function, water quality, and water yield.

Cattle producers use prescribed fire to eliminate standing dead forage and provide livestock with green forage of higher nutritive value. Fire releases phosphorus and potassium from dormant standing forage. The blackened surface generally greens up earlier than nonburned areas, thus providing earlier grazing. Cattle play the part in the prairie ecosystem that bison and other game played long ago. When cattle graze, they reduce the length of the grass. This actually helps prevent the spread of wildfire if it occurs.

Prescribed fire is also beneficial to wildlife. It even helps maintain the habitat for some endangered or threatened species. It helps manage some disease-carrying organisms and control non-native or undesirable plant species, plant diseases, insects and some animal parasites. Prescribed fire is an economically and ecologically sound alternative to herbicide use to reclaim native prairies, shrublands or forests. It also reduces the probability of wildfire.

Background Source: Bidwell, Terrence G., John R. Weir, J.D. Carlson, Ronald E. Masters, Samuel D. Fuhlendorf, Jack Waymire, and Steve Conrady, "Using Prescribed Fire in Oklahoma," Oklahoma Cooperative Extension Service Fact Sheet No. E-927, Division of Agricultural Sciences and Natural Resources, Oklahoma State University, 2003.

Activities

Read and discuss background.

—Brainstorm to find students' prior knowledge about fire, both positive and negative.

—Brainstorm reasons for wildfires.

—Using a Venn diagram, list the similarities and differences between wildfires and prescribed fires.

ACTIVITY 1

1. Hand out copies of the "Fire Triangle" worksheet included with this lesson.
   —Students will work in pairs to complete the worksheet.
   —When all students are finished, lead a discussion about the three things needed for fire to burn.
   —Draw the fire triangle on the board or have a student volunteer do it.
   —Ask students under what conditions they think it would be easy to start a fire.
   —Under what conditions would starting a fire be difficult?
2. Show students the candle and the jar and ask how they might test what happens when one of the three elements of

the fire triangle are limited. (This can be a teacher-led class demonstration or can be conducted under supervision in groups at a lab table.)
—Students record predictions and observations at every step of the demonstration.
—Light a tealight candle.
—Students identify the three elements of fire present in the burning candle: candle=fuel; air in jar= oxygen; flame=heat.
—Students predict what will happen if you place the jar over the tealight.
—Place the jar over the tealight to cut off the supply of oxygen. As the flame consumes the oxygen in the jar's air, the flame will go out.
—Students discuss the cause for the flame going out.
—Explain that cutting off oxygen is one way to manage a fire. Discuss ways to cut off the supply of oxygen in a fire.
—Remove the jar, relight the candle, and put the jar back over the tealight. This time, when the flame starts to go out, lift the jar to let oxygen in. The candle should reignite.
—Explain that this illustrates what happens when the wind picks up during a fire. The fire may reignite or burn out of control.
—Remove the jar completely, and allow the candle to burn until all the fuel is consumed and the fire extinguishes itself.
—Students estimate how much time it will take.

3. Discuss fire safety before conducting this experiment.
—Place a corn or potato chip in the aluminum baking dish and light it.
—See how long it takes to burn.
—What fuel in the chip made it burn? (vegetable oil, found in all plants) As an extension, try burning baked and regular potato chips and compare the results.

—Place the green grass and dead grass in the baking dish and light them. Which burns faster?

ACTIVITY 2

1. Hand out copies of the worksheet, "Preferred Weather Conditions for Prescribed Fires," included with this lesson.
—Students will track the weather forecast for five days to determine whether conditions are favorable or unfavorable for burning, using the information provided on the worksheet.
—Students use the data gathered to graph temperatures, relative humidity and wind speeds.

Resources Needed

tealight candles

lighter

matches

paper

scissors

clear glass jar

fresh grass

dead grass

disposable aluminum baking dish

newspapers (sometimes available free to classrooms, computer access or other resource for locating weather forecasts)

Ag in Your Community

Invite a member of a local Prescribed Fire Association to class to discuss the reasons for prescribed fires and precautions taken by landowners to control fires. (Contact your local NRCS or Conservation District Office.)

Vocabulary

arson—the illegal burning of a building or other property
debris—carelessly discarded refuse; litter.
diverse—differing from one another
ecosystem—a system made up of an ecological community of living things interacting with their environment especially under natural conditions
indigenous—produced, growing, or living naturally in a particular region or environment
nutrient cycling—all the processes by which nutrients are continously transferred from one organism to another in an ecosystem
plant succession—a gradual process incurred by the change in the number of individuals of each species of a community and by establishment of new species populations that may gradually replace the original inhabitants
prairie—a large area of level or rolling grassland
water cycling—the continuous circulation of water within the Earth's hydrosphere, usually driven by solar radiation.
watershed—the area that drains into a river or lake

—Students find the mean, medium, mode and range of the weather data they have gathered.

ACTIVITY 3

One consideration for planning a prescribed fire is making sure the smoke does not cross a road or drift into areas where people are present. Fire planners use a trajectory 30 degrees in each direction to determine how far smoke will travel, based on the direction the wind is blowing.

1. Hand out the "Wind Trajectory Map."
   —Students follow the directions to determine which burn site is least likely to allow smoke to drift into the school or the road.
   —On the back of the worksheet, students draw a simple map of their schoolyard.
   —Students determine the wind direction.
   —Students find the safest spot for burning, based on the wind direction and the smoke trajectory.
2. Divide students into groups and take them outdoors. Each group must select a location on the schoolyard for an imaginary prescribed burn. Each group should:
   —Determine which way the wind is blowing.
   —Locate a spot on the schoolyard some distance from the school building.
   —Mark off a line in the direction the wind is blowing.
   —Mark off two 30-degree trajectory lines on either side of the line.
   —Would the smoke from the burn site reach the school?
   —Students justify their reasoning.

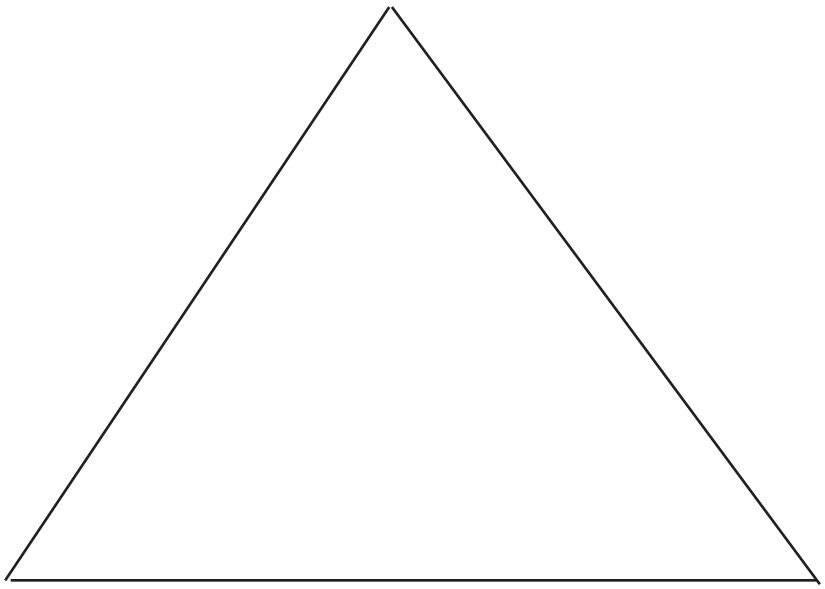
Extra Reading

Alianor True, ed. *Wildfire: A Reader.* Island Press, 2001.
Beil, Karen, *Fire in Their Eyes: Wildfires and the People Who Fight Them,* Harcourt, 1999.
Morrison, Taylor, *Wildfire*, Houghton Mifflin, 2006.
Pyne, Stephen J., *America's Fires: Management on Wildlands and Forests,* Forest History Society, 1997.

Name _____

Fire Triangle

Fires need heat, fuel, and oxygen to burn. This is known as the "fire triangle." Label each of the three sides of the triangle below with one of the components needed for fire. Draw a picture to illustrate each component.



Initially, the heat is provided by an ignition source, which can be human or natural. Name one natural and one human-caused source of heat for fire ignition.

Natural: Human:

Fires need fuel to burn. In a forest or grassland, what sort of fuels might you expect to find? Name two potential fuels:

1. 2.

Oxygen is available in the air. Weather has a great influence on when fires occur and on how they spread. Hot temperatures and dry winds can create severe fire conditions by affecting fuel, moisture, and oxygen. What can dry winds do to fuels to make them more likely to burn?

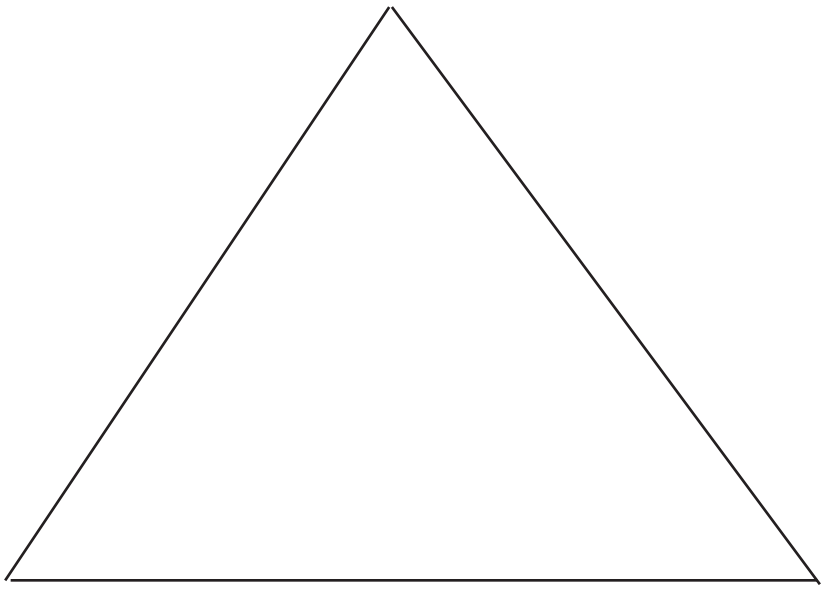
If you cut off any one of these three elements, a fire will not burn. What are some ways that firefighters might cut off each of the three parts of the fire triangle?

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2008.

Name _____

Fire Triangle (answers)

Fires need heat, fuel, and oxygen to burn. This is known as the "fire triangle." Label each of the three sides of the triangle below with one of the components needed for fire. Draw a picture to illustrate each component.



Initially, the heat is provided by an ignition source, which can be human or natural. Name one natural and one human-caused source of heat for fire ignition.

Natural: **lightning, sparks from rocks falling, volcanic activity, spontaneous combustion of plants**

Human: **playing with matches, untended campfires, arson, lit cigarettes, improper burning of debris**

Fires need fuel to burn. In a forest or grassland, what sort of fuels might you expect to find? Name two potential fuels:

1. **dry grass**
2. **dry wood**

Oxygen is available in the air. Weather has a great influence on when fires occur and on how they spread. Hot temperatures and dry winds can create severe fire conditions by affecting fuel, moisture, and oxygen. What can dry winds do to fuels to make them more likely to burn? **Remove the moisture.**

If you cut off any one of these three elements, a fire will not burn. What are some ways that firefighters might cut off each of the three parts of the fire triangle?
Remove fuel by plowing up grass or burning an area in the path of the fire; remove heat by dousing the fire with water; remove oxygen by smothering the fire with chemicals.

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Name _____

Preferred Weather Conditions for Prescribed Fire

wind speed	5-15 mph
relative humidity	30-60%
temperature	55-65 degrees F

Check the weather forecast for the next five days to determine which day would be best for a prescribed fire. Besides the conditions listed in the table above, check for variable winds and the movement of a front, which could change conditions quickly. Develop a table below showing the conditions for the next five days.

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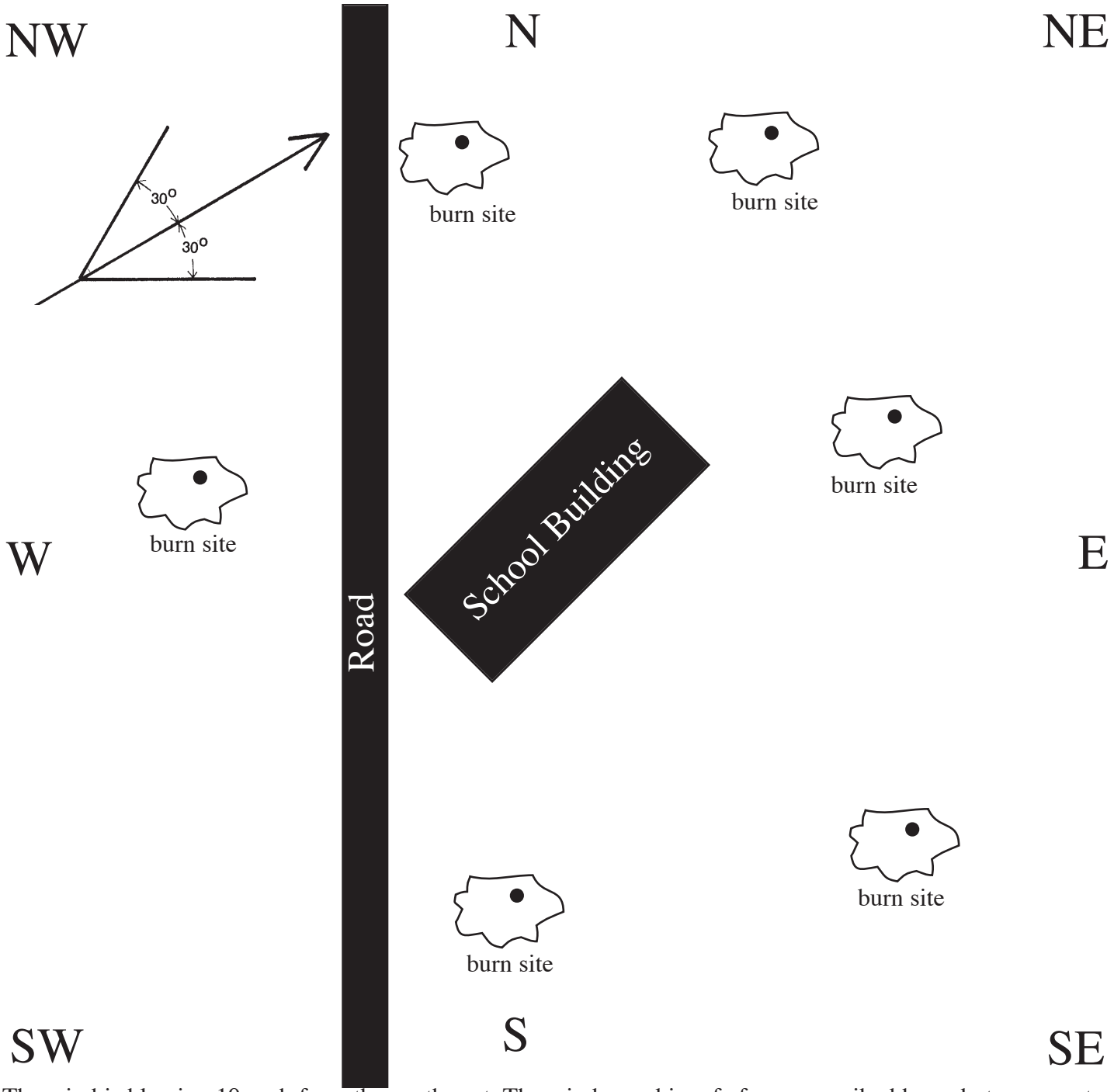
Name _____

Wind Trajectory Map



The wind is blowing 10 mph from the southwest. The wind speed is safe for a prescribed burn, but you must make sure the smoke does not drift into a nearby school or into the road.

1. Draw a straight line from each burn site in the direction the wind is blowing.
2. Draw trajectory lines 30 degrees from the straight lines.
3. Circle the sites which are safe for burning without the danger of smoke drifting into the school or the road.

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