Handout H05-1. Fuel Properties: Pre-Lab Reading and Scavenger Hunt

Name: _____

Read this information to learn about wildland fuels. This will help you design experiments to do in the lab. When you come to a "Scavenger Hunt assignment," you will need to go outdoors and either sketch something or collect something to bring to class.

Fuel Properties: Properties of wildland fuels influence how they burn. Specifically, fuel properties determine how fires heat the fuels and how much oxygen is in contact with them, and thus how quickly they will ignite and how long they will burn. Anyone who has built a campfire knows that you have to choose your fuels wisely and arrange them carefully. Several fuel properties influence fire behavior, including:

- Size and shape
- Moisture content
- Amount
- Spatial arrangement

1. Particle Size and Shape: The size and shape of fuel particles affect how fuels heat up. One component of size and shape is the surface-area-to-volume ratio (SA/V). SA/V describes fuel particle fineness – that is, the amount of outer surface exposed to air and heat, relative to its volume. Surface-area-to-volume ratio is important because it affects the rate at which a fuel particle will change temperature as a result of heat transferred from its surroundings.

Imagine lighting the fuels in a campfire by holding a match beneath them. As you know, the match's heat will rise, so the fuels will be heated by convection. Now ask: Which is easier to ignite - a thick, dead log or a dead pine needle? The pine needle is easier to ignite (if it is dry, of course), because the heat can penetrate the whole needle quickly, and the surface area exposed to oxygen is great relative to the needle's volume. The log is harder to ignite because the heat that reaches the surface is transferred to the inside (so the log heats slowly), and because the surface area exposed to oxygen is small relative to the log's volume.

a. Examples of fine (small) fuels: grasses, leaves, pine needles, and twigs. Because fine fuels are small, they burn up quickly – as long as they are dry.

Scavenger Hunt assignment: Find an example of a fine wildland fuel that is dry. Put the sample in a bag and label it "fine fuel".

b. Examples of coarse (large) fuels: logs, stumps, and thick branches. Coarse fuels tend to burn slowly. Think of a log as having many concentric layers of fuel. The outer layer has to burn away before the next layer is exposed to oxygen and heat and can burn away, exposing the next layer to oxygen and heat, etc., etc.

Scavenger Hunt assignment: Find an example of a coarse wildland fuel. Draw it below. Include a measurement or an object to show how big the fuel actually is:

2. Moisture Content: How well fuels ignite and burn depends, to a large extent, on their moisture content. The drier the fuels, the less heat is needed to remove the water they contain.

a. Wet Fuels: Moisture makes fuels hard to ignite and also makes them burn slowly. This is because the moisture must be heated up and vaporized before a particle can be heated to ignition temperature. Moisture may also make them fuels incompletely, producing a lot of smoke.

b. Dry Fuels: The drier the fuels, the less heat needed to remove water, so the more easily they will ignite and the more completely they will burn. That's why you don't use wet wood to make a campfire!

Scavenger Hunt assignment: Find an example of a moist wildland fuel and an example of a dry wildland fuel. Put them into separate bags and label them "wet fuels" and "dry fuels".

3. Fuel Loading refers to the amount of fuel present. Fuel loading is measured in terms of weight per unit area (for example, tons per acre). The more fuel, the longer your fire can burn and the more heat it can produce.

Scavenger Hunt assignment: Find a landscape with heavy fuel loading and find a landscape with light fuel loading. Sketch and label them in the boxes below.

4. Spatial Arrangement means how fuels are arranged in space, both horizontally and vertically. **Fuel continuity** describes the spacing of fuel particles – close together or far apart.

a. Continuous Fuels: fuels that are in contact with each other with no substantial gaps between them. Continuous fuels provide an uninterrupted path for fire spread, either horizontally or vertically.

Scavenger Hunt assignment: Find a landscape with continuous fuels (either horizontal or vertical) and sketch it in the box**.**

b. Discontinuous Fuels: describes fuels that have gaps between them. Fuels are interrupted by bare ground, rock outcroppings, water, and/or vegetation that is highly resistant to ignition. Discontinuous fuels along the ground surface are also called "patchy fuels."

Scavenger Hunt assignment: Find a landscape with discontinuous fuels and draw it in the box.

c. Fuel particles can be so **tightly packed** that heat and oxygen cannot easily reach their surfaces. This makes it hard to ignite them, and they burn slowly. (For example, think of a thick pile of newspapers or deep duff on the forest floor.)

Scavenger Hunt assignment: Find a spot with tightly packed fuels and draw it in the box.

d. Fuels may look continuous but be so **loosely packed** that fire cannot spread easily from one particle to the next. (For example, think of a thin layer of sparse grasses.)

Scavenger Hunt assignment: Find a landscape with loosely packed fuels and draw it in the box.

Sources:

Introduction to Wildland Fire Behavior, S-190 Wildfire Coordination Group's (NWCG), Wildland and Prescribed Fire Curriculum (http://training.nwcg.gov/pre-courses/s290/S-290%20Student%20CD/S-190_Student%20Workbook.pdf).