Soil Science Society of America

Grade Level: 3-5, 6-8, 9-12

Type of Lesson:
Activity

Materials Needed
- Soil (from garden, yard, natural area)*
- Alfalfa meal
- Aluminum containers with lids
- Distilled water
- Clear plastic wrap
- Optional: dissecting microscopes

Time
Teacher Prep: 60 minutes to gather/print materials
Student Class Time: 15 minutes, optional 15-30 minutes to have students mix the soil and prep the trays themselves

Student Learning Objectives:
- Practice observing and describing soil organisms
- Recognize the impact of fire on soil fungi
- Hypothesize how fire would impact soil ecosystems

Keywords
Fire, soil organisms, fungi

NGSS Standards
3-5, 6-8, 9-12 ESS3.C: Human impacts on Earth systems
3-5, 6-8, 9-12 LS2.C: Ecosystem dynamics, functioning, and resilience

Author : Gordon Rees

Simulating Fire Impacts on Soil Life

Overview

Wildfires have a variety of impacts on soils, altering physical, chemical, and biological properties. Many of these changes are a result of the high temperatures associated with fire, and more severe fires result in higher temperatures and bigger changes. Soil near the surface experiences the most extreme heat, with temperatures decreasing quickly with depth. Water in the soil can also help buffer temperature changes to reduce impacts. The ecosystem of living things within soils, including insects, burrowing animals, and billions of microbial organisms like bacteria and fungi, can be killed if temperatures get too hot. After severe fires, there is often a shift in soil organism communities as new organisms move into soil after previous communities have been wiped out.

Growth with Alfalfa in Soil: Fire vs. Non-Fire Credit: Gordon Rees

In this activity, the impact of fire is simulated by heating soil in an oven, and the fungal community in the soil is observed based on growth of visible structures in the presence of a microbial food source.

Procedure

*Note: Some soils may produce better results than others – try with a few different options to see which works best for you. **Avoid any material that may contain synthetic fertilizers, pesticides, or other components which may produce harmful fumes when heated.**

Mix 9 parts soil with 1 part alfalfa meal (by volume) in a bucket, and distribute into aluminum containers filling to about an inch deep.

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Label half of the containers as “fire impacted” and heat only these containers in an oven IN A WELL-VENTILATED SPACE at 350° F for at least an hour. Be careful to avoid breathing fumes that may be released during heating.

After heating, stir in distilled water until the soil looks moist but not so wet that water can be poured out of the soil when tipped.

Label the non-treated containers as “control” and add distilled water as needed until it is similarly moist.

Put lids on all containers and let sit for at least two days and up to a week. After this incubation period, open the cans and observe any fungal growth that has taken place. Cover the containers with clear plastic wrap to minimize any release of mold spores into the air. Compare the control soils to the soils that were heated. If you have appropriate microscopes available, you can observe the fungi with those as well.

Results

Record procedures and observations in the following table:

Description of soil used:	
Total time of incubation:	

Treatment	**Observed appearance before incubation**	**Observed appearance after incubation**
Control		
“Fire impacted” (heated in oven)		

Questions

- How did the observable fungal growth differ between the control and the heat-treated soil?
  (Expected results: lots of growth in the control, but none or almost none in the heated soil)
- Why do you think these differences occurred?
  (High temperatures killed the fungus living in the soil, so it couldn’t grow during the incubation)
- What is the likely impact of wildfire on fungi in soil?
  (Intense fire will kill fungi near the surface of the soil)
- Other organisms, such as bacteria and insects, were not observed in this experiment. What can you infer about how they would be impacted by heat from a fire?
  (Any living thing near the soil surface would likely be killed as well by the heat from fire)
- If soil 6 inches below the soil surface only experiences slight warming with fire, what implications would that have for the impact of fire on life in soils?
  (Though living things near the surface would die, the organisms below would likely survive and could move into the surface soil as part of recovery from the fire)

Additional experiments to learn more

To further examine how fire/heat impacts life in soils, try adjusting some of the parameters to see what changes. Example questions to explore:

- Do soils from different locations behave differently? (E.g., forest vs grass vs crops)
- What happens to the observable fungi after longer incubation times (1 week, 2 weeks…)?
- What happens if the alfalfa (fungus food) is added after the heating step vs before?
- How does temperature and time of heating impact results? What is the minimum temperature that produces results?
- How does water content of the soil before heating impact results, especially for shorter heating times or somewhat lower temperatures?
- How does the amount of water added before incubation (after heating and for the control) impact fungal growth?