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Fungi: Strongmen of the Underground

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How-To-Do-It

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Where would we be without decomposers? Think of the volume of organic materials that would be piling up all around us if it were not for these recyclers: mounds of insect skeletons, dead animals, forest litter, our own waste products. No one will dispute the importance of decomposers in maintaining our health and that of our ecosystems. However, in our classes, little credit is usually given to the fungi and bacteria that do all this maintenance for us. In fact, these essential organisms are more often presented in a negative light. Bacteria are typically stressed for their role as disease-causing microbes. Fungi are known as destructive agents, harming our crops, weakening structures, and ruining our food! (Who hasn't seen mold growing on those forgotten containers in refrigerators or lockers?)

In an attempt to have our students develop a more complete understanding of fungi, we have devised the following activity. It stresses the role of fungi as decomposers, highlights the rapidity by which they complete this process, and allows students to experiment with ways to "control" the rate of decomposition. We present the students with the following true scenario involving hop growers. (Hops are used to flavor beer.) If you find the subject of hops uncomfortable or unsuitable for your class, you can substitute the growth of pea plants, as they follow a very similar pattern.

To cultivate hops, growers must provide posts and strings for the hop vines to attach themselves to as they grow. Hop vines die back each year. In the fall, the hop vines, string and all, are cut down and the flowers are removed for processing. The waste vines and string are left in the field to rot. The most desirable situation is for the hop string to "survive" one growing season, but degrade before the next so the string remains do not build up in the field. Here is where the role of fungi comes into play. Hop growers prefer a string that is actually a type of twisted kraft paper because it is easy to work with and has the desired strength properties. However, because the string is cellulose-based and is in contact with the ground, fungi can easily spread from the soil onto the string and use it as a food source. (Cellulose degrades rapidly with soil contact.) The problem is to control the growth of the fungi so the hop string will maintain its strength until it is no longer needed to support the vines.

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Our students readily agree that it is easier to manipulate the string than to try to manipulate the naturally occurring population of fungi in the soil. Their task is to find ways to alter the string so the rate of fungal decomposition of the string will be slowed. Depending on the size of your class, you may want the students to work on this problem in small groups, or brainstorm as a class and then divide into groups to perform the experimental setups. We do the latter. Variables that our students have come up with as possible retardants of fungal decomposition have included dipping the string in diesel fuel, paraffin, paint, cooking oil, and commercially available fungicides. Basically, we allow the students to use anything that they decide would be practical in terms of effectiveness, safety, economics and availability.

Setting up the experiment takes very little money, time and material. The standard needs are cellulose-based string (Thomas Suave, Biotwine Manufacturing, P.O. Box 430, Toppenish, WA 98948; Phone: 509-865-3340; FAX: 509-865-5525), containers with slits (disposable, aluminum bread loaf pans; you will need two containers for each variable tested), soil with fungal populations (that is, soil from a garden—not sterilized potting soil), plastic bags large enough to fit around the containers, and a mister. Other materials depend on the students' chosen variables. At the close of the lab, to test the effectiveness of the antifungal agents, we use a ring stand with a ring, an "s" hook and suspendable weights to test the ability of the string to support a load.

In each of our aluminum containers we make five evenly spaced slits extending from the open top halfway down both the sides. This is where we will place the strings. Five slits enable us to have four replicates and a control string in each container. Cut equal lengths of string that are at least 12 centimeters longer than the width of the container. Make a loop knot at each end. (This will allow for insertion of the "s" hook and weights later in the lab.) Treat the test strings and leave the control strings unaltered. Treating can be done by soaking the strings in a small aluminum tray for 30 to 60 seconds. (Do not use water-based solutions as the cellulose string rapidly absorbs moisture and unravels.) Next, fill the container up to the slit with the active garden soil. Place the strings across the container, with the looped ends extending out on both sides of the container. The sequence we use is two test strings, the control string, and two more test strings. Fill the remainder of the container with soil. Be sure to mark the container (masking tape works well) as to the variable being tested. Make a duplicate setup. Mist one of the containers until the soil is damp. Place in a plastic bag and close with a twist tie. Keep the other container dry. Place in a plastic bag and close. Both containers should be placed in a convenient location where they can remain undisturbed for about 7 to 10 days. Continue with this setup until duplicate sets of the other variables have been prepared.

After the 7-to-10 day test period, it's time to see how the variables fared. Remove the containers from the plastic bags and gently scoop the soil from the top half of the containers. Test

Table 1. Amount of weight (in grams) needed to break treated strings exposed to fungi in wet soil.

	Amount of Weight (in grams) Needed To Break Strings				
Treatment	Sample 1	Sample 2	Sample 3	Sample 4	Average
Control					
Diesel					
Paraffin					
Paint					
Oil					
Fungicide					
(Other)					

each string to determine how much weight is needed to break the string. This can easily be done by suspending one end of the string from the ring on the ring stand with an "s" hook. Suspend weights from the looped knot at the other end of the string. Small increments should be added until the string breaks. It generally does not take much weight to make the string fail, especially those that have been kept damp! (We have never needed more than 500 grams and, in some cases, the string is already in pieces when we try to take it out of the container!) Have the students look at the soil in the container to see just how much fungal growth or mycelium is present to the naked eye. (Generally, it's not much!)

The students should record the weights needed to break each string. We find it easiest if they record the data on two separate data tables: one for the wet containers and one for the dry. (See Table 1 for an example.) They can then compare the variables and the moisture factor as an influencing effect. If desired, they can construct double bar graphs to depict the data, pairing up the dry and wet conditions for each variable. Whether they use the graphs, tables, or both, the students should be able to easily determine that moisture is an important component in the growth of fungi and that small amounts of fungi are capable of rapid degradation of cellulose!

Students should gain an appreciation for how strong these hidden decomposers are, how much of a role they play in our lives, and how "tricky" they can be to detect. If students are interested, they can research what methods/techniques are used in industry to protect our cellulose-based structures (i.e. wood) from fungal attack or devise new fungicidal inhibitors themselves! With a little ingenuity, the strongmen of the underworld can be controlled and subdued.