Microbes ate my homework

### The aims of this practical are:

* to investigate how quickly different kinds of paper decompose under the action of soil microbes
* to explore the role of soil microbes in the carbon cycle
* to introduce the use of enzymes in industrial processes.

**Investigation**

A large part of paper is the chemical substance called cellulose. Paper is made from woody plants and cellulose makes up 40-50% of the cell walls of plants. The molecules are very large and very long – so they are not soluble in water. But if they are digested or broken down by enzymes from microbes, they are changed into smaller molecules that will dissolve in water. Once the cellulose is broken down, microbes (and other living things) can use it as food. We can’t digest cellulose ourselves, so all the cellulose we eat passes through our digestive system unchanged. This is called ‘dietary fibre’. In this investigation you will find out how microbes in the soil change paper over a few weeks. You might be able to find out about paper in our rubbish and cellulose in composting as part of this investigation.

### Procedure

1. Label 6 test tubes A-F, and add your name and date.
2. Use the graduated pipette and filler to place 5 cm3 of nutrient broth in a test tube. Carefully drop in a 1 cm x 2 cm sample of filter paper.
3. Place 5 g of soil and 40 cm3 of nutrient broth in the conical flask. Swirl the contents to form a suspension. Allow it to settle for a minute to avoid blocking the pipette.
4. Pipette 5 cm3 of the supernatant of the nutrient broth/ soil suspension into each of the five remaining tubes. Put the pipette into a discard beaker.
5. Into tube B, carefully drop in a 1 cm x 2 cm sample of filter paper.
6. Put a 1 cm x 2 cm sample of a different kind of paper or card into each of the other four tubes C-F.
7. Stopper each tube with cotton wool or cover loosely with aluminium foil.
8. Record the contents of each of the six tubes in a table like the one overleaf.

|  |  |  |  |
| --- | --- | --- | --- |
| Tube | Treatment | Appearance after …… weeks | Appearance after …… weeks |
| A | Nutrient broth (sterile) + filter paper |  |  |
| B | Nutrient broth + soil + filter paper |  |  |
| C | Nutrient broth + soil +  |  |  |
| D | Nutrient broth + soil +  |  |  |
| E | Nutrient broth + soil +  |  |  |
| F | Nutrient broth + soil +  |  |  |



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1. Leave the tubes at room temperature for at least a week.
2. Before reviewing the tubes, give each a tap with your finger. Observe carefully what happens to the paper strip. Do not take out the cotton wool stoppers.

**QUESTIONS**

1. In this investigation, what is the purpose of the tube containing filter paper with sterile nutrient broth and no soil?
2. Why is it important not to take out the cotton wool stoppers?
3. How have the papers changed as a result of the action of microbes from the soil?
4. Which paper has decomposed the least?
5. What would you do to develop this investigation to give you more information about soil microbes and cellulose? How could you improve it?
6. Mark the position of soil microbes on a diagram of the carbon cycle.
7. How much do you think we should worry about the paper we have thrown away into landfill?
8. Cellulose in plant material is a store of carbohydrate. If we can release the carbon from that cellulose, it might make a useful fuel, or a useful foodstuff. How could soil microbes help us to release the carbon from plant cellulose?
9. If you are interested, you could find out how herbivores such as cows and rabbits manage to get nutritional value from the cellulose in their food – with the help of microbes. Are you glad your digestive system doesn’t work like a rabbit’s?

**ANSWERS**

1. The filter paper with no soil added acts as a *control*. It shows us that any change in the papers is due to the soil suspension, not to the nutrient broth, or the effect of damp and light on the paper over time.
2. To reduce the risk of contamination, especially from airborne spores, we leave the stoppers in.
3. The papers will have become softer and begun to disintegrate in the liquid – to a greater or lesser degree depending on the type of paper.
4. Depends on samples.
5. Depends on student response.
6. Depends on your diagram.
7. Depends on student opinion.
8. If we could digest cellulose on an industrial scale, we might be able to use cellulose as a feedstocks for producing biofuels or even for the food industry.
9. An internet search should turn up some interesting information.