1. Investigating food sources for microbes

1.5 hour activity

Children adopt the role of scientists working on behalf of a pharmaceutical company to develop a new cough syrup. They investigate a range of food sources for cultivating yeast. This information about growing conditions can then be used to grow a micro-organism for extraction of an active ingredient.

TYPE OF ENQUIRY

- Fair test
- Observation over time

OBJECTIVES

- To plan different types of scientific enquiry including recognising and controlling variables where necessary.
- To record data and results using scientific diagrams and tables
- To report and present findings from enquiries including conclusions, causal relationships and explanation of and degree of trust in results in oral and written forms.
- To develop their understanding of micro-organisms as living things

SCIENCE VOCABULARY

Micro-organism	Ingredients	Change
Investigation	Fair test	Factor
Compare	Improve	Evaluate
Results		

RESOURCES

(per group of 2-4 children, unless otherwise stated)

- Activity sheet 1
- Activity sheet 2 (one per child)
- 4 sachets dried yeast
- 300 ml warm water (approximately 50°C, e.g. in Thermos flask)
- 5 ml sugar
- 5 ml salt
- 5 ml flour
- 5 ml lemon juice
- 4 small plastic drinks bottles
- 4 balloons or air-locks available from brewing outlets

- 100 ml measuring cylinders or suitably graded bottles
- Measuring spoons or teaspoons
- Blank sticky labels

PRIOR KNOWLEDGE/EXPERIENCE

Children should have had opportunities to set up simple practical enquiries, comparisons and fairs tests. They should be able to recognise when a fair test is necessary and help to do some of the planning required for this.

ADVANCE PREPARATION

Place sugar, salt, flour and lemon juice in separate labelled containers so that children can collect them easily when needed. Sugar and salt may be confused if care is not taken.

Provide water at about 50°C. By the time the children have measured and transferred the water it will have cooled to about 40-45°C. If thermometers are available, the exact temperature can be recorded after the bottles are set up.

INTRODUCING THE TOPIC

Introduce the topic of medicine by asking the children to think about medicines they have taken. Ask for ideas about who makes medicines and what kinds of processes are important in developing new ones. How do the companies know that their medicines will help to make sick people well? Posters that introduce medicines in a child friendly format are available from the Association of the British Pharmaceutical Industry website, www.abpischools.org.uk.

Give each group some real boxes that have contained medicine bottles. These can be obtained from pharmacies. Ensure the boxes are empty and contain no trace of medicine. Identify that each medicine has an active ingredient. Explain that this is the substance that works on the cause of the illness to make the patient better. Many active ingredients are derived from plant sources. You could illustrate this by reminding children that dock leaves can be rubbed on nettle stings to ease the stinging. The substance that does this may be extracted from the dock leaves and could form the active ingredient in an ointment. Although many illnesses are caused by micro-organisms, some active ingredients are derived from others. Penicillin, an antibiotic, is an example of this, as it is produced by a type of mould. The story of Alexander Fleming could be introduced in literacy as a piece of non-fiction writing, to illustrate the work of scientists.

ACTIVITY NOTES

Read the letter from Medivelop Ltd (Children's sheets) and ask children for their initial thoughts and ideas.

Discuss with children the first requirement: finding the most effective method of producing the active ingredient. In an industrial setting, this would be the primary manufacturing stage.

A possible introduction to the investigation would be to smell freshly baked bread or a yeast extract jar and talk about the contribution that yeast has made to these products. In bread the fermentation produces a gas that makes the bread rise, and in yeast extract the yeast itself adds flavour. There are different types of yeast, just

like there are different types of plants, and different types of yeast are used for different purposes. Other micro-organisms also produce useful by-products, e.g. yogurt.

Some micro-organisms produce substances that will kill other micro-organisms. If they can do this without harming the patient, they can be used in medicines. Many tests will be carried out throughout the development of a new medicine. From the very beginning safety is of greatest importance. In the first stages of this investigation we are going to use yeast because it is safe and easy to grow in the classroom and can be used to investigate optimum growth conditions.

Yeast is a one celled micro-organism that grows by reproducing itself and dividing into two. To grow, it needs the right conditions, the same as animals and plants do. Ask the children for suggestions as to what these may be: food, oxygen, water and warmth are needed, whereas light is not.

Organise the children into working groups of four. Their task is to find the conditions in which the yeast will be most productive.

The CIEC interactive planning tool can be used to plan both this and the next investigation – to establish a procedure for finding out (i) the effects of food type, and (ii) the effects of temperature, on the growth of yeast.

Show the children the resources that will be available and allow each group time to consider how the problem can be investigated. Ask each group to explain how they think the investigation might be carried out. This first investigation can be used as an opportunity to model how to conduct a fair test.

Here is one possible investigation, though children may suggest suitable variations to this:

- Label four identical containers or small pop bottles each with one of sugar, salt, lemon juice and flour and also the name of the group.
- Add the same quantity (by volume) of food to the bottles using a teaspoon or measuring spoon. A clean spoon must be used each time.
- Add 1 sachet or 1 heaped teaspoon of dried yeast to each bottle.
- Top up each with an equal volume of warm water to about ⅓ full and place a balloon over the open neck of the bottle or add an airlock if used.
- Observe each of the mixtures and record initial observations. There should be frothing in the sugar mixture quite soon after setting up.
- Leave the bottles in a warm place where they can be easily observed. As the yeast feeds on the sugar and produces carbon dioxide, the children will observe the balloons inflating.

Note: Don't stress the importance of temperature at this point as children will investigate this next.

Balloons will inflate with the carbon dioxide produced. The production of gas can also be demonstrated by the bubble of air passing through the water in an air-lock.

The children should make observations every ten minutes and record their findings in a table (Children's sheets).

Encourage the children to observe the bottles carefully and record information about what is happening. This can be done by using digital cameras and sequencing the images or by drawing diagrams and adding accurate label descriptions.

Examples of children's recording are provided to illustrate the minimum amount of information that should be gathered.

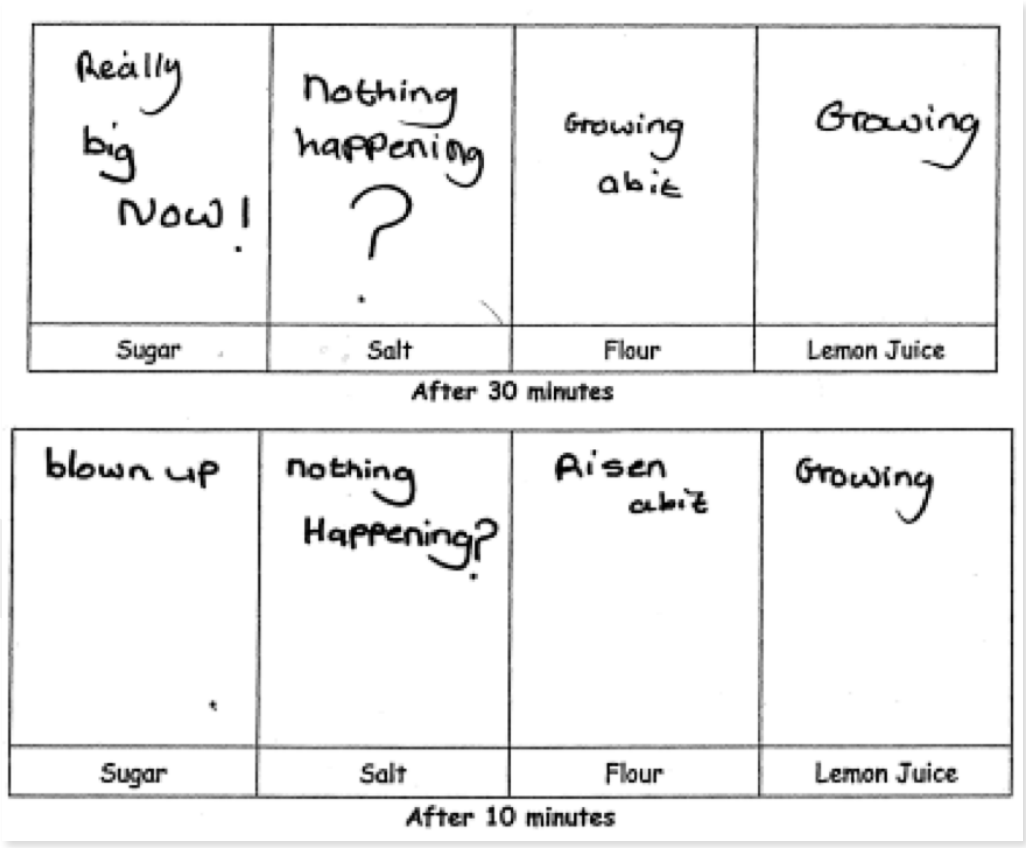

Figure 1

The information recorded in **Figure 1** is limited and does not provide evidence for what the child is claiming.

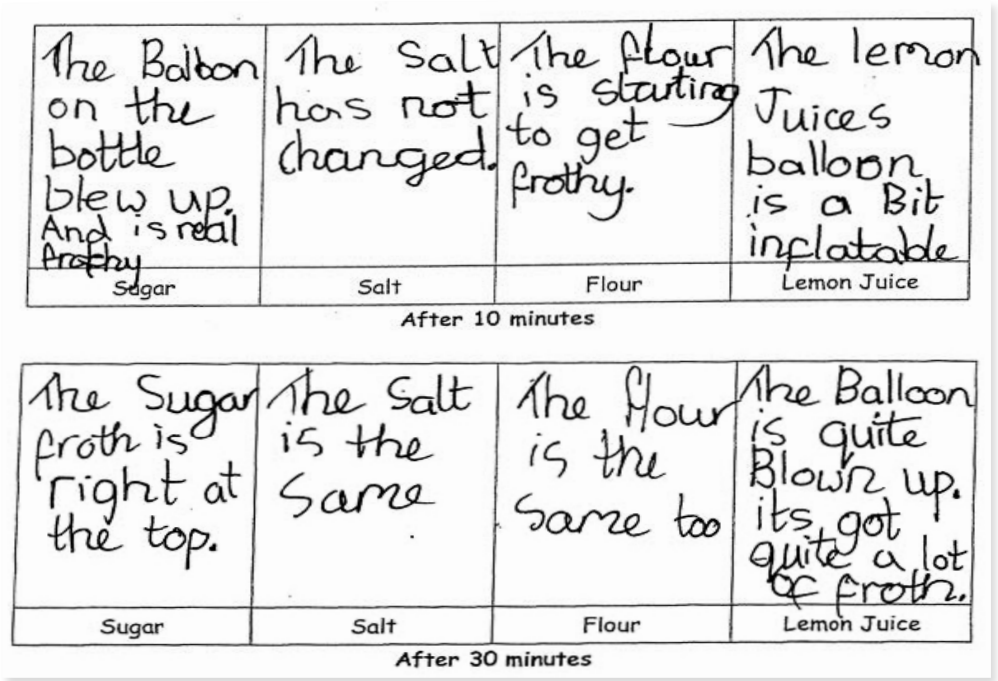

Figure 2

In **Figure 2** more information is given specifically about the contents of the bottle and the balloon. These observations will provide evidence to support the conclusion made.

In between observations, children could begin to think of a marketing campaign for the new medicine. The samples of packaging, shown when introducing the topic, can be a starting point for this. Advertising a product needs careful wording to attract buyers, as well as safety messages and warnings.

They should avoid existing brand names but could think about the kind of names used and how these portray a certain brand image. An opportunity exists here for links with design technology and English.

Each group should find that the solution containing the sugar caused the balloon to inflate most. There may be some partial inflation of the balloons from the solutions containing the flour and the lemon juice as these contain starch and sugar for the yeast to feed on but it will be noticeably less. The salt solution should not produce any inflation. Leave the solutions to settle so that the yeast forms a layer at the bottom. The yeast in sugar solution should have increased and so form a thicker layer. After approximately 30 minutes the children should look at the data they have collected and discuss what conclusions can be drawn from it.

Ask each group to present their findings to the whole class. The questions for thinking can be used to stimulate discussion, and to encourage the use of appropriate vocabulary.

Explain that, as yeast is a living micro-organism, it needs to feed. As it feeds on the sugar, it produces a gas called carbon dioxide. It is this gas that inflates the balloon. Flour will not harm the yeast but salt in the water would. This could be investigated by repeating the conditions for growth with sugar and salt in the same bottle.

EXTENSION

The children have been told that the gas produced by yeast is carbon dioxide. Although they have no reason to doubt your word, can they think of any way to demonstrate this? This would be very challenging work and would depend on children having a high level of knowledge. One way may be to carefully pour the gas from the balloons over a tea light placed in a shallow container to extinguish the flame. Carbon dioxide being heavier than air will sink to the bottom of the container. This does not necessarily prove that the gas is carbon dioxide, and not some other heavier than air gas, but it reduces the possibilities and encourages creative thinking.

Further investigations could be carried out to explore the effect that using artificial sweetener in place of sugar would have.

QUESTIONS FOR THINKING

- Have all the balloons expanded?
- Have they all expanded to the same size?
- If not, what may account for the variation?
- What caused some of the balloons to inflate?
- What conclusions are the children able to draw from their investigation?
- How can the most yeast be grown in the shortest time?

- How would the new cough syrup be packaged?
- What would be a good name for a new cough syrup?

SAFETY GUIDANCE

- Basic advice about medicines not being taken unless prescribed should be given.
- Children should wash their hands carefully after handling the bottles of yeast

INDUSTRY LINKS AND AMBASSADORS

The development and manufacture of medicines is a lengthy and expensive process which can be broken down into three stages.

- **Research and development (R&D)** includes the identification of a potential treatment and the research needed to develop the idea into a new drug.
- **Primary manufacture** is the manufacture of the 'active ingredient'. An active ingredient is the part of a medicine that has a beneficial effect and usually comprises a small part of the whole medicine.
- **Secondary manufacture** is the incorporation of the active ingredient into a form which can be taken or applied.

Some active ingredients are produced using 'chemical technology' which is combining substances to create the active ingredient. However, this investigation mimics the R&D stage of producing an active ingredient using 'biotechnology'. A real life example of this would be the cultivation and extraction of penicillin to make an antibiotic.

CROSS CURRICULAR LINKS

English: Opportunities to use spoken language to develop understanding through speculating, hypothesising, imagining and exploring ideas. Also, links to writing whereby pupils identify audience and purpose, as well as selecting the appropriate form, especially if considering ways to market their medicine.

Mathematics: Opportunities to practice taking and recording measurements and performing simple calculations

Design and Technology: Opportunities to design packaging for the medicine.