ICR The Institute of Cancer Research

ON THE HUNT FOR NEW KNOWLEDGE

Teachers guide

Many thanks for sharing your interest in our challenge. In this pack, we'll hopefully provide you with all the information you need to help your students.

Background

The Institute of Cancer Research, London are running a challenge to introduce students to some of the activities scientists do and to support learning about the experimental process on the KS3 curriculum.

We are hoping that students will design, carry out and write up an individual experiment, and present their work in the form of a poster.

Doing the experiment

The students' guide describes how to set up and carry out the experiment.

You will need to prepare in advance:

- Hydrogen peroxide, in a range of concentrations. You'll need 2cm^3 per group at each concentration.
- Fresh pureed potato in beaker with syringe to measure amounts. You could possibly need different types of potatoes if any of your students are interested in investigating the effects of this, or whole potatoes for people who want to look at the effect of surface area on the experiment.
- Apparatus or reagents to allow students to change variables – for example heating or cooling apparatus, or acids or bases to adjust pH.

For each group of students you will need:

- pneumatic trough/ plastic bowl/ access to suitable sink of water
- conical flask, 100 cm^3
- syringe (2 cm^3) to fit the second hole of the rubber bung,
- measuring cylinder, 100 cm^3
- measuring cylinder, 50 cm^3
- clamp stand, boss and clamp
- stopwatch
- pens that can write on boiling tube

- rubber bung, 2-holed, to fit into your conical flasks – delivery tube in one hole (connected to 50 cm rubber tubing)

Health and safety notes

Wear eye protection and cover clothing when handling hydrogen peroxide.

Wash splashes of pureed potato or peroxide off the skin immediately.

Be aware of pressure building up if reaction vessels become blocked.

Take care inserting the bung in the conical flask – it needs to be a tight fit, so push and twist the bung in with care.

Hydrogen peroxide

Solutions less than 18% volume are low hazard but solutions at concentrations of 18-28% volume are irritants.

Take care when removing the cap of the reagent bottle, as gas pressure may have built up inside.

Dilute immediately before use and put in a clean brown bottle, because dilution also dilutes the decomposition inhibitor.

Keep hydrogen peroxide in brown bottles because it degrades faster in the light.

Discard all unused solution. Do not return solution to stock bottles, because contaminants may cause decomposition and the stock bottle may explode after a time.

Pureed potato

Pureed potato may irritate some people’s skin.

Make fresh for each lesson, because catalase activity reduces noticeably over 2/3 hours.

You might need to add water to make it less viscous and easier to use.

Cubes or discs of potato generally react too slowly to be used in this experiment, although your students might want to test this.

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Student's expansion of the experiment

We have written a list of variables the students might like to change.

- **Amount of potato**
  More potato will probably not affect the rate of reaction much, as the availability of catalase is not initially the limiting factor. They may be able to find a plateau where more hydrogen peroxide does not increase rate of reaction and catalase availability becomes the limiting factor.

- **Different type of potato**
  Different varieties of potato may well have more catalase – and fresh picked potato will almost certainly have more.

- **Temperature**
  If the temperature is too cold it will slow the reaction and too much heat will denature the enzyme (this occurs at around 45º)

- **pH**
  This should affect how quickly the experiment goes – a very acidic or alkaline pH will affect the ability of the enzyme to catalyse the reaction.

- **Freshness**
  If you leave the potato for too long, the enzyme will start to break down.

- **Product accumulation**
  This should not have an effect – however, the reaction will slow down as the hydrogen peroxide is used up.

- **Reusable enzymes**
  You should be able to add more and more hydrogen peroxide and the enzymes will keep catalysing the reaction – however, do remember that they may break down over time, see the "freshness" point above.

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Further information

We have provided an introduction document for the students on enzymes and cancer but you may want to read around the latest developments in the area to help answer questions and to give you some examples you can use.

Note: Do be careful if encouraging your students to independently research enzymes and cancer. The fact that enzymes are 'natural' has led to a lot of websites advertising various enzymes as cancer cures.

Here are some discoveries that the ICR has made about enzymes in cancer.

Drug that blocks enzyme enters clinical trials

The ICR discovered a drug called a protein kinase B inhibitor that has now passed into clinical trials. The ICR has a long interest in the potential of PKB as a cancer drug target, beginning when the ICR's Professor David Barford became the first in the world to determine the enzyme's crystal structure.

Invading cancers secrete enzyme that hijacks healthy tissue

This ICR research showed that an enzyme, called LOXL2, helps the process of tumour cell invasion, which is a key stage in cancer progression.

Kinase inhibitors: the science behind a revolution

It was discovered during the 1980s at the ICR that in cancer cells a certain enzyme pathway, relating to MAP kinase lost its ability to be switched on and off, which drives some cancers to grow.

Using this knowledge, a class of drugs known as kinase inhibitors have helped to revolutionise treatment options across several different cancers.

Study reveals enzymes that cancers depend on to survive

Scientists at the ICR used a large-scale genetic screen in 117 tumour samples from 10 different types of cancer to identify kinase enzymes that are essential in distinct forms of cancer. Finding cancer specific genes could help scientists to develop new potential drug targets, refining ways of treating the disease.

Links to other resources

Resources on what cancer is:

Cancer Research UK

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Macmillan

Resources on enzymes in cancer:

Cancer growth blockers

Tyrosine kinase inhibitors

Cancer metablomics

Resources on designing an experiment:

BBC Bitesize

Resources on designing a scientific poster:

Tips for poster design