**ON THE HUNT FOR NEW KNOWLEDGE**

**Teachers guide**

Many thanks for sharing your interest in our awards. 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 competition 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.

**Practicalities**

The competition runs from **08 February 2018 to 01 May 2018.**

Students from Years 7 to 9 are eligible to apply and can enter alone or in teams of up to five.

Entries are in the form of posters created by the students. They will be assessed by a panel of judges from the ICR made up of cancer researchers and communications staff.

They will judge the creativity, experimental care and presentation style.

We suggest that you could run this competition across several sessions, whatever works best for your own school.

For example, you could first use a teaching session to introduce the concept of enzymes, then discuss how to plan experiments to study them, then hold a practical session to do the experiments. You might then want to run a separate session to prepare a poster.

**Sending your entries**

Please let us know as soon as possible if your school are planning to enter the competition.

Posters can be submitted as electronic documents or hard copies.

Please either email entries to helen.craig@icr.ac.uk or post them to Helen Craig, Communications Department, The Institute of Cancer Research, 123 Old Brompton Road, London, SW7 3RP.

We'd recommend electronic documents for ease of sharing, but are happy to accept physical hard copy posters if you prefer.

Please make sure your entries are submitted by 01 May 2018.

**Prize and ceremony**

The Institute for Cancer Research (ICR) will arrange a visit for two winners, one from the Royal Borough of Kensington and Chelsea and one from the London Borough of Sutton.

We will also provide an individual prize to the winners.

If you have any questions, contact the ICR's Public Engagement Officer, Helen Craig, on helen.craig@icr.ac.uk.

**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.

**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.

## 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 recent 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.

Genetic weakness points to potential drug target

This ICR research funded by Cancer Research UK focuses on the PolQ enzyme, which helps repair DNA and, if blocked, can kill some cancer cells.

A 'gap in the armour' of DNA allows enzyme to trigger cancer-causing mutations

This discovery shows that the enzyme APOBEC3G - a known trigger for mutations – may cause harmful changes by mutating genes during the replication of DNA.

## Links to other resources

Resources on what cancer is:

Cancer Research UK

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