CREST AWARDS

GOLD AWARD

MEASURING ALCOHOL LEVELS

70H Typically 70 hours of project work
Recommended for 16-18 year olds

Research project

Investigate ways of measuring alcohol levels.

#chemistry
#health
#crime

HOW TO RUN CREST USING THIS ACTIVITY

Entering your project without a teacher or facilitator? No problem! You can enter your work yourself by following this link: **www.crestawards.org/sign-in**

Looking for some support? Find a mentor by contacting your local STEM Ambassador hub: **www.stem.org.uk/stem-ambassadors/local-stem-ambassador-hubs**

To use their project to achieve a CREST Gold Award your students will need to:

- **Develop and lead the project**
- **Complete a minimum of 70 hours of project work**
- **Consider the broader impact of their project and demonstrate an innovative approach**
- **Write a project report or portfolio of evidence**
- **Reflect on their work during the project using a student profile form**

Preparation

Ready to get going with CREST? Sign up for a CREST account here: **www.crestawards.org/sign-in**

Create a new Gold Award project with the name(s) of the student(s) and the title of their project. If you don't have all these details, you can fill them in later!

We have some super handy workbooks and profiles for your students to use when running a CREST Award. You can download these when you create your CREST account by following the link above.

Run the project

Encourage your students to use the Gold student guide to plan and carry out their project. Each student involved in the project should complete their own profile form.

You don't want all their good work to go to waste, so be sure they keep a record of all their amazing progress. Keeping a regular project diary will save them precious time when writing their final project report.

The students should spend at least 70 hours on the project in total.

Remember to consider safety and risks!

Reflection

So, your students have been hard at work and completed their CREST project, but don't let this be the end of their learning. At the end of the project, each student should complete a Gold profile form and communicate their project. This is a chance for them to reflect on all the interesting things they've learnt and the invaluable skills they have used.

Students working in a group can either submit a joint report or separate reports, but they must each complete a profile form.

Use the CREST criteria on the profile form to help the students check that they have included everything in their report.

Enter your project for a CREST Gold Award

Hard work deserves a reward! Celebrate and certify your student's achievements by entering their project for a CREST Gold Award. Simply:

Log in to your CREST account at **www.crestawards.org/sign-in**

Select your project and upload the profile form per student, project report and other evidence, such as pictures and diagrams.

Finally, complete the delivery and payment details for assessment and to order your snazzy certificates.

Congratulations on submitting for CREST Gold!

What next?

Is university on the horizon for your students? They can use their project to help demonstrate their newly found STEM skills and knowledge in UCAS personal statements.

Don't keep all the fun to yourselves, encourage others to take part in CREST projects and share the wonder of science. For free ideas on how to get started, see **www.crestawards.org**

STUDENT BRIEF

GOLD AWARD

Measuring alcohol levels

In much of the UK, it is illegal to drive if the alcohol level in your blood is above 80 mg per 100 ml, about 0.08%. In Scotland, the legal limit is 50 mg of alcohol per 100 ml of blood. We therefore need ways to determine whether a person is 'over the limit'. The aim of this project is to find out how a suspect's alcohol level can be measured. You will investigate simple chemical tests, and more sophisticated methods.

Getting Started

Start with simple aqueous solutions of ethanol, and progress to testing for ethanol dissolved in artificial urine.

This project concerns 'ethanol', the alcohol present in drinks. However, the ethanol you use for testing has had methanol added. It is toxic and is not drinkable.

Qualitative tests: Try out, chemical tests for alcohols, including reduction of dichromate ions. Are any of these specific to ethanol, or do they detect alcohols in general?

By progressive dilution, determine the lowest concentration of aqueous ethanol that you can detect. Is it low enough to detect the legal limit? What would be the problems in applying such tests to a driver's blood or urine sample? You could try testing alcohol dissolved in artificial urine instead of in water.

Quantitative tests: Devise, and try out, a method of adapting one of the above tests to measure the concentration of ethanol in an aqueous solution, not just detect it. Colorimetry might help:

Again, test whether you could measure concentrations at least down to the legal limits.

Explain whether the method could be used with blood or urine samples.

Devise, construct and test an alcohol analyser. This could be a portable breathtester, or a piece of laboratory apparatus, such as a simple gas chromatograph. Initially, aim to distinguish between 'pass' and 'fail', for example test samples with ethanol levels half and double the legal limit. The next step would be to calibrate your device, and then to measure samples with concentrations known to your teacher, but not to you.

Things to think about

The reduction of dichromate was used as the basis of the original breath-in-a-bag 'Breathalyser'. Find out how it measured, rather than just detected, the ethanol in breath. The dichromate reaction is not specific to ethanol. Why is it reasonable to assume that ethanol is the only alcohol likely to be present in a person's breath? The legal limit for ethanol in breath is 35 Qg per 100ml or 22 Qg in Scotland (Qg = microgram). Some people claimed that eating pickled onions would beat the Breathalyser - devise a way to test this theory.

Useful Resources

Local police may be willing to show you their breath alcohol meters. You should also link up with an organisation that uses appropriate instrumental analysis (though not necessarily for ethanol), so that you can see the instruments in use, and maybe analyse some of your own samples.

Recipes for artificial urine can be found on the internet.

Measuring ethanol concentration in blood or urine is more complex than in an aqueous solution. It needs a quantitative method that is specific to ethanol and unaffected by other substances in the mixture. Miniaturisation and electronics have allowed some laboratory techniques to be incorporated into portable alcohol meters. These are used not only by police, but also in the rail and airline industries and other workplaces. If you have made external links, why not use these to investigate these methods?

STUDENT BRIEF

GOLD AWARD

Health and Safety

Science project work is both dynamic and exciting but can also carry some risk. To avoid any accidents, make sure you stick to the following health and safety guidelines before getting started:

- find out if any of the materials, equipment or methods are hazardous;
- assess the risks (think about what could go wrong and how serious it might be);
- decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on);
- make sure your teacher agrees with your plan and risk assessment.

Don't eat pickled onions in the laboratory and don't drink alcohol.

Ethanol is HIGHLY FLAMABLE.

Dichromate ions are TOXIC. Check for hazards of the chemical tests and consider what control measures are necessary to reduce the risk.

Remember!

Science isn't just about data. The most successful projects will demonstrate good communication skills and show original ideas that address a real-world problem.

Look at the world around you and consider all the innovative ways that you could address the challenge. Even if things go wrong, use this to show what you have learned. Don't forget to use the student profile form to help structure your project.