CREST
AWARDS

Industrial Strategy Grand Challenges:

AGEING SOCIETY, ARTIFICIAL INTELLIGENCE, CLEAN GROWTH, FUTURE OF MOBILITY

COLLECTION

This pack contains eight project ideas which allow students to investigate the four Industrial Strategy Grand Challenges of Ageing Society, Artificial Intelligence, Clean Growth, Future of Mobility.

#AgeingSociety

#ArtificialIntelligence

#CleanGrowth

#FutureofMobility

IN PARTNERSHIP WITH

BRITISH
SCIENCE
ASSOCIATION

HM Government

TO DELIVER

INDUSTRIAL
STRATEGY

How to run CREST using these activities

Preparation

Ready to get going with CREST? Enter your student's Award by signing up for a CREST Account here: crestawards.org/sign-in

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

Run the project

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. Encourage your students to use the workbook or profile to plan and carry out their project, keeping a record of all their amazing progress. Make sure you 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. They should now fill in any remaining sections of their profile. This is a chance for them to reflect on all the interesting things they've learnt and the invaluable skills they have used.

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 crestawards.org/sign-in

- Select the project and upload a profile form per student and other project evidence. Check the participating students have met each of the criteria on the teacher assessment page.

- Finally, complete the delivery and payment details to order your snazzy certificates. Congratulations on completing 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 crestawards.org
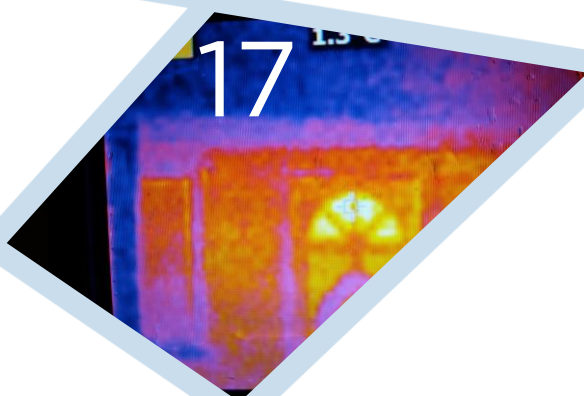
Entering your project without a teacher or facilitator? No problem! You can enter your work yourself by following this link: crestawards.org/sign-in

Looking for some support?

Find a mentor by contacting your local STEM Ambassador hub:
stem.org.uk/stem-ambassadors/local-stem-ambassador-hubs

Contents

Instructions for teachers

These resources will help your students explore the four Industrial Strategy Grand Challenges and the impact they have on lives now and in the future:

- Ageing Society
- Artificial Intelligence (AI) and Data
- Clean Growth
- Future of Mobility

The resources in this pack have been developed with some of our partners, who have kindly contributed resources on the Grand Challenge topics.

In this pack you will also find pages that can be used as a handouts for students. These are indicated in the titles and contents page.

Choosing a project

We want young people to use their project to explore innovative ideas and solutions. Encourage them to consider local and personal connections with the Industrial Strategy Grand Challenges. What do they imagine the future could be like? What problems might arise with new technology and these changes in society? What most interests and excites them?

Students can use the project ideas on pages 11-18 as inspiration or use the activity on page 5 to help them design their own project around the theme and topic which most interests them. They could work individually or in small groups on the same project.

Resources

There are new developments around these areas all the time. The resource links on the project pages give a starting point for students to research but they could also search local and national news articles for more recent developments on each theme.

Project outcomes

Your students could design and make a new product, carry out a practical investigation, do a research project or create a communication campaign for their target audience. Encourage them to consider the impact of their project on people's lives now and in the future. Students should record their work in a final project report or presentation.

Supporting students to complete their project

Each project should involve approximately 70 hours of student work from start to finish. The project should be led by the students. As a teacher or mentor your role is to:

- Act as a sounding board for students' ideas and nurture the students' work;
- Check your students' project plans before they begin the next stage;
- Help students see mistakes and setbacks as an opportunity for positive learning and lateral thinking (leading to creativity);
- Where relevant, support students to access professionals or experts who could support them;
- Provide access to the Internet, library books and magazines;
- Help students to complete their project and record their findings;
- Encourage them to reflect on their own performance and learning.

Use the tips on page 10 to help students complete their CREST Gold project report.

Health and safety

Students should be encouraged to make their own risk assessment before they carry out any activity, including surveys. They can use the CLEAPSS student safety sheets to help them science.cleapss.org.uk/Resources/Student-Safety-Sheets/.

They should write out their project plan, identifying the risks involved in each stage and the control measures and precautions they will take.

In all circumstances this must be checked by a competent person.

Students using specialised equipment should be supervised at all times. Students may want to set up unorthodox experiments and you may need to seek specialist advice. Contact CLEAPSS directly cleapss.org.uk for advice if you are unsure. Teachers in Scotland should refer to SSERC www.sserc.org.uk.

Unless stated, no external links have been checked by CLEAPSS. Safety checked but not trialled by CLEAPSS.

Get your students thinking

about the Industrial Strategy Grand Challenges

1. What do you know already?

Collect 2-3 images relating to each of the Industrial Strategy Grand Challenge themes. Ask students to discuss what words, themes and topics are represented in the images. Ask them to think of other similar examples, encouraging them to consider things which are local and personally relevant to them.

You could ask students to collect and add their own images but using examples from their local area, community, interests and hobbies. They should provide an explanation for each one including why they have chosen it. Alternatively, you could use news articles and headlines and ask students to research other examples in the local and national press.

2. Connecting questions

In small groups of 3 or 4, ask students to list the things that are important to them in their everyday lives and write these on cards. Ask them to consider each one in turn and think about how it might be affected by the Industrial Strategy Grand Challenges. Challenge them to come up with a question to frame their investigation. E.g. Could an artificially intelligent machine replace my sports coach?

3. Where do you stand?

Using some of the questions students have generated, ask students to decide where they stand on the issues and to explain their position. Challenge them to think of other potential dilemmas linked to the Industrial Strategy Grand Challenges.

4. Selecting a project idea

Ask students to create a mind map to show how the four themes link to their lives and interests before deciding which ideas they are most interested in investigating further. They could choose a project from the ideas in this pack or come up with their own idea linked to their interests. Make sure they check through their plan for how they will approach the project with a teacher of mentor before they begin.

The Industrial Strategy Grand Challenges
Student handout

The four Grand Challenges of the UK's Industrial Strategy are Ageing Society, AI & Data, Clean Growth and Future of Mobility – four global trends that the Government believe the UK should be at the forefront of tackling today and in the future.

It is hard to imagine any part of our lives which won't be affected by one of these Grand Challenges in some way. They will affect the jobs we do, the homes we live in, how we get around, how we spend our money and the design and manufacture of the products we use.

By exploring them further you will be helping to identify the challenges and opportunities they present and come up with new products, business ideas, original research and communication campaigns to improve the lives of people of all ages and backgrounds.

Ageing Society

What would you do to help us all age better?

How do you think your life will be different to that of your parents or grandparents? The UK population is ageing – with 1 in 3 babies born today expected to live to a 100. This will have an impact on everyone, not just older people.

We're living longer, but we need to do more to improve our quality of life – we want everyone to age better. This might affect the skills you need throughout a longer career, how you will care for an older relative, the type of home you live in and who you live with. As people live longer, older people will be a much bigger market for new products, technology and services, to help healthy ageing and living independently.

Technology could help people live healthier lives, work more efficiently, give them better access to services and could even help care for older people. New home designs might need to accommodate more multigenerational families, transport will need to be more accessible and solutions found to combat loneliness and isolation in old age.

We have an obligation to help our older citizens lead independent, fulfilled lives, continuing to contribute to society. If we succeed, we will create services, technologies and products which work for everyone, regardless of age.
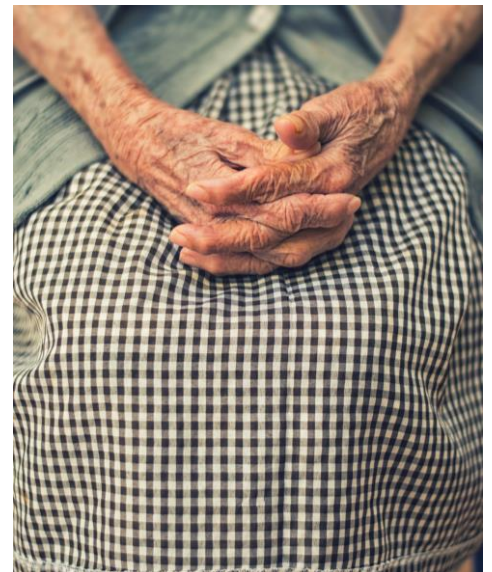
The Industrial Strategy Grand Challenges

Student handout

Artificial Intelligence and Data

Would you trust a computer to buy clothes for you? If you shop online, you might find that intelligent computer systems are already influencing your decisions.

Artificial intelligence (AI) is when a computer thinks and makes decisions like a human being. These decisions might be too difficult or time consuming for humans or just too mundane.

The more data we give the computer, the better the decision it can make. Very often this is a better and much faster decision than any human could make.

AI is the foundation of smart technologies, such as driverless cars and personal digital assistants and it also might affect what you see on your social media feed and recommendations on shopping sites.

These technologies are already a part of your life and are starting to transform the global economy. They can identify better ways of doing complex tasks – from helping doctors diagnose medical conditions more effectively to allowing people to communicate across the globe using instantaneous speech recognition and translation software.

However, with new technology come concerns about security of data and the limits of machines. The more data that is collected the higher the risk that it could be used in way that is unethical or puts lives at risk. What would you not trust a computer to do for you?
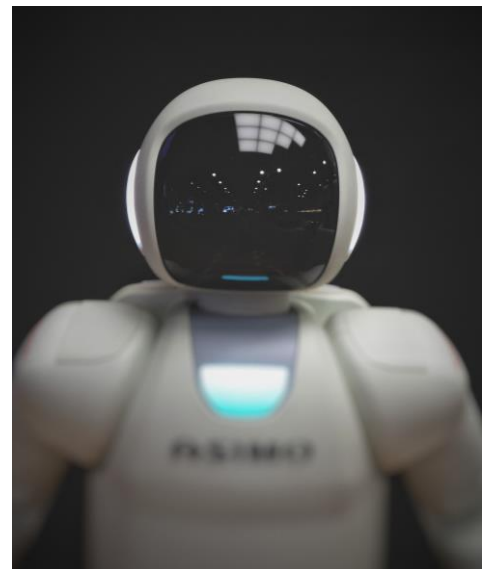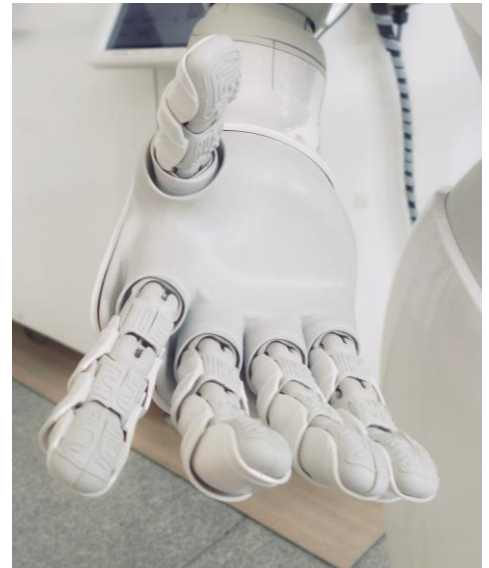
Clean Growth

How could you heat and light your home or school if the power was cut off?

In order to combat climate change, we need to move towards a low carbon, more resource efficient way of life. We need to develop new technologies for energy generation as well as products and services which ensure everyone has access to sustainable and affordable energy. That means using renewable sources of energy, reducing waste and improving efficiency to reduce our energy use.

In future, energy might be produced more locally using solar panels, wind turbines or biogas generators.

As well as generating energy, the development of battery technology is vital to ensure that energy is available when it is needed. This will affect homes and schools too. Improvements in the design and construction of buildings will help us reduce the amount of energy we need.

The government has announced a mission to halving the energy we use in new buildings by 2030. It has also announced plans to hold a competition to design a home of the future and build more energy efficient homes for all generations, with high quality affordable design.

What would your ideal home of the future be like?
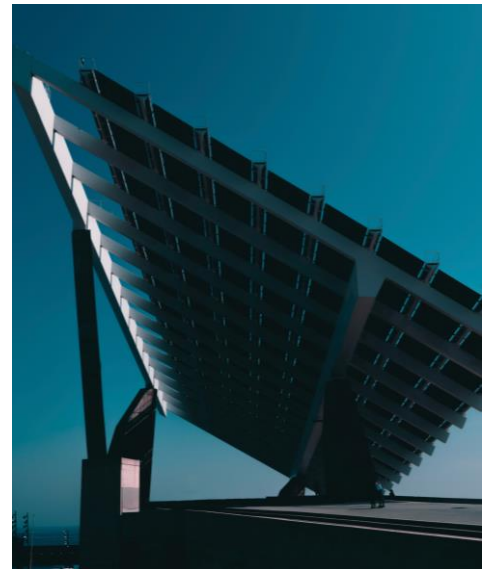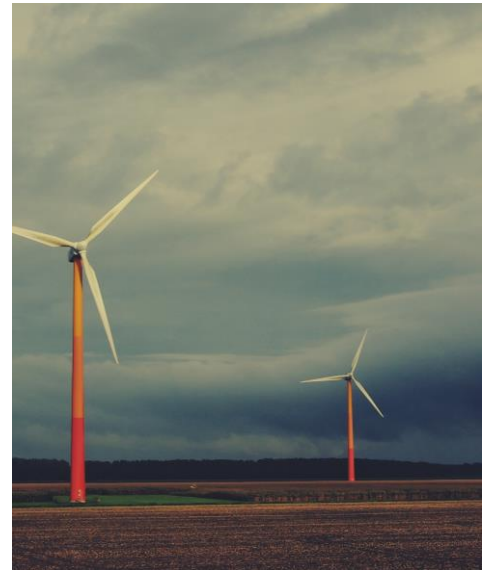
The Industrial Strategy Grand Challenges

Student handout

Future of Mobility

Would you travel on a bus powered by human waste?

Everyone needs to be able to get around – from travelling to school or work to visiting friends or going to the shops. We're reliant on our transport systems to get from A to B.

But it isn't just people that need to move around, products need moving too – from warehouses to shops or direct to your home.

Planning for the movement of people, goods and services around our towns, cities and countryside is a big challenge. Solutions might include driverless cars, more shared transport, electric bikes, drone delivery, low carbon air travel and using mobile apps to get people walking more.

The important thing is to ensure that transport is available when we want it, where we want it and how we want it.

Future mobility solutions must also meet the needs of everyone including older people and those with disabilities who might currently find it more difficult to travel around.

How would you improve the transport in your local area?
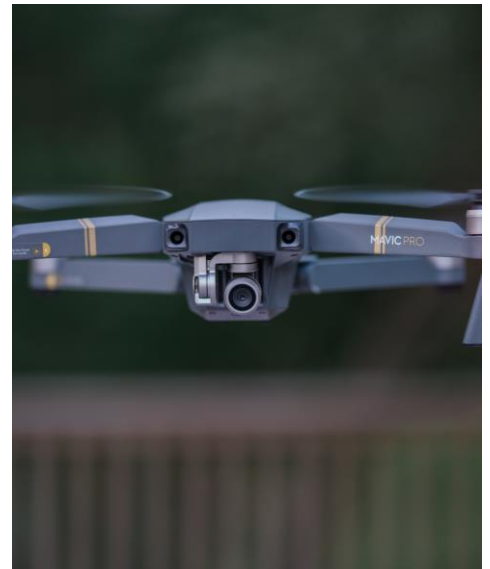
TOP TIPS
for students completing a Gold project

1. Understand the problem

Find out more about the Industrial Strategy Grand Challenge and make sure you are clear about the problem you need to solve and the time you have. If you are developing you own project idea, discuss your ideas with your teacher or mentor.

2. Plan your approach

Draw or write a plan showing how you'll approach the problem, the tasks you'll complete, the resources you'll need and how long you will spend on each task. Ask your teacher or mentor for feedback on your plan.

3. Watch out!

Identify any risks to health and safety or ethical concerns you think there will be. Decide how you will limit or overcome these risks. Show your risk assessment to your teacher.

4. Research

Find a professional mentor by contacting your local STEM Ambassador hub: stem.org.uk/stem-ambassadors/local-stem-ambassador-hubs

Find out more by doing some research using the suggested links on the project page. Research relevant news articles, blog posts and other media sources.

5. Use your research to improve your plan and generate ideas

Use your research to help you come up with a possible solution or to select the best experiments to use in your practical work.

6. Finalise your idea and carry out practical work

Carry out any practical work including experiments, surveys, designing and making activities. When testing your ideas, make sure you make it a fair test and record all your results clearly. You could also use photos and a diary to record your project activities.

7. Concluding your project

What have you found out by doing your project?

Did you come across any problems? How did you overcome them?

What is the impact of your project for other people? How could it be developed further?

Has it changed how you feel about the Industrial Strategy Grand Challenges?

8. Choose the best way to communicate it

Tell others about what you did. You could use a written report, a digital presentation,

a blog or a poster display. Make sure you include each stage from planning through to the conclusion.

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.

Even if things go wrong, use this to show what you have learned.

Personal assistant

DESIGN & MAKE PROJECT

THE ROYAL SOCIETY

Project brief

In this project you will design and program an AI personal assistant tool to support an older person living alone. You will need to investigate the needs of older people before selecting the most appropriate basic tool to use and programming it to carry out a specific task.

You will need to:

- Research the needs of older people living independently;
- Identify and assess a range of digital personal assistant tools available;
- Design a prototype model or programme of your personal assistant tool and test it with your target audience.

You should start by researching current robotic personal assistants such as chatbots available for the home and for the workplace. You could also research the use of artificially intelligent virtual companions. Are any of them currently designed specifically for elderly people?

Research the needs of older people living alone. What roles do human carers and other adult support workers play in their lives?

If you design a concept for a new AI personal assistant tool you will need to show how the system would collect and use data to trigger actions. Alternatively, you could program an existing device to carry out a specific task to enhance the life of an elderly person.

Things to think about

- What tasks and decisions can be carried out by a machine?
- Will it be controlled by voice, text or visual stimulus?
- How would your device enhance life for an older person?
- Are there any risks to relying on a digital personal assistant?
- What would happen if the data collected by the device got into the wrong hands?

Useful resources

- theguardian.com/ commentisfree /2018/jul/02/ robo-carers-human-principles-technology-care-crisis
- independent.co.uk/life-style/health-and-families/health-news/the-robot-that-could-revolutionise-home-care-for-elderly-people-stevie-us-a8068931.html

Health and safety

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 using science.cleapss.org.uk/Resources/Student-Safety-Sheets/
- assess the risks (think about what could go wrong and how serious it might be);
- think about how data and information on your system will be stored;
- when testing your ideas, make sure participants understand the purpose of your project and how you will use the information collected;
- 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 there is plenty of space to work;
- clear up slip or trip hazards promptly;
- make sure your teacher agrees with your plan and risk assessment.

Are we ready for driverless cars?

RESEARCH PROJECT

Project brief

In this project you will research the advantages and challenges of driverless cars and assess the public's opinion of this new technology.

Begin by finding out how machine learning is used in driverless cars and some of the challenges faced by the technology's developers.

It is important to plan your approach to your research. Make a list of all the sources of information available to you on driverless cars. This might include news articles, professional journals, public opinion polls, policy documents, case studies and interviews with professionals. Decide which sources you will choose to look at in your investigation and why and consider how you will record your findings in a logical way.

If you decide to use case studies in your research, you will need to decide how you will select them.

If you are looking at articles you might decide if they are generally positive or negative first before analysing the evidence.

If you have access to public opinion polls, try to look at the raw data. You could investigate what people think compared with their background or demographic. You could carry out your own survey to find out what people of different ages and backgrounds think.

You could plan and carry out your own interview with an expert professional. This could be someone who works in the car insurance or car manufacturing sectors, or could be a university researcher working on artificial intelligence. Ask your teacher for help connecting with experts.

Things to think about

- What tasks would a machine be better at than a human driver?
- If there was a crash, who would be responsible?
- What might be the wider implications if all or most vehicles became driverless?
- Can driverless cars safely coexist with other road users?
- Who might lose out if most vehicles became driverless?
- How might public opinion impact on the future of driverless cars?

Useful resources

Ask your teacher to help you find an expert mentor: stem.org.uk/stem-ambassadors

Articles:

- wired.co.uk
- newscientist.com

UK public opinion poll results

- yougov.co.uk
- ipsos.com/ipsos-mori/en-uk

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Ageing Society
A balanced diet

PRACTICAL PROJECT

Project brief

This project is split into two parts. The first is very much research-based. The second involves analytical chemistry and biology, as you will conduct food tests. Your aim is to collate data and information and suggest two menus for two days for somebody with a nutritional disorder.

First things first, you should carry out some research into a nutritional disorder of your choosing. Some examples to choose from include:

- Type 1 or Type 2 Diabetes
- Coeliac disease
- Crohn's disease
- High blood pressure
- Anaemia

You could interview a dietician from a local hospital or relevant professional to find out more about how the nutritional disorder can be managed.

You should produce a promotional poster or leaflet telling people about the condition. You should include information about diagnosis, symptoms, recommendations for treatment (including modification to diet) and which people are most likely to be affected.

Your second task is to produce two menus for two days. Each day should include three meals (breakfast, lunch, dinner), as well as drinks (and any snack breaks you feel appropriate). The first menu should be for an average working day (either at work or at school/college). The second should be for the weekend. Each menu should be designed to meet the patient's total recommended daily allowance for major food types.

Include general advice on ingredients and cooking methods.

You should also carry out your own food tests to check such information. It's up to you to decide which types of food test you want to carry out. You will need to design the methods yourself, too. Here are three suggestions to get you started:

- Energy content
- Unsaturation of fats
- Determine quantities of minerals and vitamins

Things to think about

- Which nutritional disorders are age related?
- How have the frequency of these nutritional disorders changed in recent years?
- In an ageing society, what will be the biggest challenges facing dietitians?
- How could food labelling help improve lives of people with nutritional disorders?
- What other solutions are being developed to help manage nutritional disorders?

Useful resources

- Contact with a dietitian or other relevant qualified professional.

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- find out if any of the materials, equipment or methods are hazardous using science.cleapss.org.uk/Resources/Student-Safety-Sheets/
- assess the risks (think about what could go wrong and how serious it might be);
- do not eat any food used in experiments in a laboratory or science classroom;
- if you decide to eat food you have made, you will need to ensure food hygiene recommendations are followed and these are included in your risk assessment;
- 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 there is plenty of space to work;
- clear up slip or trip hazards promptly;
- make sure your teacher agrees with your plan and risk assessment.

Clean Growth | Future of Mobility

Alternative fuel flights

RESEARCH PROJECT

Activity created by

UNIVERSITY OF
WEST LONDON
The Career University

Project brief

In this project you will investigate the current use of sustainable and alternative fuel sources for air travel and research their potential for growth, and current limitations.

Start by looking at how many flights there are daily, annually and how many of these are sustainable/alternative fuel flights. You could use a flight radar website to do this.

Decide how you will approach the project and the resources you could use for your research. These could include interviews with experts in the industry, company websites and government legislation. You should compare the strategies of at least two different aviation companies in your research.

Ask your teacher to help you contact an expert in the aviation industry or a university researcher specialising in aviation technology. Prepare some questions for them to find out more about the latest developments in their field of work or research.

Research current and alternative aviation fuel sources currently being considered to power commercial aviation to 2050. Consider why alternative aviation fuel technologies are required and how these link to government environmental targets.

Investigate at least three alternative/sustainable fuels which are currently being used or developed for future use.

Using your research decide what you think the future will look like for the aviation industry.

Create an A3 poster to present the findings from your research.

Things to think about

- Why do we need to have a sustainable aviation industry?
- Why do we need to consider alternative aviation fuel?
- What are the negative impacts on the environment of aviation?
- What is the industry doing to minimise the impacts on the environment?
- Which are the most interesting alternative fuel sources/sustainable sources of fuel being developed?

Useful resources

Aviation company websites:

- ICAO
- IATA
- CORSIA
- Boeing
- Airbus
- flightradar24.com/60,15/6
- icao.int/environmental-protection/GFAAF/Pages/default.aspx

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- make sure your teacher agrees with your plan and risk assessment.

AI and Data
How could AI prevent infection?

DESIGN & MAKE PROJECT

Activity created by

abpi
Bringing medicines to *life*

Project brief

In this project you will design an app which monitors health and lifestyle to identify, as early as possible, the likelihood of a person developing a disease which affects the immune system. These diseases increase the susceptibility to infection from multi-resistant bacteria.

Start by researching disease areas which affect the immune system (e.g. diabetes and cancer) using your text book or online. Choose one of these to focus your project on. Ask your teacher to put you in touch with a relevant professional working in pharmaceuticals or healthcare.

Find out how the disease impacts on the immune system and how it might put patients at risk of an infection from multi-resistant bacteria. Find out what steps can be taken to reduce the risk of developing the diseases.

Use your research to design a concept for your app. Identify what data you would need to track to monitor susceptibility to the disease, e.g. waist circumference as one identifier of risk of Type 2 diabetes. Consider what alerts the app could send the user to reduce risk of developing the disease.

Produce a wire frame for your app showing the user facing screens and annotate it to explain how it would work.

Things to think about

- Who will benefit from reduced susceptibility to infection from multi-resistant bacteria?
- What are the risks and ethical issues to using an app to identify those at risk of developing a disease?
- How will your app differ from those health-related apps which have already been developed?
- Who would use your app and would it be accessible to everyone?
- What steps can society take now, to reduce future risk of developing diseases which weaken the immune system?

Useful resources

- abpischools.org.uk
- abpi.org.uk
- antibioticguardian.com/keep-antibiotics-working
- improvement.nhs.uk/resources/fight ing-antimicrobial-resistance

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- assess the risks (think about what could go wrong and how serious it might be);
- keep in mind the potential sensitivity of this topic;
- pay attention to any disclaimer on the suggested websites above;
- 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);
- take care if collecting any personal data in your survey;
- make sure your teacher agrees with your plan and risk assessment.

Clean Growth

Biogas generator

PRACTICAL PROJECT

Project brief

In this project, you will design and make a model of a biogas generator which could be used to turn waste into electricity in your school or local community. You will need to research what waste is generated locally before deciding on the position and the design of your generator.

Find out what biogas is and how it is produced. Make a collection of pictures or diagrams of biogas generators. Include those which are used for cooking and those which are used to generate electricity. Do they have common features? Find out what the function of each part is.

Make a list of the materials required for making the generator and for collecting and burning the gas produced. Make a list of the organic materials that you could use as the feedstock for a bio gas generator. Think of things you might find in household green-waste. From your list, which things could you safely try in your bio gas generator?

Using your research, and the guidance below, design your own bio gas generator. Check your plan with a teacher before starting to make it. A suggested set up is given here: build-a-biogas-plant.com/PDF/School_activity_1abiogas-generator.PDF

- It can take at least six weeks to produce any meaningful amount of gas.
- Add a mineral absorbent / cotton wool plug in the tube between the feedstock and the first tube clamp.
- Only carry this out in a fizzy drinks bottle up to 2ltrs in size. Do not use other types of bottles or containers.
- Use a plastic measuring cylinder.
- This will be under partially anaerobic conditions, so you need to be aware of the presence of anaerobes at the end of the process.
- At the end of the experiment submerge all items (including tubing etc...) in a 1% Virkon solution for at least 10mins, and then dispose of in the general waste (not recycling). Do NOT open the bottle, or tubing.
- Monitor the gas production and adjust the time and conditions where necessary.
- Choose an appropriate location for your generator.

The gas generated can be tested for the presence of saturated or unsaturated hydrocarbons by bubbling through bromine or iodine water.

Investigate the effect of different variables. You will need to find a way of measuring the gas output of the biogas generator and compare the amount of gas produced.

You could try comparing the amount of biogas produced by different feedstocks. Or you could investigate the effect of changing climatic conditions by placing it in different locations such as by a window, outside or in a dark room with a relatively constant temperature.

Check your plan with your teacher before carrying out each stage.

Things to think about

- How will you keep it a fair test?
- What are the pros and cons of each feedstock?
- How would your generator work on a large scale?
- What are the advantages and disadvantages of using bio gas to generate electricity?

Useful resources

- practicalaction.org
- microbiologyonline.org.uk
- royalsociety.org

Suggested design for a biogas generator:

- build-a-biogas-plant.com/PDF/School_activity_1a biogas-generator.PDF

Health and safety

- Read carefully the safety sheet: science.cleapss.org.uk/Resource/SSS076-Bioreactors-and-fermenters.pdf
- Teachers should refer to CLEAPSS Guide GL206 for more details;
- Visit microbiologyonline.org.uk/teacher s/safety-information for topic specific safety advice;
- choose a suitable location to store and carry out the gas generation;
- the organic matter should be chosen carefully and checked by a science teacher or technician;
- wear disposable gloves, goggles and an apron when handling organic matter and wash your hands at the end of the activity;
- keep incubation below 30°C to avoid the growth of potential human pathogens;
- assess all the risks (think about what could go wrong and how serious it might be);
- make sure your teacher agrees with your plan and risk assessment.

Green building design

PRACTICAL PROJECT
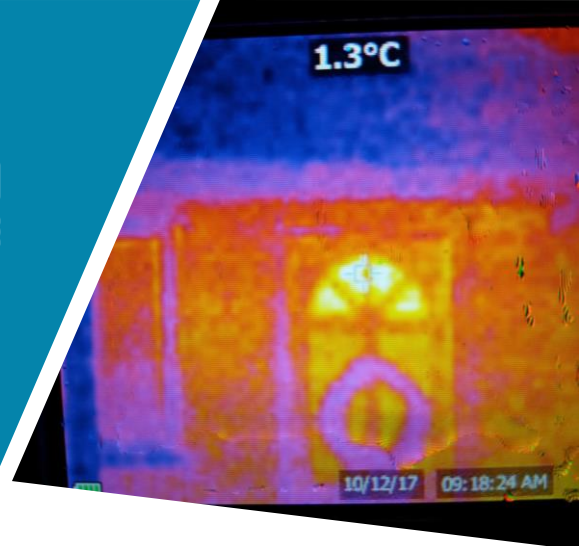
Project brief

In this project you will investigate the use of new technology and materials to improve energy efficiency in new buildings. You will design and test a system to monitor and control energy usage in your home.

You could start by making a list of features in your home which are designed to save energy. What other features can you think of which other houses might have?

Do some research into energy efficiency in homes. Have a look at how buildings have changed over time to make them more energy efficient. Find out about the different materials used in buildings. What are their properties and which are used for insulation? Make a note of features included in modern houses to increase energy efficiency.

Plan and carry out an energy efficiency audit of your own home. In your plan you should identify the things you will look for; these could be materials, energy saving features, such as double glazing and devices, or systems designed to reduce or save energy such as thermostats and energy monitors.

Design an experiment to monitor energy use in your home. This could include energy for heating, hot water, electrical appliances and cooking. You could use a digital monitor and mobile app provided by the utilities company or alternatively keep a manual record each day of energy use from the meter.

Consider how you could calculate your home's baseline energy while running essential equipment such as the fridge and freezer. You could keep a diary of devices being used each day as well as the outside temperature. You could investigate what happens when you limit the use of certain devices or increase insulation.

If you have access to a thermal imaging camera, you could use this to measure the heat energy loss from different parts of your home. How useful are curtains and blinds for saving energy?

Display your results in an appropriate way and discuss in your report what you have found. Make some recommendations to improve the energy efficiency of your home. Make an estimate of how much energy could be saved and the cost to make the changes.

Things to think about

- What are the energy needs of you and your family?
- How could you reduce the energy your home uses?
- How will you make your experiment a fair test?
- Are there any variables outside your control such as outside temperature? If so, how will you control for this?
- How could you persuade your family to make changes?

Useful resources

- energysavingtrust.org.uk/home-energy-efficiency/home-improvements
- www.ukgbc.org

Specialist equipment:

- Home energy monitor (optional)
- Thermal imaging camera (optional)

Health and safety

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 using science.cleapss.org.uk/Resources/Student-Safety-Sheets/
- assess the risks (think about what could go wrong and how serious it might be);
- ask an adult before turning off electrical appliances in your home;
- 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.

Research project ideas

RESEARCH
PROJECT

Project brief

In this project you will choose one of the research questions below and write a balanced report in response:

- How does loneliness impact on health?
- If people are living and working longer, how will that impact on the future of jobs and careers?
- Will new battery technology solve the energy crisis?
- Can data and artificial intelligence beat cancer?

You should start by researching the theme and making a note of the key issues.

Next decide how you could approach the research question and where you could look for evidence to support your theory. Make a list of all the sources of information available to you on the topic. This might include news articles, professional journals, public opinion polls, policy documents, case studies and interviews with professionals. Decide which sources you will choose to look at in your investigation and why. Consider how you will record your findings in a logical way.

If you decide to use case studies in your research, you will need to decide how you will select them.

If you are looking at articles you might decide if they are generally positive or negative first before analysing the evidence.

If you have access to public opinion polls, try to look at the raw data. You could investigate what people think compared with their background or demographics. You could carry out your own survey to find out what people of different ages and backgrounds think.

You should plan and carry out your own interview with an expert professional. This could be a professional working in a related job or a researcher at a university.

Things to think about

- Who will benefit most from new technology? Will anyone lose out?
- Are there any ethical considerations?
- What evidence is used to support the ideas in the articles you have read?
- What problems did you face?
- If you had more time, how could you extend the project further?
- What are the implications of your findings to the real world?

Useful resources

Ask your teacher to help you find an expert mentor:

- stem.org.uk/stem-ambassadors

Articles:

- wired.co.uk
- newscientist.com

Public opinion surveys:

- ipsosmori.com
- yougov.co.uk

Health and safety

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 using science.cleapss.org.uk/Resources/Student-Safety-Sheets/
- assess the risks (think about what could go wrong and how serious it might be);
- if you collect your own data from surveys or interviews, make sure you get permission to use it in your project report;
- 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.

Managed by

www.crestawards.org
email: crest@britishscienceassociation.org