SILVER LEVEL

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 and 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 Award by signing up for a CREST Account here: crestawards.org/sign-in

Create a new Silver 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 form. 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 Silver Award

Hard work deserves a reward! Celebrate and certify your student's achievements by entering their project for a CREST Silver 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 Silver!

What next?

The scientific discovery doesn't need to end here. Students can have a go at the next level up – CREST Gold. 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 30 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 Silver 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.

CLEAPSS

Photo credit: Diana Novikova

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.

Photo credit: Diana Novikova

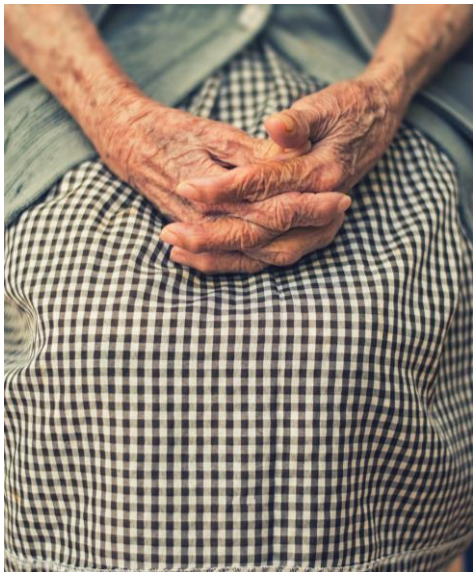
The Industrial Strategy Grand Challenges

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.

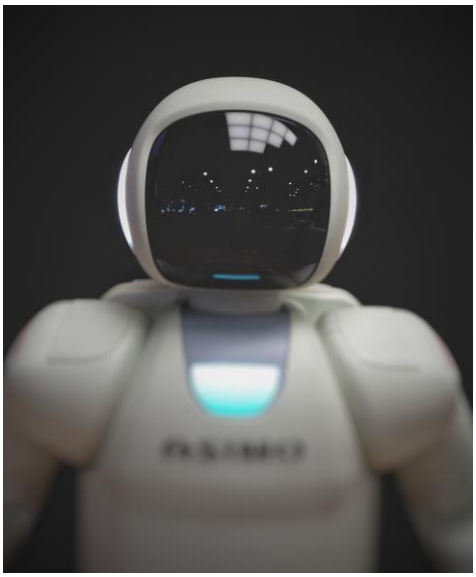
Artificial intelligence (AI) is when a computer thinks and makes decisions like a human being. These decisions might be too difficult or time consuming for humans or just too mundane.

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?



The Industrial Strategy Grand Challenges
Student handout

Clean Growth

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

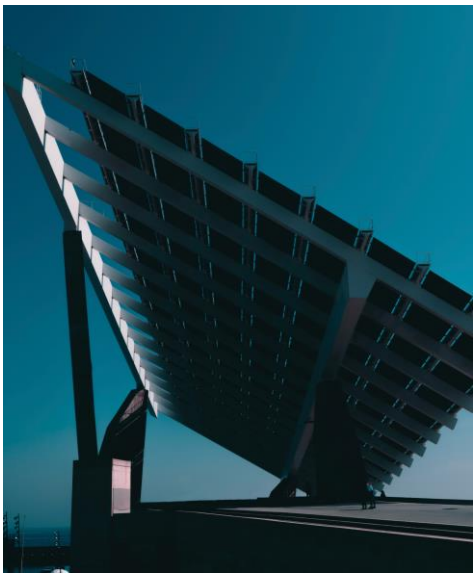
In order to combat climate change, we need to move towards a low carbon, more resource efficient way of life. We need to develop new technologies for energy generation as well as products and services which ensure everyone has access to sustainable and affordable energy. That means using renewable sources 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 – to 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 Silver 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 will complete, the resources you'll need and how long you'll 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.

Photo credit: Diana Novikova

AI and Data

Teach me tool

DESIGN & MAKE PROJECT

Activity created by

THE ROYAL SOCIETY

Project brief

In this project you will design a new artificial intelligence tool for use in a classroom.

You will need to research the use of machine learning in education and try out some tools yourself. You will then develop a concept for your teaching tool, explaining how it would use data and what tasks it would carry out.

You should start by finding out how machine learning is being used in education currently and how it might be used in the future. Use the links under 'useful resources' as well as searching for news articles, blog posts or science magazine articles.

List the tasks normally led by a teacher or other member of staff that you could develop your machine learning tool for. For example, taking a register, testing student knowledge, giving information on a topic, meeting and greeting students, assigning groups, developing a curriculum. Also think about the classroom environment: what might help you work more effectively? What extra support could computers provide, for example to those with learning difficulties?

Break down these tasks into smaller steps and consider all the data that the computer will need to complete each one. Consider the risks to a computer making these decisions rather than a human. Will they be fair? What are the limits to what a machine is trusted to do?

Decide on one task and develop a plan for your machine learning tool with a detailed explanation of how it will use data to make each decision.

You could test some of your ideas or simple versions of them using an AI design tool such as teachable machine: experiments.withgoogle.com/teachable-machine

Find out what students and teachers think about your ideas.

Create either a simple prototype or a physical model to represent your tool along with an explanation of how it will use data to make each decision.

Write up your project into a report or set of blog posts explaining how it would work and the data it would use.

Things to think about

- What tasks could a computer do to save teachers' time and resources?
- How can you create a system that meets the needs of all students?
- Could the computer be better than a human at some of the tasks?
- What skills does a human teacher have which would be hardest for a machine to replicate?
- What are the risks of using data or machine learning in your system?

Useful resources

- royalsociety.org/topics-policy/projects/machine-learning/what-is-machine-learning-infographic/
- royalsociety.org/topics-policy/projects/machine-learning/machine-learning-in-the-world-around-you-infographic/
- nesta.org.uk/blog/exploring-future-ai-education/
- experiments.withgoogle.com/teachable-machine

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);
- 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);
- only collect personal information that you need;
- you might want to collect views and opinions anonymously;
- make sure you communicate the purpose of the survey and how you will use the results;
- make sure your teacher agrees with your plan and risk assessment.

AI and Data | Clean Growth | Future of Mobility

Active travel

COMMUNICATION PROJECT

Project brief

In this project you will use data from Transport for London or Google Maps to develop a tool and accompanying campaign which encourages people to walk or cycle more.

Begin by making a list of the benefits of, and barriers to, active methods of travel such as walking and cycling. Are there any particular barriers in your local area?

Research examples of tools used by Transport for London (TfL) to encourage walking and cycling. For example, Transport for London's walking map, Santander cycle hire scheme, Legible London street signs. Look at similar examples in your local area such as other cycle hire or walking schemes.

Carry out an initial survey of students in your school to see how many walk or cycle each day.

Make a list of ideas to encourage more students to walk and cycle to school. You could adapt one of the tools created by TfL for your area or come up with your own idea. For example, you could create a walking times map for your local area or a walking signage to show places accessible on foot from your school.

What data will you need to make your tool work? You could use estimated journey time data or distances from TfL journey planner or from Google Maps.

You could plan and deliver an 'active' travel campaign at your school to launch your new tool and encourage students to walk or cycle to school as regularly as possible.

Evaluate your tool and campaign by measuring how effective it was. Has there been an increase in the numbers walking and cycling to school? Carry out a repeat of your initial survey.

Things to think about

- Who is your target audience and what are their needs?
- How will you test if your tool works?
- Are there any ethical considerations? Is it accessible for everyone?
- If you had access to more data what other tools would help?

Useful resources

- googlemaps.com
- tfl.gov.uk/modes/walking/

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- assess the risks (think about what could go wrong and how serious it might be);
- include road safety awareness in your campaign and make sure other students follow this;
- 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.

AI and Data | Future of Mobility

Smart lamppost

DESIGN & MAKE PROJECT

Project brief

In this project you will design a new piece of smart street furniture to help save energy, monitor air pollution and meet the needs of the local community.

Find out what smart street furniture is. You could start by researching smart lampposts: find out how they work, what functions they have, what data they collect and where you can find them. What do you think the benefits are to the local community and for the environment?

How are streets lit in your local area? Do the lights stay on all night? Are there areas with no street lights which make people feel unsafe?

Make a list of features that might be useful on a piece of smart street furniture in your local area. Consider who lives there and what their needs might be. Where would be the best location? You could carry out a survey amongst students or community members to find out.

Using your research and survey results, design a new piece of street furniture for your local area. Consider how you will ensure it is useful and accessible for people of different ages.

Make a scale model or set of drawings of your design, along with an explanation of how it would work, where it would be positioned and how you have made these decisions.

Plan how you will evaluate your idea and gain feedback from your target audience.

Things to think about

- Who is your target audience and what are their needs?
- How will you test if your product idea works?
- Is it accessible to everyone?
- How will it be powered?
- Where would you position your smart furniture?

Useful resources

An introduction to smart lampposts:

- intelligenttransport.com

Look for more articles on these sites:

- newscientist.com
- wired.com

History of street lighting:

- theguardian.com/cities/2014/nov/13/sci-fi-future-lamp-posts-street-lighting

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- assess the risks (think about what could go wrong and how serious it might be);
- show your plan and risk assessment to your teacher before you begin any practical work.
- 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);
- check your plan for using tools and materials with a teacher before beginning any practical work;
- make sure your teacher agrees with your plan and risk assessment.

Clean Growth | Future of Mobility

Hydrogen fuel cell

PRACTICAL PROJECT

Project brief

In this project you will design a prototype fuel cell, which you will present at a Dragons' Den type forum, to bid for further development funding. Your first step is to undertake practical experiments to:

- Investigate factors that affect the performance of a hydrogen fuel cell;
- Evaluate methods of generating hydrogen for use in fuel cells.

Vehicle exhaust fumes pose serious pollution problems in cities. One suggestion is to use hydrogen as a fuel instead of petrol and diesel –but that's not as simple as it sounds. Hydrogen-powered vehicles do exist, but so far, they are still experimental. Many cities around the world are trying out hydrogen buses. Several car manufacturers are developing hydrogen models. Are you about to witness a 'green transport' revolution?

Start by researching hydrogen fuel cells. You should find out about the fuel cell components and their functions and the reactants and products in cell reactions.

Make a hydrogen fuel cell with the model kit. Alternatively design your own simple fuel cell. Show your design to your teacher before making it.

Set up an experiment to measure the performance of your fuel cell. You will need to measure the energy input and output. You can then use this to calculate the efficiency.

Design a series of experiments to find out the affects of different designs on its performance. Consider what characteristics you will change. Make sure you only change one variable at a time to keep it a fair test. You could try changing:

- Electrodes – type of material, size, shape, distance apart
- Electrolytes – solute, solvent, concentration, solid electrolyte/ membrane
- Physical design – arrangement of components, overall size, shape and mass

Record your results in an appropriate way and draw conclusions about how each variable affects the performance.

Things to think about

- How does a hydrogen fuel cell work?
- How does altering the design of a fuel cell affect its performance?
- How can you measure the performance of a fuel cell?
- How effective are hydrogen fuel cells compared with other 'green' energy sources, such as biodiesel?
- If hydrogen fuel cell vehicles become common, where will all the hydrogen come from?

Useful resources

- Ask your teacher for a model kit for making a hydrogen fuel cell (available from laboratory suppliers, usually with instructions for various investigations).

Normal laboratory equipment for:

- measuring heat and electrical energy;
- generating hydrogen and oxygen, including by electrolysis;
- hydrogen vehicles worldwide;
- hydrogen-oxygen fuel cells;
- how hydrogen fuel cells work;
- making a rudimentary DIY hydrogen fuel cell (Alternatively, use carbon electrodes, collecting gases in electrolyte-filled test tubes above them).

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- 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.

Ageing Society

Antimicrobial resistance and healthy ageing

COMMUNICATION PROJECT

Activity created by

abpi

Project brief

In this project you will research antimicrobial resistance and ageing and produce a presentation and infographic for a global non-specialist audience to raise awareness of the most important issues and how they should be solved.

Antimicrobials, especially antibiotics, are becoming less effective in part due to overuse and incorrect usage.

Action regarding antimicrobial resistance (AMR) is necessary so that it does not impede the Grand Challenge ambition for people to enjoy at least five extra healthy, independent years of life, by 2035.

Start by researching disease areas which affect the immune system (e.g. diabetes and cancer).

Research what steps can be taken to reduce risk of developing such diseases.

Identify the link between a weakened immune system and developing an infection from multi-resistant bacteria.

Identify how antimicrobial resistance could impede ambitions for people to enjoy at least five extra healthy, independent years of life, by 2035.

Produce a presentation, together with a summary infographic, for a non-specialist audience which covers what you have researched.

Things to think about

- Who will benefit from reduced susceptibility to infection from multi-resistant bacteria?
- What is antimicrobial resistance and why is it an issue that impacts on everyone?
- What are the diseases which weaken the immune system?
- What steps can society take now, to reduce future risk of developing diseases which weaken the immune system?
- What are the factors which could have an impact on the ambition for people to enjoy at least five extra healthy, independent years of life, by 2035?

Useful resources

- abpischools.org.uk/
- antibioticguardian.com/keep-antibiotics-working/

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- 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.

Ageing Society

Design for an ageing society

DESIGN & MAKE PROJECT

Activity created by

the DESIGN MUSEUM

Project brief

How can design help people lead fuller, healthier and more rewarding lives into old age? How can designers meet the challenge of a rapidly ageing society?

Can you identify a problem that is faced exclusively in old age and design your own solution to it?

You will need to interview three or more people above the age of 70 and find out what everyday problems they struggle with. Refine this list to one problem and come up with five potential solutions to your problem. Test all of your solutions and develop the best idea into a rough prototype.

Start by interviewing three or more people over the age of 70.

You'll need to make a record of what they said and present it in your final work. Ask them some questions about their everyday life. Ask them about the tasks that they do on a regular basis.

Look at the results of your interviews. Are there any common themes or problems? Can you define one main problem?

Come up with five rough ideas as to how to solve the problem (you can think of more if you want). Don't throw out any ideas; all ideas should be considered no matter how weird and wonderful.

Work your ideas down to just one. Perhaps you could combine aspects of a few ideas and take the best bits from each.

Create a prototype of your best idea. This just has to be a rough model. You can add functionality but remember; this is a prototype.

Test your prototype with the user and report back on your findings. Talk them through your prototype and get their feedback on what they would like to see incorporated into the next iteration.

Things to think about

- Don't think about any potential solutions until you have identified the problem.
- Don't get hooked on one idea too early.
- Never dismiss any ideas. Even our failures teach us something.
- Take the best parts of all your ideas.
- Test your final design with your target user.

Useful resources

- Visit the Design Museum website and Dezeen to read about the Design Museum's New Old exhibition that looked at design for an ageing population.
- designmuseum.org/whats-on/pop-up-exhibitions/new-old
- design.britishcouncil.org/blog/2016/dec/08/mapping-research-design-disability-and-ageing-popu/
- dezeen.com/2017/01/12/design-museum-new-old-exhibition-six-projects-improve-life-older-people/

Health and safety

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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);
- your solution should be sympathetic to the end user. When you are interviewing someone you must first ask their permission;
- 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.

Clean Growth

Solar oven

DESIGN & MAKE PROJECT

Project brief

In this project you will design and make an oven to cook food using solar energy. You could use climate data to investigate further how effective your oven would be in different locations and times of year.

Make a list of heating sources which are used for cooking. What are the advantages and disadvantages of each one?

Find out what a solar oven is, what designs exist, where they are used and how they work.

Collect together a number of examples of designs for a solar oven. Are there common elements which appear in all designs? For each example, make a note of the materials it is made from, how powerful it is and the country or climate it is designed for.

Design your own solar oven to work in your own local area during a period of warmer weather. You could use the designs you have seen as inspiration. You can construct a simple solar oven out of a cardboard box and tin foil.

Design a test to measure how efficient your solar oven is. You could measure the increase in temperature of a container of water. How will you make this a fair test?

You might choose to repeat your experiment and keep the length of time and the volume of water the same. After each test make sure you record your results before making changes to the design to improve it.

Evaluate your design. How useful is solar energy for cooking in the UK?

Things to think about

- Consider the materials you have used in your design. How sustainable are they?
- Is your oven transportable?
- What are the limitations of solar energy for cooking?

Useful resources

- Materials to make your oven from which might include cardboard boxes, tin foil, clean foil food containers
- sunoven.com
- solarcooking.org
- earthobservatory.nasa.gov/features/RenewableEnergy/renewable_energy4.php
- she-inc.org

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);
- never eat or drink food in a science laboratory;
- if you plan to eat the food which has been heated using a solar oven you will need to follow recommended food hygiene procedures and check the centre of the food has reached a safe temperature, as well as completing the experiment in a food tech room.
- 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.

AI and Data

Future farm

DESIGN & MAKE PROJECT

Project brief

In this project you will investigate how artificial intelligence could be used to increase food production and design and test an AI tool to recognise when fruit is ready for picking.

Either research on the internet or interview someone who works on a farm to find out what is involved in growing food commercially. Make a list of the tasks which need doing.

Do some research to find out how AI works and how this technology is being developed to support farming. You could investigate farm drones which use machine visual recognition technology, farming chatbots and farming apps like Plantix.

An artificially intelligent system learns using examples rather than following a set of instructions. You will need to train the computer using lots of example images of fruit, both ripe and unripe. Decide what fruit or crop you will use and how you think the system might work.

Use machinelearningforkids.co.uk or a similar web-based tool to try out ideas. Ask your teacher to set up an account for you. Use the project worksheets on this website to give you more ideas for your own project.

Decide how many images you will need to collect, how you will group them into classes, how varied the images will be and how you will know once you have enough. You may need to experiment with the computer model to see what works.

Once you have created a trained model, test it to see how effective it is.

Consider how your tool could be used on a real farm and how it might need to be adapted.

Things to think about

- How does the variety of images affect how successful your tool is?
- How useful would your tool be for farmers?
- How could your tool be combined with other technology to make it more useful?
- What tasks in growing food might a computer be better at than a human being?
- What impact do you think AI technology will have on farming in the future?

Useful resources

- microsoft.com/en-us/research/project/farmbeats-iot-agriculture/
- ensia.com/features/deep-learning/
- teachablemachine.withgoogle.com
- machinelearningforkids.co.uk
- plantix.net
- plantvillage.psu.ed

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 to set you up with a student account when using web applications;
- 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);
- remember, never consume or taste food or drink in the laboratory or which has been opened in the laboratory;
- make sure your teacher agrees with your plan and risk assessment.

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