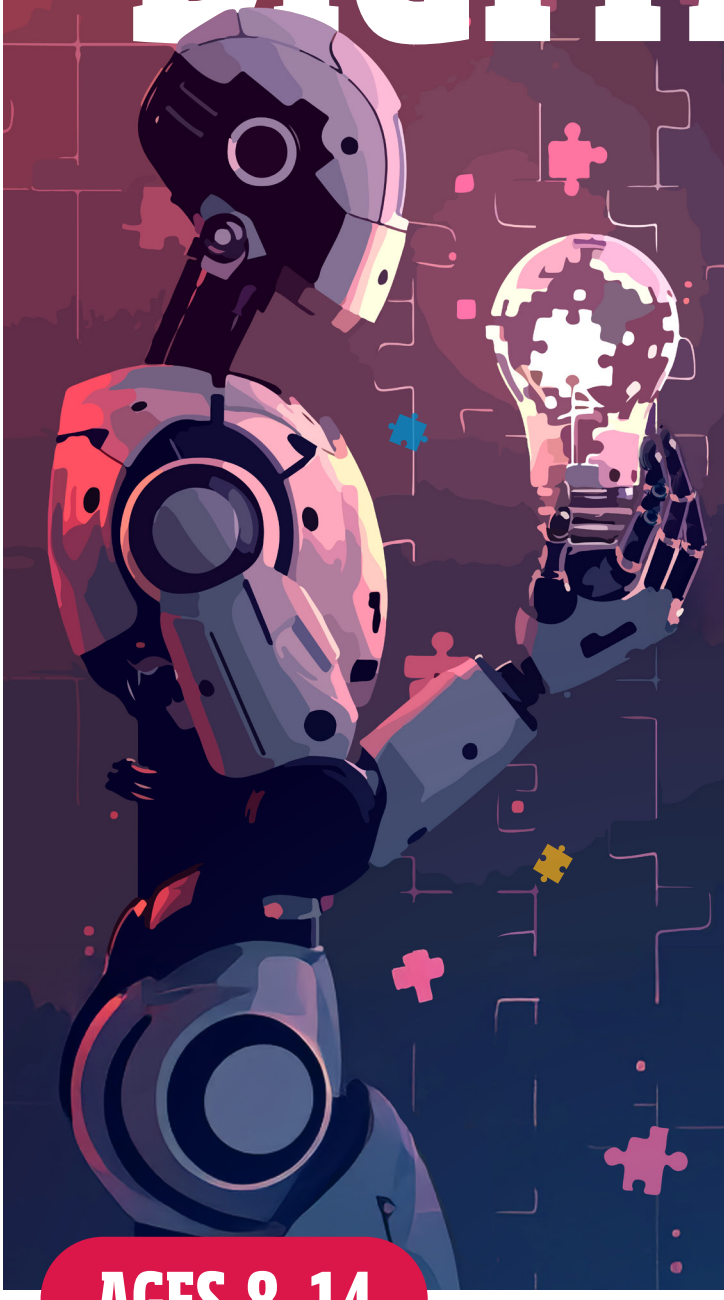
Schools Roadshow 2025

DIGITAL & AI

Aligned to the National Curriculum,
The Curriculum for Excellence
& The Curriculum for Wales



5 Unplugged Activities Inside

- **Cipher Challenge**
- **Pattern Predictor**
- **How do Machines Learn?**
- **Coding Commands**
- **Unbeatable Opponent**

Suitable for those who attended the BAE Systems Schools Roadshow, and those who didn't.

Unplugged

Screen-Free

AGES 8-14

Developed in partnership with

smallpeice
Dare to imagine

BAE SYSTEMS

ROYAL AIR FORCE

ROYAL NAVY

Introduction

We have an exciting collection of cross-curricular, unplugged digital and AI activities for students.

If you're a teacher or STEM Ambassador, please read through the activities carefully. Each activity is designed to run without requiring technology. Some have an optional extension if you have devices available to use. The activities can be adapted to suit different age and ability levels. Many of the activities are cross-curricular and can be linked to history topics, science and maths. There is also plenty of career information at the back. Please complete risk assessments as required by your school.

If you're a student, please use these activities sensibly – we want you to have fun and learn about digital technology and Artificial Intelligence.

These Activities Support The Curriculum for students aged **8-14**

For England
The Computing National Curriculum for Key Stage 2 & 3

For Scotland
The relevant Computing Science sections for the Curriculum for Excellence

For Wales
The relevant sections for Science and Technology in the Curriculum for Wales

The activities can be made more or less challenging to suit the needs of your students.
Feel free to select the activities which you think best suit your class.

From pixels to possibilities!

Let's dive into the digital world and uncover the secrets of AI and digital technology.

Teacher Testimonials

"All activities cover different areas of computing and embedded the technical terminology using practical activities that put it into context for the students"

"Great range of activities and linked well to computing curriculum"

"The children were quickly engaged and curious"

Recap of the Fundamentals

We live in an age where technology is advancing rapidly, and digital technology and artificial intelligence (AI) are transforming our lives. Digital tools have become an integral part of our daily routines and have transformed industries, from healthcare and education to entertainment and finance.

Coding and algorithms are the foundational elements of digital technology. Coding is the process of writing instructions for computers, while algorithms are step-by-step processes for solving problems.

AI is a branch of computer science that aims to create machines that can learn, reason, and make decisions. By developing and refining algorithms, programmers can create intelligent systems capable of performing tasks that were once thought to be exclusively human, such as language processing and image recognition. Machine learning, a subset of AI, trains algorithms on large datasets to identify patterns and make predictions.

The skills we use when working with digital and AI are applicable across the whole curriculum and in many other aspects of our day-to-day lives. To truly benefit from technology we need skills such as communication, teamwork, problem solving and creativity, which are essential to harnessing digital and AI technologies.

Cipher Challenge

ACTIVITY 1

Students will learn how encryption works and its applications in online safety.

They will create and crack their own codes.

EQUIPMENT

Squared Paper | Card | Sellotape

Scissors | Coloured Pens

QUESTIONS FOR STUDENTS

How is our information kept safe online?

Why do we need to keep our information safe online?

KEY VOCABULARY

Encryption: The process of transforming plain text to a secret code using a mathematical algorithm.

Decryption: The process of transforming a secret code back into plain text using the correct decryption key.

Cipher: A type of encryption method that uses a specific set of rules to convert plain text into a secret code.

METHOD

- Explain encryption: changing plain text to a secret code which can only be read by someone with the correct decryption key.
- Demonstrate encrypting and decrypting a message using a Caeser wheel **www.101computing.net/cipher-wheel.html**

  ENCRYPTION EXAMPLE: 'HELLO' SHIFT KEY 4 = 'DAHHK'

  DECRYPTION EXAMPLE: 'MYWLYN' SHIFT KEY 6 = 'SECRET'
- Working in pairs or small groups, students create their own Caeser tubes following the instructions below:
  - Cut a strip of squared paper 27 squares long. Write the letters A-Z in each square, leaving the end blank.
  - Create a loop by overlapping the A square with the empty square and sticking with Sellotape.
  - Create a tube out of card, slightly narrower than the loop, so it can turn around the tube without falling off.
  - Create a second identical alphabet loop, written in a different colour and also one numbered 0-25.
  - Stick the two new loops onto the tube so you have one stationary alphabet loop at the top, then a rotating one, then a stationary number loop. Make sure the 0 is lined up with the top.
- The Caesar tubes work in the same way as the wheel: the stationary loop is the original text (plaintext) and the rotating loop is the encoded text (ciphertext). The numbered loop will show your shift key (e.g. when A lines up with 5, the shift key is 5).
- Students create their own secret messages for each other to decode. They need to specify the shift key.
- Discuss as a class why encryption is important in online safety.

EXTENSIONS

Students research other types of ciphers and codes e.g. Pigpen Cipher, Morse Code and Atbash Cipher.

RELATED CAREER

Cybersecurity Analyst

Protects businesses and individuals from cyberattacks and data breaches.

Cryptographer

Develops encryption techniques to create unbreakable codes, protecting information.

ENRICHMENT

Learn about the codes and ciphers used in WW2
www.bit.ly/CodebreakingWW2

KEY SKILLS

PROBLEM SOLVING · CREATIVITY · AIMING HIGH

DIFFICULTY RATING =

TIME FRAME = 60 MINS

Pattern Predictor

ACTIVITY 2

Students will learn about how AI detects and predicts patterns in data.

They will create their own patterns and use logical reasoning to predict what comes next.

EQUIPMENT

Equipment to make patterns
e.g. Lego bricks, coloured lollypop sticks, squared paper and coloured pencils, counters, cubes, plastic 2D shapes

QUESTIONS FOR STUDENTS

Which patterns were easiest to predict? Why?

Which patterns were the hardest? What made them challenging?

Which patterns do you think an AI would find the most challenging to predict?

KEY VOCABULARY

Artificial Intelligence: When computers or machines are programmed to think and solve problems like humans.

Anomaly: Something different that deviates from the common rule.

METHOD

- Ask students for examples of when AI is used.
- Explain that AI can detect and predict patterns based on information they are given. E.g. weather forecasts, facial recognition, predictive text, filtering spam emails.
- Today, students will act like the AI to spot and predict patterns.
- Demonstrate a repeating pattern using the equipment chosen or by drawing on the board (e.g. shapes and colours). Ask students to predict what comes next and explain how they know.
- In groups, students use the equipment to create simple repeating patterns. Patterns could be based on colour, shape, size, number of objects. Encourage creativity.
- After 5 minutes, students exchange places with another group to analyse their pattern and predict what comes next. Students then check their predictions with the original group.
- Repeat this 3-4 times, encouraging students to make their patterns more creative and challenging.
- Discuss what strategies students used and how this is similar to how AI works: AI systems learn by identifying patterns in data and using logical reasoning to predict what comes next.

EXTENSIONS

- Ask students to create patterns with a deliberate mistake (e.g. incorrect colour, missing a step) and exchange with another group who must identify and correct the mistake.
- Discuss how AI systems can identify mistakes or anomalies in data.

RELATED CAREER

AI engineer
Designs and develops intelligent machines that can learn, think, and solve problems like humans.

Meteorologist
Identifies and predicts patterns in weather data, using advanced technology such as AI systems to process large amounts of data from satellites and weather stations.

ENRICHMENT

Can AI predict what your next move is in a game of Rock, Paper, Scissors?
www.bit.ly/RockPaperScissors-ML

KEY SKILLS

SPEAKING · CREATIVITY · TEAMWORK

DIFFICULTY RATING =

TIME FRAME = 30 MINS

How do Machines Learn?

Students will learn the process behind machine learning.

They will conduct an activity which replicates the process computers use for image recognition.

EQUIPMENT

Paper | Pens | Rulers

OPTIONAL: Images of UK Wildlife

EXTENSION: Devices with access to the internet

QUESTIONS FOR STUDENTS

How does a machine learn?

When might we see this in everyday life?

When is machine learning helpful?

KEY VOCABULARY

Machine Learning: A subset of artificial intelligence where computers or machines learn for themselves from data.

Database: An electronically stored, systematic collection of data.

METHOD

- **STARTER:** Play 20 questions. Think of an animal and students ask up to 20 yes/no questions until they identify it.
- This is a way to narrow down possibilities, which is what a machine learning algorithm can do.
- Explain that machine learning is like teaching a computer to learn new things. E.g. showing a computer lots of pictures of cats and dogs, so it can learn to tell the difference between them.
- Students are going to work in groups to replicate the machine learning process that would be used to identify wildlife photographed in the UK. Students can choose their animals or you could suggest some (e.g. fox, badger, hedgehog, owl, squirrel, toad). You may want to provide images for reference. To make this more challenging, choose animals with similar characteristics e.g. different birds or insects.
- **ACTIVITY 1:** Feature extraction. Students make a data table to record 4-6 physical features for their chosen wildlife (e.g. fur colour, shape of ears, number of legs, tail length).

	COLOUR	NO. OF LEGS	SIZE	EAR SHAPE
Squirrel	Red	4	Medium	Triangle
Badger	Black & White	4	Large	Triangle
Snowy Owl	White	2	Medium	-

- **ACTIVITY 2:** Database search. Students take it in turns to choose an animal from their list and play 20 questions, based on their database, to determine which animal it is.
- Discuss how the activity they have done mimics machine learning. The larger the database, the more accurate the outcomes.

EXTENSIONS

Students explore how machine learning has been trained to identify doodles on Quick, Draw!

https://quickdraw.withgoogle.com

RELATED CAREER

Robotics Engineer

Designs, develops and tests robots and robotics systems, often using machine learning.

Data Scientist

Uses software, AI and machine learning to understand large amounts of data, working in fields such as healthcare, finance and marketing.

ENRICHMENT

Train a machine learning algorithm with Google's Teachable Machine.

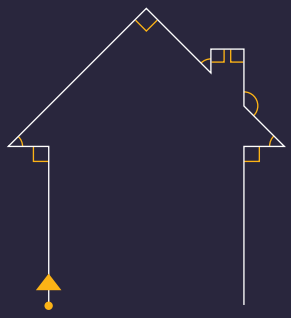
https://teachablemachine.withgoogle.com

KEY SKILLS

DIFFICULTY RATING =

TIME FRAME = 45 MINS

Coding Commands



ACTIVITY 4

Students will learn how coding and algorithms work.

They will create pseudocode, step-by-step instructions, for others to follow.

EQUIPMENT

Squared Paper
Pens (at least 2 colours)

OPTIONAL: Plain Paper

EXTENSION: Devices with access to the internet

QUESTIONS FOR STUDENTS

How easy were the instructions to follow?

Would a computer be able to follow the instructions?

KEY VOCABULARY

Coding: Creating a set of instructions for computers to follow.

Algorithm: A sequence of logical instructions for carrying out a task.

Pseudocode: Writing up a set of instructions for a computer program using plain English.

Debugging: Finding and fixing errors or bugs in code.

METHOD

- Discuss what coding is and what algorithms are.
- Explain that code is a set of instructions for computers to follow and they are going to write pseudocode, which is code written in plain English.
- Demonstration: display a simple line image on the board (e.g. house). Work as a class to write clear, step-by-step instructions to draw this. Include key language like left, right, 90 degrees/quarter turn.
- This activity can be done in pairs or small groups. To simplify this, use 2D polygons, to make it more challenging use line drawings of simple objects (e.g. flower, tree, car).
- **STEP 1:** Students draw a simple line drawing on squared paper.
- **STEP 2:** Pass the image on to another group.
- **STEP 3:** Students work together to write pseudocode for how to draw the image they've been given.
- **STEP 4:** After 10-15 minutes, students give their pseudocode to a third team to draw.
- **STEP 5:** Follow the instructions to draw an image. To make this more challenging, draw on plain paper.
- **STEP 6:** Return the drawn image and pseudocode to the previous team.
- Explain to the students they will now be 'debugging' their code, which means finding and correcting mistakes.
- **STEP 7:** Compare the original image to the one drawn following their pseudocode. Using a different coloured pen, students improve their pseudocode, making the instructions clearer.
- Students can then give the instructions back to the group to see if their second attempt is closer to the original.

NOTE: This activity could also be done with practical equipment (e.g. Lego) instead of drawing.

EXTENSIONS

Using a simple coding program, like turtle academy playground, ask students to change their pseudocode to written code. Discuss how the instructions differ.

RELATED CAREER

Manufacturing Engineer

Supervises and improves how products are manufactured, working out the best step-by-step process.

Project Manager

Helps plan, organise and guide a team to make sure a project is successful from start to finish.

ENRICHMENT

Practice your debugging with these coding challenges
https://www.kidlocoding.com/debug

KEY SKILLS

DIFFICULTY RATING =

TIME FRAME = 45 MINS

Unbeatable Opponent

ACTIVITY 5

IF / THEN

Students will learn how algorithms work.

They will write step-by-step instructions on how to win different games.

EQUIPMENT

Paper | Pens

Whiteboard for demonstration

OPTIONAL: Counters

QUESTIONS FOR STUDENTS

What strategies are you using to win?

What instructions would you give a person to win?

What instructions would you give a computer?

KEY VOCABULARY

Algorithm: A sequence of logical instructions for carrying out a task.

Pseudocode: A method of writing up a set of instructions for a computer program using plain English.

METHOD

- As a class, play **'Get to Zero'**.
- **RULES:** Work in pairs. Start from 16 and each person subtracts either 1, 2 or 3 each time, keeping track of the running total. The person who gets to 0 wins.
- You could use counters to show the subtraction each time.
- Give students time to play in pairs.
- Bring the class back to discuss their strategies: how can you ensure you win each time?

  HINT: If you get to '4', the other person cannot win because the most they can subtract is 3 so you can always make it to zero. To control the game, you want to go second and react to your opponent so you always subtract to make 12, then 8, then 4, then 0.
- Ask students what an algorithm is.
- Discuss how you would write instructions to win the game. If your opponent does X, you do Y. This is like an algorithm: a set of step-by-step instructions to solve a problem.
- Ask students to write clear, step-by-step instructions (an algorithm) for how to win.

EXTENSIONS

- Ask students to write the instructions (an algorithm) to increase the likelihood of winning noughts and crosses. In the algorithm, the 'computer' always gets to go first.
- Ask students to colour code their algorithm depending on the type of instruction.

RELATED CAREER

Software Developer

Creates innovative software solutions that solve real-world problems. They bring their ideas to life through coding and algorithms.

Game Designer

Brings new types of games to life. They create and test prototypes to make sure games work properly.

ENRICHMENT

Learn about the Minimax Algorithm that allows AI to play Noughts and Crosses and other games.
www.youtube.com/watch?v=SLgZhpDsrfc

KEY SKILLS

PROBLEM SOLVING · CREATIVITY · STAYING POSITIVE

DIFFICULTY RATING =

TIME FRAME = 45 MINS

Chirag

Software Engineer

I joined BAE Systems Digital Intelligence through a coding bootcamp. I have plenty of opportunities to work on interesting projects and I'm currently working for the Space Business on the AZALEA satellite project! I work on lots of different software projects which can be quite simple or really complicated. As I work through each project I will test things and see if they work as I expect them to and work with my team to achieve a positive project outcome.

There are lots of different skills that are needed to work within digital but the main skill that is important for a software engineer is problem solving. Computers and code are really complicated so you can often find yourself stuck. It's really important to be able to find a way to fix your issue and I work through and research possible solutions to enable me to eventually solve the problem.

Akshada

Cyber Security Degree Apprentice

I'm currently on the Digital and Technology Solutions Degree Apprenticeship, specialising in cybersecurity. The combination of hands-on experience and structured learning has allowed me to develop practical skills within cybersecurity that make a real-world impact. I currently work in the International Bid Team and I communicate with companies around the world to explore new business opportunities. I'll support the sales and business development teams by presenting technical capabilities or demonstrating products to potential clients whilst analysing market trends.

Effective communication skills are really important in my role. These skills are essential when working with global companies to explore new business opportunities and ensuring our proposals are clear and compelling. Also, teamwork is equally important, as I regularly collaborate with colleagues across the business in order to navigate complex projects and build strong relationships.

www.baesystems.com/en/careers/careers-in-the-uk/apprenticeships

https://rafyouthstem.org.uk • https://recruitment.raf.mod.uk/apprenticeships

WHERE DO YOU GO FROM HERE?

STUDYING AT SCHOOL

There's loads more to learn about digital technologies and AI – far more than we have had time to cover here. Computing and Computer Science will explore these areas in more depth.

APPRENTICESHIPS

You can do an engineering or digital apprenticeship once you're 16 or older. This gets you right into the wider world, learning everything from how to service an RAF aircraft to writing the software that guides the Royal Navy aircraft carrier underneath it.

A-LEVELS, SCOTTISH HIGHERS & T-LEVELS

Being 16 years old might feel like a long way away, but that doesn't mean you can't plan for it. Engineering, Physics, Maths, Computer Science and even Chemistry, are great choices if you want to be an engineer.

DEGREES & DEGREE APPRENTICESHIPS

Degrees, just like apprenticeships, will give you a wider view of the world, focusing more on the theory. Degree apprenticeships are a blend of the two: you have a hands-on job and also do university work.

Throughout the activities, you've seen just a few of the careers connected with digital technology and AI. There are so many more...

We hope you learned a lot about digital technologies and AI.

Engineers use all of these skills. If you enjoy solving problems, being creative, or working as a team, maybe you'd like to be an engineer.

Ravenscroft, T.M. (2020), Skills Builder Universal Framework of Essential Skills, London: Skills Builder Partnership at **www.skillsbuilder.org/framework**

If you enjoyed these activities, why not try our Magnetism, Space and Electricity resources, found here: www.baesystems.com/learninghub