# What's the Deal?
# Internet of Things
# Teachers' Guide

# Internet of Things Overview

The Internet of Things (IoT) project aims to support children in engaging with and developing their understanding of data and its uses in the everyday world. The University of Edinburgh has provided schools with sensors that gather different types of data: light, humidity, Carbon Dioxide ($CO_2$), temperature, motion, air pressure, and particulate matter. This data is collated and uploaded to the university server, where learners can interpret and analyse it.

Below are activities in the suggested four lesson blocks. The initial focus is gaining an understanding of IoT. Learners then consider how sensors are used in industry with AI and how they can capture or use their data through coding and Micro:Bits. These activities and lessons can be interspersed with further research and exploration, depending on Learner interest, to develop pupil-led projects.

## Outline of Lesson One - What is IoT?

This introductory session is about setting the scene for IoT. Pupils will learn about sensors that gather live data in their everyday lives and how this is linked to a more global IoT network.

**Learning Intention**

- We are learning about the importance of data collection and analysis.

**Success Criteria**

- I can explain a definition of the Internet of Things
- I can analyse the use of Connected Devices
- I can discuss and share my IoT research with others

Discussions should begin using the key vocabulary, allowing time for intra/interspecific discussions and time allocated to research definitions.

## Lesson One – What is IoT?

Pupils should be given ample time to complete research on the concept of IoT. Key questions could be posed to prompt research, such as:

- What does the Internet of Things mean?
- How do you know if a device is connected to the Internet?
- Do you have any IoT devices at home?
- How can you control IoT devices?
- Are you surprised by specific devices being part of the IoT network?
- Were you already aware that particular devices were part of IoT?

Support learners in developing their questions about IoT, which can be explored as further IoT lessons are taught and shared with peers during the session.

Depending on their writing and literacy focus, learners could write notes on their research, create a Sway, Video, or news report, and collaborate on an online platform such as Teams, Google Classroom, Padlet, Mural, etc. At the end of the lesson, learners should share their learning and allow others to make notes and further their understanding through peer discussion.

Plenary - Pupils summarise learning from the session. They then consider the statement - "IoT is omnipresent in today's world" and give an informed response. Pupil responses may include, for example:

*IoT is omnipresent in today's world because*:
- We have all used IoT today by….
- Towns/cities are filled with IoT. E.g.
- IoT has helped me today through…

*IoT is omnipresent in today's world because*:
- I haven't used IoT devices today by not…
- Certain areas of the World are without an internet connection, such as…

Click here to watch a BBC News explanation of IoT or copy the following URL into your browser:

https://www.bbc.co.uk/news/av/technology-36912701

## Outline of Lesson Two – IoT and my School

This lesson develops an understanding of using data to monitor and help understand school environments. Pupils will learn about sensors that gather live data in their own classrooms and compare this information to live data collected from other schools in Scotland.

**Learning Intention**
- We are learning about the importance of data collection and analysis

**Success Criteria**
- I can say how data can be used to develop learning environments
- I can analyse data from my school
- I can compare data from different settings.

Discussions should begin using the key vocabulary, allowing time for intra/interspecific discussions and time allocated to research definitions.

## Lesson Two – IoT and my School

The teacher should give pupils some free time to explore the live data for their own classroom and schools in their wider area/nationally. Encourage pupils to find interesting data points, make inferences, and be ready to share them with the class.


*Possible similarities*

- They show the same date and time period
- They all have time at zero
- They all follow the same "bell curve"
- They all have an X-axis and a Y-axis

*Possible differences*

- The Scale is different
- The Range is different
- Classrooms with relative highest/lowest Lux, $CO_2$, Motion, Temperature, Humidity
- The Sensors are in different locations nationally and within school buildings


Encourage annotations on the data sets, discussions and explanations of why – there are no right or wrong answers regarding data analysis.


Ask learners to choose their favourite data set/point/location and explain why they are particularly fond of it. Then, learners are tasked with deciding where they would like to place or hide sensors around their school and putting forward the best argument for why the sensor must be placed there. This thinking could lead to learners/adults hiding the sensors in their school building, asking learners to guess where they are hidden, and explaining how they used the data to decide where they are hidden.


Plenary - Pupils compare learning from the session. They then consider the statement - "This data is my favourite because…" and give an informed response.  Pupil responses may include, for example:


*This data is my favourite because***:**

- It shows that our Teacher entered and left our classroom at this time...
- It shows the times of sunrise and sunset were…
- I can see the highest/lowest temperature today was at…


*I want to learn more about this data because***:**

- I don't know why I see *X* at this time/in this place
- I wonder if I can improve the humidity/Lux levels/$CO_2$ Levels


*I think the sensor should be placed here because***:**

- It will show if the levels of $CO_2$ are safe during indoor PE
- It will show motion for the highest number of learners in the school day

- It will help to improve our learning environment/timetable during the school day

## Lesson Three – IoT and Industry

Lesson three explores how data and sensors are used in industry and commercial settings to develop efficiency, improve conditions, or reduce emissions. Pupils will learn about sensors gathering live data in industry and commercial settings. They will then compare this data from various sources to further explore the Industry Internet of Things (IIoT) and Commercial applications.

**Learning Intention**

- We are learning about the importance of data collection and analysis

**Success Criteria**

- I can say how data can be used to develop industry and commerce
- I can show how data analysis can be applied
- I can show how to use data to improve industry/commercial environments

Discussions should begin using the key vocabulary, allowing time for intra/interspecific discussions and time allocated to research definitions.

Learners should explore their preferred examples of Industry/Commercial IoT:

- Dynamic Positioning on large sea/ocean-going vessels to ensure a ship stays in the exact position it should be using automation and AI
- IoT agriculture sensors that can be attached to animals on a farm to monitor their health and wellbeing and physical location
- Biscuit factories ensure that each biscuit is perfect through IoT technology
- Football players wearing IoT devices to improve performance and monitor health
- IoT sensors inside rugby balls

There are excellent explanations of how factories make certain foodstuffs on 'Inside the Factory' which can be accessed on BBC iPlayer but not all content is suitable for all learners. Click here to explore episodes or copy the following URL:

https://www.bbc.co.uk/programmes/b07mddqk/episodes/player

Once learners have grasped how IoT is used in their preferred area of research, they should develop/design their own industrial machine, inspired by their research, that uses IoT to support core functions. They should then create an exhibition in the classroom or in the wider school setting to exhibit these machines and illustrate their functions.

Plenary - Pupils share learning from the session. They then consider the statement - "IoT is necessary in all industries because…" and give an informed response.  Pupil responses may include, for example:

*IoT is necessary in all industries because:*

- It supports efficiency by...
- It develops uniformity…
- It helps the environment by reducing unnecessary emissions…
- AI is the future of industry.

*IoT is not necessary in all industries because:*

- It takes jobs from humans.
- AI cannot 'feel' like humans can.
- The ease of accessing data worldwide can be a security issue.

## Lesson Four – Micro:Bits and IoT

Session Four explores how learners can collect their data by coding sensors. Pupils can subsequently compare their collected data to live data gathered from their classrooms to explore how they can maintain a better learning environment.

### Learning Intention

- We are learning about the importance of data collection and analysis

### Success Criteria

- I can say how data can be used to develop industry/working environments
- I can analyse data from my school
- I can compare data from different settings

Discussions should begin using the key vocabulary, allowing time for intra/interspecific discussions and time allocated to research definitions.

Learners can code their own sensors using the Micro:Bit website and Micro:Bits. There are two beginner coding step counters for Micro:Bits, which you can find by clicking here or clicking here. Alternatively, you can paste the following URL into your web browser:

- https://microbit.org/projects/make-it-code-it/step-counter/
- https://microbit.org/projects/make-it-code-it/low-energy-step-counter/

Learners should familiarise themselves with using the Step Counters. Key questions could be posed to prompt thinking during this time, such as:

- How many steps are there between the gym hall and our classroom?
- Can you use the fewest steps to get around our classroom and the most?
- Does everyone take the same number of steps when they cover certain distances?

Once the learners are familiar with using the step counters, they should use these Micro:Bit step counters in the same locations as the sensors, if possible. Collect a range of different step counter data sets and display these graphically, either in bar graphs or using other methods. Compare their graphs to their peers' graphs.

Display and share the IoT sensor data for this time and support learners to complete an investigation into the following:

- Does my pedometer number increase in direct proportion to the Motion Detection?
- Can this be linked to $CO_2$, and if so, how?

Learners are welcome to develop their own avenues for research on this topic, but they should be mindful of the question: *How can I make this a fair test?*

Plenary - Pupils compare learning from the session. They then consider the following questions:

- How can I make this a fair test?
- Does my pedometer number increase in direct proportion to the Motion Detection?
- Can this be linked to $CO_2$, and if so, how?

## CfE Experiences and Outcomes

### Numeracy and Maths

MNU 2-10b   I can carry out practical tasks and investigations involving timed events and can explain which unit of time would be most appropriate to use.

MNU 2-20a   Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading.

MTH 2-21a  I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology.

### Literacy

ENG 2-27a  I am learning to use language and style in a way which engages and/or influences my reader.

LIT 2-02a   When I engage with others, I can respond in ways appropriate to my role, show that I value others' contributions and use these to build on thinking.

LIT 2-14a   Using what I know about the features of different types of texts, I can find, select and sort information from a variety of sources and use this for different purposes.

LIT 2-25a   I can use my notes and other types of writing to help me understand information and ideas, explore problems, make decisions, generate and develop and develop ideas or create new text. I recognise the need to acknowledge my sources and can do this appropriately.

LIT 2-26a   By considering the type of text I am creating, I can select ideas and relevant information, organise these in an appropriate way for my purpose and use suitable vocabulary for my audience.

LIT 2-29a   I can persuade, argue, explore issues or express an opinion using relevant supporting detail and/or evidence.


**Technology**

TCH 2-03b  Throughout all my learning, I can use search facilities of electronic sources to access and retrieve information, recognising the importance this has in my place of learning, at home and in the workplace.

TCH 2-12a   I can extend my knowledge and understanding of engineering disciplines to create solution.

TCH 2-15a   I can create, develop and evaluate computing solutions in response to a design challenge.


**Social Studies**

SOC 3-08a   I can identify the possible consequences of an environmental issue and make informed suggestions about ways to manage the impact – if researching around farming/industrial applications of IoT.