

The Secret Sensor
Internet of Things
Teachers' Lesson Guide
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THE UNIVERSITY
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Internet of Things: Overview

The Internet of Things (IOT) project aims to ensure children are 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, CO₂, temperature, motion, air pressure and particulate matter – uploaded to the university server, where learners can interpret and analyse the data.

This guide covers four activities related to the 'The Secret Sensor' project. This uses a discovery learning approach to use data to help us understand more about the factors influencing our environments. There is also a robust investigative element.

The Secret Sensor: Overview

This CfE Level 2 project is designed for use at an early stage of learning about the Internet of Things. A sensor is hidden at a secret location within the school, and learners must locate it by examining the data it produces, such as light, motion, temperature, and humidity readings. The discovery learning approach is engaging for learners and helps them gain a better understanding of the factors that influence their environment. After the initial discovery, one group repositions the sensor, and the challenge is set anew for the others. Students can deduce its location by recognising the sensor's data patterns, variables, and correlations.

Activity 1

In this introductory lesson, the teacher should have already hidden the sensor somewhere in the school around one to two weeks before introducing the lesson.

During this time, the pupils should familiarise themselves with the sensors' measurements. Introducing this lesson after the pupils have completed 'The Classroom Environment series' (or are familiar with what the sensors measure) is helpful.

Task 1 – Discussion

Inform learners there is a secret sensor in the school, and we will try to find it. Make it clear that we will not physically look for it and pose the question: How will we find it?

Allow the pupils to discuss this question and facilitate discussion around using the data emitted by the sensor to locate its position in the school.

Then, ask the pupils to co-construct the success criteria.

Key questions:

What do you wonder? How will we find it? What will we need to look for? What will make us successful? What evidence will we gather?

Go over the Learning Intention and Success Criteria.

Learning intention

- Interpret, ask questions about, and analyse data.

Success criteria

- I can discuss some variables in the data.
- I can spot and discuss patterns in the data.
- I can compare two sets of data from different sensors.
- I can work well in groups.
- I can back up my arguments using the data.

Task 2 – Real life context

Discuss a real-life context where data is used to locate something. Pupils can research online and make notes in groups. They can present back to the class. This could be something local to the pupils, or you could use the example of forensic scientists. The following weblink could be a lesson to enhance this project:

<https://cyberskillslesson.com/activity/how-to-solve-a-murder/>

This lesson examines data and how to gather it to solve a case. In modern policing, collecting evidence at a crime scene is more than just dusting for fingerprints or searching for hair strands. In many crimes, a trail of digital evidence can lead to the criminal.

After the pupils have explored the usefulness of using data to locate or find something, they can start to discuss how they will plan their project.

You can also link data to other real-life contexts they will be familiar with; for example, how is data used to learn more about athletes? Have you ever noticed data collection during a football match? You can discuss how they interpret this type of data in a football game and what it helps them to find out about athletes.

Task 3 – Making links to our community

It is helpful to initially present the live data from the secret sensor to the whole class on the Promethean board (or alternative device). Then, ask the pupils to hover over certain times of day on the graph and encourage them to predict where they think the sensor is - based on the data. It is helpful to show *different* sensors in locations they are already familiar with - to compare the data sets so they can spot patterns and correlations. For example, show the live data from the sensor in their classroom and highlight when there was a lot of movement or the lights went on. What does this tell us? (If you only have one sensor, you can go over the data from the secret sensor without giving the location away). Ask what they notice about the data.

The teacher can guide students with prompting questions, such as: What time did the lights turn on? What times are showing the most and least movement? When is the Co2 the highest/lowest? Then, follow with questions about when we are all in and out of different rooms and noticing timings and routines in our school community. (Use questioning here for differentiation)

Task 4 - Project

Learners should work in pairs or threes to examine and explore the data. They should note down their findings and work to build a case together. They should be able to choose how they would like to present their findings. They should come to a consensus in their group on where they think the sensor is based purely on the data, and they should use specific evidence from the data to support their argument. (This project has no particular time frame, so it can take some groups longer.)

They could present digitally, working on SWAYs or presentations and using clips and screenshots of live data (they can annotate screenshots to show specific evidence). This project will encourage teamwork and rich discussion about the data.

Giving learners a copy of school timetables can help them to correlate their findings. For example, the Reduced Class Contact Time (RCCT) timetable can check times when certain classes are empty, etc.

Questions to pose:

Examine our school timetable and check if any patterns match the data. Where do you predict there is a lot of movement at this time? Can you imagine a place in our school that matches the data patterns?

Activity 2

Task 1 – Hiding the sensor

Once the sensor has been successfully found, tell the pupils that one group will choose the new hiding place.

Pose questions for the pupils to think about:

(Class discussion to build the success criteria) Where would be an excellent place to hide the sensor? Think about the data it will collect. What will you need to consider?

They should consider their previous learning and draw on their school community environment. Ask groups to devise a plan, critically thinking about where they would like to hide the sensor. Ask them to write down their reasons for choosing their new hiding place. Tell them this is top secret and must be kept within their pair.

The pupils must then send this plan to their teacher by email or handwritten letter in a sealed envelope marked top secret. They must try to persuade the teacher that their location is the best location to hide the sensor. They can use expository language skills to convince the teacher that they have the best hiding spot while explaining what data they predict will be collected and why this spot would be a good challenge. This lesson can be repeated weekly, encouraging more interesting hiding places and data sets.

Example sentence from a persuasive application: I would like to place the secret sensor in the P4 classroom next to the gerbil cage as it will show erratic movement. This will be a challenge for everyone to crack. The gerbils might also raise the Co2 levels, providing an exciting interpretation data set.

Learning intention

- Predict, critique and question data sets.

Success criteria

- I can predict and discuss what data might be collected.
- I can work well in a pair.
- I can use persuasive writing to present my case.
- I can make links between our environment and data.
- I can demonstrate my creativity skills.

Task 2 – Finding the sensor

The pupils should build on their investigative skills from Activity 1 to analyse the live data over a prolonged period (around a week or more). They should track any changes in the data, prompting discussions around these. They should link the data directly to their environment. Some pupils might even want to study the RCCT timetables further and learn more about school meetings that week (or ask other staff/pupils investigative questions) to correlate the data with times when the classrooms or other spaces might be empty.

This encourages triangulation in their thinking, linking the live data to their environment. (This meets some experiences and outcomes in Mathematics, providing real-life contexts to timetables and time).

Pupils can even plan experiments to manipulate the data, for example, walking past certain areas to track movement changes. However, it should be stressed that the pupils should only use the data to find the secret sensor. It should not be physically looked for. In this part of the lesson, you can recap the PPDAC model and how they can use this approach to find the sensor. The problem is that they need to locate the sensor.

Learning intention

- Interpret environmental data to locate the sensor.

Success criteria

- I can ask questions about the data.
- I can question what is missing from the data.
- I can link the data sets to my environment.
- I can create investigative methods to manipulate the data.
- I can record and present my findings.

Task 3 – Challenge/plenary

Learning intention

- Utilise my knowledge of data and share it.

Success criteria

- I can predict data sets.
- I can link data collection to my environment.
- I can work well in a team.

- I can create investigative methods to manipulate the data.
- I can record and present my findings and share them.

As a challenge, it would be helpful to continue to place secret sensors in various exciting places around the community or Scotland. One sensor is placed in a reptile enclosure in a zoo in West Lothian, and this sensor could be used as a whole class extension secret sensor activity. The pupils can research and create a project around their findings before following on and completing the series of lessons linked to the reptile enclosure.

Classes have used this as an extension of their knowledge from the secret sensor lessons to research the habitats of different animals to justify their predictions. More of these secret sensors could create richer discussions and increase data literacy in a real-life context. Learners could think of interesting places to put secret sensors around their community.

As a plenary, the pupils can collate their work and share their secret sensor journey with another class, encouraging the other classes to get involved. They could create competition and do job of the class teacher in activity one, receiving and reviewing applications for the sensor's location. This series of lessons is cyclical and can continue through the year.

Coverage of Skills Progression

Focusing - Second level

- asking questions to clarify tasks, remaining focused to plan and set goals with some support to complete an activity/task
- organising their thinking and focusing on an activity to avoid distractions
- drawing from various sources of information, sorting through the information to focus on what is essential
- suggesting changes to their environment to support their ability to focus on an activity.

Adapting – Second level

- posing interesting questions and constructively challenging ideas to adapt thinking and behaviour
- identifying problems and researching different ways to understand and find solutions, including using online tools
- understanding and responding to feedback when working with their peers
- changing their way of working to fit with different activities and different groups
- reaching agreements and beginning to manage disagreements.

Initiative – Second level

- evaluating and classifying information and selecting the most appropriate methods for a particular task
- setting their own goals in order to complete a task within a deadline
- evaluating what they have learned and being able to compare their approach with others in the group
- understanding directions and being confident in undertaking a task
- confidently challenging themselves when faced with the unexpected, but knowing when to ask for help.

Communicating – Second level

- communicating confidently in a variety of familiar and unfamiliar situations, in a range of different ways
- posing interesting questions that do not have straightforward answers
- using what they see and hear to form and justify opinions, and find out more information
- sharing, explaining, and justifying their own views, and beginning to use language to influence others
- asking more focused questions in order to understand a task and to be able to plan activity

Collaborating – Second level

- working within a group taking on different roles and tasks\learning to understand, respond to and build on feedback from others
- being happy to work in a group and willing to help others with their learning
- showing sensitivity to other's feelings and being willing to challenge poor behaviour in others, if necessary
- sharing, explaining and justifying their views and beginning to use language to influence others.

Leading – Second level

- learning and building on other people's ideas and suggesting solutions during group work
- helping to lead a group towards an agreed purpose or goal through listening, discussion and collaboration
- supporting others to participate through verbal and non-verbal cues
- using a variety of research tools to deepen understanding and knowledge in order to make suggestions
- working through discussion, supporting others to reach agreements.

Curiosity – Second level

- being curious about the unfamiliar and unexpected • posing relevant questions to develop their understanding
- actively building on their own and other's ideas and experiences to solve problems and develop understanding

- constructively challenging ideas that are presented
- independently using a range of sources of information to form and justify opinions
- showing an understanding of whether the source of information is reliable or not and giving reasons why.

Creativity – Second level

- posing interesting questions that do not have straightforward answers
- beginning to understand the value of their own judgements and the merit of their own work
- creating and designing solutions to a problem independently and collaboratively as part of a wider group
- understanding that mistakes and failures can lead to solutions to problems
- learning from, and building on, other people's ideas and experiences.

Sense making – Second level

- using creativity and knowledge of different subjects to contribute ideas
- identifying problems and researching different ways to find solutions including using online tools
- asking, researching and answering questions about the world, extending their own world map
- using memory strategies to deepen understanding and comprehension
- identifying and ordering patterns and relationships through a range of strategies such as grouping, classifying and/or comparing and contrasting
- examining options, sharing their opinions and justifying their answers.

Critical thinking – Second level

- using different types of questions systematically and with purpose
- making and testing predictions, examining evidence and making links between possible causes and effects
- examining options when working through a task and weighing up the pros and cons of different approaches
- explaining and justifying methods, opinions and conclusions whilst understanding more than one point of view
- selecting the most appropriate strategy to solve a problem and complete a task.

CfE Experiences and Outcomes

Science

SCN 2-20a Through research and discussion I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society.

SCN 2-20b I can report and comment on current scientific news items to develop my knowledge and understanding of topical science.

SCN 3-20a I have collaborated with others to find and present information on how scientists from Scotland and beyond have contributed to innovative research and development.

Literacy

LIT 2-07a I can show my understanding of what I listen to or watch by responding to literal, inferential, evaluative and other types of questions, and by asking different kinds of questions of my own.

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

ENG 2-03a I can recognise how the features of spoken language can help in communication, and I can use what I learn. I can recognise different features of my own and others' spoken language.

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 2-10a I am developing confidence when engaging with others within and beyond my place of learning. I can communicate in a clear, expressive way and I am learning to select and organise resources independently.

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.

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.

Numeracy and Maths

MNU 2-10a I can use and interpret electronic and paper-based timetables and schedules to plan events and activities, and make time calculations as part of my planning.

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.

MNU 2-20b I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way.

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.

Technology

TCH 2-01a I can extend and enhance my knowledge of digital technologies to collect, analyse ideas, relevant information and organise these in an appropriate way.

TCH 2-07a I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment.

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

TCH 2-14b I understand how information is stored and how key components of computing technology connect and interact through networks.

Social Studies

SOC 2-12a By comparing my local area with a contrasting area outwith Britain, I can investigate the main features of weather and climate discussing the impact on living things

SOC 2-10a Having explored my local area, I can present information on different places to live, work and relax and interesting places to visit.

Expressive Arts

EXA 2-06a I can develop and communicate my ideas, demonstrating imagination and presenting at least one possible solution to a design problem.

EXA 2-05a Inspired by a range of stimuli, I can express and communicate my ideas, thoughts and feelings through activities within art and design.