The Croc That Got Too Hot

Lesson Guide

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, C02, temperature, motion, air pressure and particulate matter –uploaded to the university server, where learners can interpret and analyse the data.

Below are six activities that break into a suggested 12 lessons. The initial focus is on how data is being used in a zoo in Scotland to create the right environment for crocodiles. Pupils then consider how data capture and use can benefit other animals.

Activity 1   Meet the Crocodiles

This introductory session sets the scene for using data to monitor and help animals. Pupils will learn about sensors that gather live data from crocodiles in the Lost Kingdom exhibit in the Five Sisters Zoo, Polbeth, Scotland. Pupils then compare this information to live data collected from their classroom.

Learning Intention

- We are learning the importance of data in the everyday world.

Success Criteria

- I can say why humans can use data to benefit animals.
- I can analyse environmental data from a zoo.
- I can create a piece of art that shows my understanding of crocodiles.

The teacher should present the key vocabulary, first showing the words and giving pupils time to think and then share their thoughts. Then, show all the definitions.

Share the information about Bob & Bindi, setting the scene for the topic.

https://fivesisterszoo.co.uk/our-zoo/animals-a-to-z/dwarf-crocodile/

Task 1
- Share the questions for discussion on comparing three graphs (crocodiles/Lost Kingdom/classroom).
- Pupils then share their answers and discuss which graph is each of the locations and why.
- Answers:
    - ○ Top data set = crocs

- ○ Middle data set = Lost Kingdom
- ○ Bottom data set = classroom
- ○ Date - 5th June
- ○ Time – 24 hour period
- ○ Measuring - Light
- ○ Possible similarities
  - ■ They show the same date and time period.
  - ■ They all have time at zero.
  - ■ They all follow the same "bell curve"
- ○ Possible differences
  - ■ The scale is different – light LUX differs significantly in each.
  - ■ Classrooms are highest LUX, Crocodiles are lowest LUX, Lost Kingdom is in the middle LUX.

Task 2

- The teacher should provide pupils free time to explore the live data for the crocodile environment, the Lost Kingdom, and their classroom. Encourage pupils to find interesting facts about the data, make inferences and be ready to share them with the class.

- At this point, the teacher should round off the first lesson of this activity and revisit the learning intention and success criteria.

- The teacher should start the second session of Activity 1 by revisiting learning intention, success criteria and key vocabulary.

- Share information about crocodile scutes to provide more background knowledge about a crocodile's anatomy.

Task 3

- Challenge children to show this information creatively. This may include:

  - o Pencils focusing on shading
  - o Print with newspaper and paint
  - o Collage
  - o Clay
  - o Textiles

- Plenary - Pupils summarise learning from the session. They then consider the statement - "Data is not important for animals" - and give an informed response. Pupil responses may include, for example:

*Data is important for animals because***:**

- Humans can make changes to their enclosure.
- Humans can try to replicate their natural habitat.
- Humans can track and monitor animals' health.
- Humans can compare zoo and wild animals' similarities and differences.

Data is not important for animals because:

- Animals can't read data.

Activity 2   Exploring the Crocodile Data Further (CO2 and temperature)

This session is about looking more deeply into the data collected from the crocodiles. Pupils identify data points and make inferences to explain changes in the data. There is a focus on C02 and Temperature.

Learning Intention

- We are learning to critically analyse data gathered from the zoo.

Success Criteria

- I can suggest possible reasons for changes in data about animals' habits.
- I can give clear definitions for C02 and temperature.
- I can say why particular levels of CO2 and temperature are essential to crocodiles
- I can show my understanding of a crocodile's needs through a written piece.

- The teacher should present the key vocabulary, first showing the words and giving pupils time to think and then share their thoughts. Then, show all the definitions.

- The teacher asks, "Can you remember what C02 and Temperature are?" and gives pupils time to discuss before showing definitions.

- The following two slides show data from the crocodile's enclosure relating to C02 and temperature. Give pupils time to make observations. Questions to probe investigation and thinking will appear on the PowerPoint.

- Temperature questions and answers: Questions to pop up after thinking/discussion time given to data.

    ○ Where is the X-axis? What does it show?
    ○ What is the highest recorded temperature?
    ○ What is the lowest?
    ○ What is the difference between the highest and lowest?
    ○ Are there any spikes in the data here?
    ○ What could make this graph more clear?

- Co2 questions and answers: Questions to pop up after thinking/discussion time given to data.

- - Where is the Y-axis? What does it show?
    - How would you describe the change in C02 over a day?
    - Are crocodiles high or low producers of C02? Say why.
    - How do you think this might differ from wild crocodiles?

- Pupil then display the class live data and compare the crocodile data sets to their own.

- The teacher should share information about a crocodile's ability to regulate its breathing underwater.

Tasks 1 & 2

- Pupils make comparative graphs using the crocodile data and their data to show key data points for C02 and temperature. Pupils must know how to calculate averages and draw comparative bar graphs. Mixed ability [maths] groups may be one way to approach these tasks.

- The teacher rounds off the first lesson of this activity and revisits learning intention and success criteria.

- The teacher begins the second session of activity two by revisiting learning intention, success criteria and key vocabulary.

Task 3

- Pupils are challenged to show their knowledge of what they have learned about the crocodiles, temperature and C02. Two story starters have been provided - "An imaginative story titled "The Crocodile that Got Too Hot" and an article for the newspaper Crocodile Weekly titled "World Record Croc Celebrates Winning Breath Holding Contest." However, pupils are free to complete this written task in any creative way.

- Plenary – Pupils summarise learning from the session. They are then posed with the statement, "Thanks to data, I know crocodiles are intelligent," and give informed responses.

- Pupil responses may include:

  - They can regulate their breathing underwater - data shows this as they keep their C02 levels low compared to humans.
  - They can stand high temperatures because of their sweat glands - data shows their average temperature and humidity levels are higher than humans can withstand.
  - Their scutes and webbed feed allow them to move through water without moving the water much, as shown by the low motion values.

Activity 3   Exploring the Crocodile Data Further (Motion and Humidity)

This session is about looking deeply into the data collected from the crocodiles. Pupils will identify data points and make inferences about why they are as they are. There will be a focus on motion and humidity.

Learning Intention

- We are learning to critically analyse data gathered from the zoo.

Success Criteria

- I can suggest possible reasons for the changes in data linked to animal habits
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- I can show my understanding of a crocodile's motion by using my Maths knowledge of speed, distance and time to compare my speed versus a crocodile's.

- I can clearly define motion and humidity and explain why they are relevant.

- The teacher should present the key vocabulary, first showing the terms and giving pupils time to think and then share their thoughts. The definitions are then displayed.

- The teacher asks, "Can you remember what motion and humidity are?" After pupil discussion, definitions are displayed.

- The following two slides show data from the crocodile enclosure relating to motion and humidity. Give pupils time to make observations. Questions to probe investigation and thinking will appear on the PowerPoint.

- The teacher asks, "In a race with a crocodile, do you think you would win?"

Task 1

- Pupils investigate speed, distance and time. It may be beneficial to display the SDT triangle for constant reference. Pupils go outside in pairs/small groups and measure a 20m running track. When ready, they should time each other to see how long it takes them to run 20m. They use the information gathered to determine what speed (mph) they can run at and if they are faster than a crocodile.

- It may be fun to display on a graph or display those who are/are not faster than a crocodile and discuss the possible consequences of being slower!

- At this point, the teacher should round off the first lesson of this activity and revisit the learning intention and success criteria.

- The teacher should start the second session of activity three by revisiting learning intention, success criteria and key vocabulary.

Task 2

- Pupils research where crocodiles live in the wild and zoos. They should display this information in a poster. Pupils may choose to draw world maps and label them or draw a list.

- Plenary – Pupils summarise learning from the session. They are then presented with the statement "Maths and data are linked" and asked to provide informed responses.

- Pupil responses may include:
  - Data can be shown on a graph like other things in Maths.
  - To understand a scale, you must be able to count step by step, like working with numbers.
  - You need to be able to add and subtract to see differences on a graph.
  - You need to be able to divide to work out averages.
  - Problem solving.

Activity 4   Exploring Different Animals

This session allows pupils to use what they have learned about the crocodiles and apply that knowledge to other animals that interest them. This activity is explicitly linked to the next, where they will use what they learn. Pupils will work in the same groups for both.

Learning Intention

- We are exploring the homes of different animals to predict the data they produce.

Success Criteria

- I can make predictions about living environments.
- I can create my own data set.
- I can work well as part of a team.

The teacher presents the key vocabulary, first showing the words and giving pupils time to think and then share their thoughts. Then, show all the definitions.

Task 1

- Pupils can learn through play, using trusted zoo websites' enclosure webcams to see what they notice about the habitats. They may try the links provided or find their own. Most zoos have this webcam feature.

Task 2

- Pupils as a pair or group should select one of the animals they like and make deductions about their enclosures and how they live. Questions are provided to probe thinking, but these are not exclusive. Pupils may need to conduct more research online to gain a deeper insight.

- At this point, the teacher should round off the first lesson of this activity and revisit the learning intention and success criteria.

- The teacher should start the second session of activity four by revisiting learning intention, success criteria and key vocabulary.

Task 3

- Pupils should use what they have learned about their chosen animals to predict their sensor data (CO2, humidity, temperature, light and motion). This should be plotted on a graph. Blank graphs could be printed before this activity. (5 graphs per group).

- Plenary – Pupils summarise learning from the session. Pupils are then presented with the statement – "Data is boring" - and give informed responses.

- Pupils' responses may include:

Data is boring:
- It isn't very easy to look at.

Data is not boring:
- You get to solve real problems and help make the world better.
- Data can help athletes achieve more success.
- Data can help businesses make more money.
- Data could help save the planet.
- You get to use cool technology.
- You could get a good job.

Activity 5   The Perfect Enclosure

This session is about allowing pupils to use their data knowledge to solve real-world problems for live animals. They will plan, design, and create an animal enclosure throughout this activity.

Learning Intention
- We are using our knowledge of data to improve an animal's environment in a zoo.

Success Criteria
- I can investigate a problem and plan a solution.
- I can describe the role of data in our investigation and predict results.
- I can create visual representations of my ideas.

- The teacher should present the key vocabulary, first showing the words and giving pupils time to think and then share their thoughts. The definitions are then displayed.

- Pupils join with their group from the previous session. They discuss their animal's problems living in its enclosure and how they could improve this. Questions are provided to probe thinking but are not exclusive.

- Pupils then create a presentation that lists their animal's needs and wants, the problems they have identified and how they would solve them with a new enclosure.

- Following this, pupils could make a 2D Minecraft or other model of their enclosure. Emphasis should be made on the labelling of each part and explaining how it would benefit the animals and the data being gathered.

- At this point, the teacher rounds off this activity's first lesson and revisits learning intention and success criteria.

- The teacher should start the second session of activity five by revisiting learning intention, success criteria and key vocabulary.

Task 1

- Pupils, in their groups, should create a 3D version of their model. A shoebox or other similar sized box would be an ideal starting point, but this is not essential. This should mirror the design planned and designed in Tasks 1 and 2.

- Plenary – Pupils summarise learning from the session. They are then presented with the statement, "Data has the power to bring about meaningful changes in the world," and provide informed responses.

- Pupil responses might include:

Examples of real-world change could be:

- Reducing the amounts of greenhouse gases produced, slowing down global warming.
- Improving existing products by monitoring human habits, making tech, etc, more efficient.
- Make animals more comfortable in zoos and slow down extinction rates in the wild.
- Finding solutions to medical problems, improving health and saving lives.

Activity 6   Making Your Project

This session is about allowing pupils to create their own data project using their interests. They will also show their knowledge of the overall project by debating social issues.

Learning Intention

- We are learning to be inventive and use data to solve interesting problems.

- I can say how gathering data in different places would be beneficial.
- I can use data to back up my opinions.

Task 1

- The teacher poses questions about interests and skills to assemble groups of pupils with various skills but similar interests.

Task 2

- After forming groups, pupils discuss how they can use something they are interested in to begin their own data project. They discuss what data could be gathered and how it might benefit a person or organisation. This could be done verbally; notes could be collected, and a poster or a presentation could be created.

Task 3

- Pupils should use notes or discussion points to draft an email to their chosen person or organisation. Adding detail about their experience, showing their enthusiasm and how they could benefit the person/organisation, will increase the likelihood of getting a reply. The teacher should proof read before any emails are sent.

- At this point, the teacher rounds off this activity's first lesson and revisits learning intention and success criteria.

- The teacher begins the second session of activity 6 by revisiting learning intention, success criteria and key vocabulary.

- Task 4 – The teacher informs the class they will use all the knowledge they have gained to debate social issues relating to animals. Below are some potential responses:

Animal hunting

The case for:
- To gather food.
- It can control wildlife populations.

The case against:
- Causing pain to animals unnecessarily.
- Killing endangered species, causing extinction.
- Morally wrong/abusive.
- It can be dangerous.
- It could have a knock-on effect on the food chain.

Animals being kept in zoos

The case for:

- Saving animals that could not survive in the wild.
- Boosting numbers in species by allowing them to breed safely.
- People can see/learn about animals they would never be able to see without zoos.

The case against:

- Animals are not in their natural habitat.
- Animals' enclosures are much smaller than their wild habitats.
- Animals lose their wild instincts.

- Plenary – Pupils summarise learning from the session. They are then presented with the statement - "Children aren't capable of understanding data," – and they provide informed responses.

- Pupils may answer:

Children are capable of understanding data because:

- We have been reading complex graphs and can make sense of them.
- We have worked out ways to improve animal learning environments from raw data.
- We have compared the data of animals and humans.
- We have created our own data sets, showing our understanding.
- We can do this at age "X", by the time we are adult we will know so much more.

CfE Experiences and Outcomes

Science

SCN 2-01a   I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction.

SCN 2-02a   I can use my knowledge of the interactions and energy flow between plants and animals in ecosystems, food chains and webs. I have contributed to the design or conservation of a wildlife area.

SCN 2-04a   By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy.

SCN 3-01a   I can sample and identify living things from different habitats to compare their biodiversity and suggest reasons for their distribution.

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 2-10c   Using simple time periods, I can give a good estimate of how long a journey should take, based on my knowledge of the link between time, speed and distance.

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

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.

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.

Art & Design

EXA 2-02a   I have the opportunity to choose and explore an extended range of media and technologies to create images and objects, comparing and combining them for specific tasks.

EXA 2-04a   Through observing and recording from my experiences across the curriculum, I can create images and objects which show my awareness and recognition of detail.

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

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 2-08b   I can consider the advantages and disadvantages of a proposed land use development and discuss the impact this may have on the community.

SOC 3-08a   I can identify the possible consequences of an environmental issue and make informed suggestions about ways to manage the impact.

Resource List

Week 1
- Print out a slide with 3 line graphs – 1 per pair/group.
- Devices with internet access - 1 per pair/group.
- Art and Craft materials may include, but are not limited to, pencils, newspaper, paint, collage, clay, textiles, etc.

Week 2
- Squared paper.
- Lined paper/jotters.

Week 3
- Stopwatches.
- Measuring tapes.
- Devices with internet access - 1 per pair/group.

Week 4
- Print out of blank data graphs or square/blank paper
- Devices with internet access - 1 per pair/group.
- Pens, pencils, paper, rulers.

Week 5
- Devices with internet access - 1 per pair/group.
- Art and Craft materials may include, but are not limited to, shoe boxes, pencils, newspaper, paint, collage, clay, textiles, etc.

Week 6
- Devices with internet access - 1 per pair/group.