POWERED BY

SMART CONSERVATION SECONDARY

Combining design and technology, biology, geography and zoology

PARK LIFE 2.0 (SECONDARY)

AGES 11-14

Lesson plan x2

SKILLS COVERED:

- Technical drawing/CAD
- Animals' needs
- Habitats
- Preserving natural habitats
- Conversation Conservation
- Research into animal needs and habitats
- Adapting and amending designs
- Exotic animal care

Taking inspiration from the story and career of Colin Hartley the maintenance engineer at UK zoo Drusillas Park, and the keepers at West Midlands Safari Park this resource combines biology, geography and zoology together to teach your pupils about the varied world of ‘smart conservation’.

This pair of lessons – one theoretical and one practical – explores how technology can help animals survive and thrive in captivity, encouraging your pupils to garner greater respect for animals and their natural habitats.

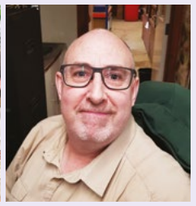
Overview

RS hero – smart conservation

Meet Colin. He features in the intro video for this lesson, which is included in the presentation – see slide 15.

Colin may well have the best STEM job an animal lover could hope for. He is the zoo electrician at Drusillas Park, which is a small UK zoo dedicated to the conservation and care of over 100 endangered species of animals – including lemurs, sloths, penguins, iguanas and bats. His job is to ensure the constructed habitats of these exotic animals are up to date and well maintained, so the animals stay healthy and happy.

Colin is the RS Hero for these consecutive lessons, as your class step into the shoes of a zoo maintenance engineer to learn all about the exciting world of smart conservation and exotic animal care, and how technology – and technical skill – can be used in this field. All of this will help them pick up some new perspectives on what’s possible with a STEM career, while expanding their world view.

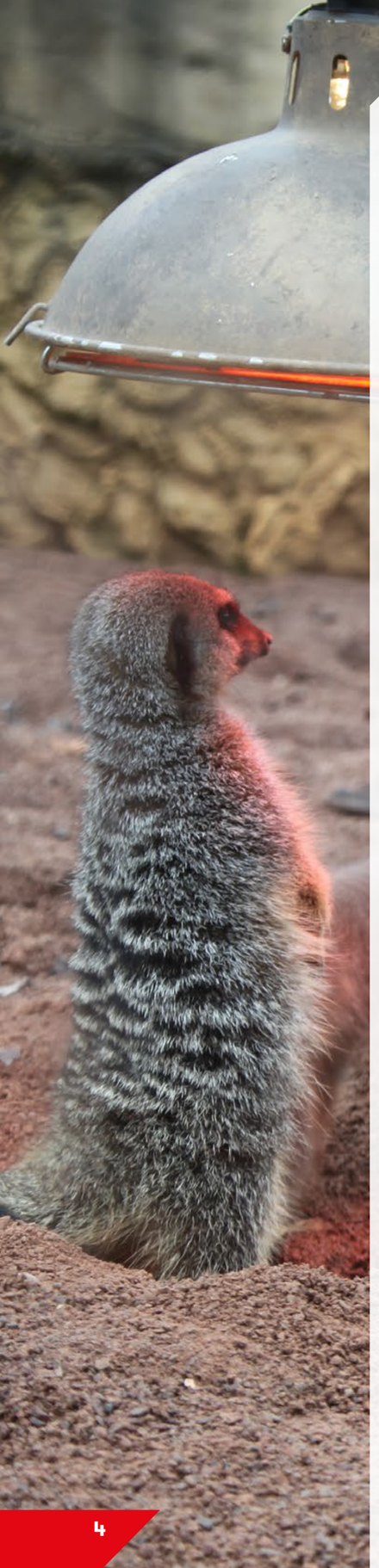


Meet Vicky, Amy and Steve some of the keepers at the West Midlands Safari Park.

We have also been leant a hand by the West Midlands Safari Park, who’s keepers let us meet some of their residents and explore their natural habitats.

REMEMBER...

While this lesson plan has been timed to run over a two-lesson timeframe, it can also be spread out over a longer timeframe. Younger or less advanced classes may benefit from three or more sessions using the same material.



LESSON 1 (informative)

- Endangered animals
- The role of zoos in conservation
- Conservation success stories
- The role of the zoo maintenance engineer
- Different animal needs
- Different animal habitats

LESSON 2 (practical)

- Constructed habitats
- Enclosure technology
- Designing smart enclosures
- Adapting designs for changing needs

DESIRED PUPIL OUTCOMES (lessons 1 & 2)

- I can now describe different species and their different needs
- I can now understand and explain why different animals have different needs, and what those different needs are
- I can now understand and explain how and why animals can become endangered and extinct
- I can now understand and explain the importance of conservation, and the role of the zoo in saving species from extinction
- I can now understand and explain the different methods used in captive breeding programmes
- I can now explain different habitats, which species they would be best suited for, and why
- I can now understand and explain the role of the zoo maintenance engineer
- I can now understand and explain how natural environments are mimicked for animals in captivity
- I can now design a suitable enclosure for different animals based on their needs, using either graph paper of CAD
- I can now adapt an enclosure to make it suitable for changing animal needs
- I can now explain how technology can be used in captive animal care, and include examples within my design
- I can now understand and explain how human behaviour, including my own, can impact on animals in the wild

DESIRED PUPIL OUTCOMES (lesson 3 optional)

- I can now build and/or 3D print a scaled-down model of a captive animal habitat
- I can now evaluate the usefulness of different features of a captive habitat, and adapt if necessary

Lesson 1

REMEMBER...

There are slides accompanying this lesson plan, including activities.

Before you run this lesson, make sure you have the PARK LIFE 2.0 presentation downloaded and set up on a projector at the front of the class. Please see teaching notes for further instructions.

There are two main activity options. OPTION 1 requires access to a computer lab, OPTION 2 does not.

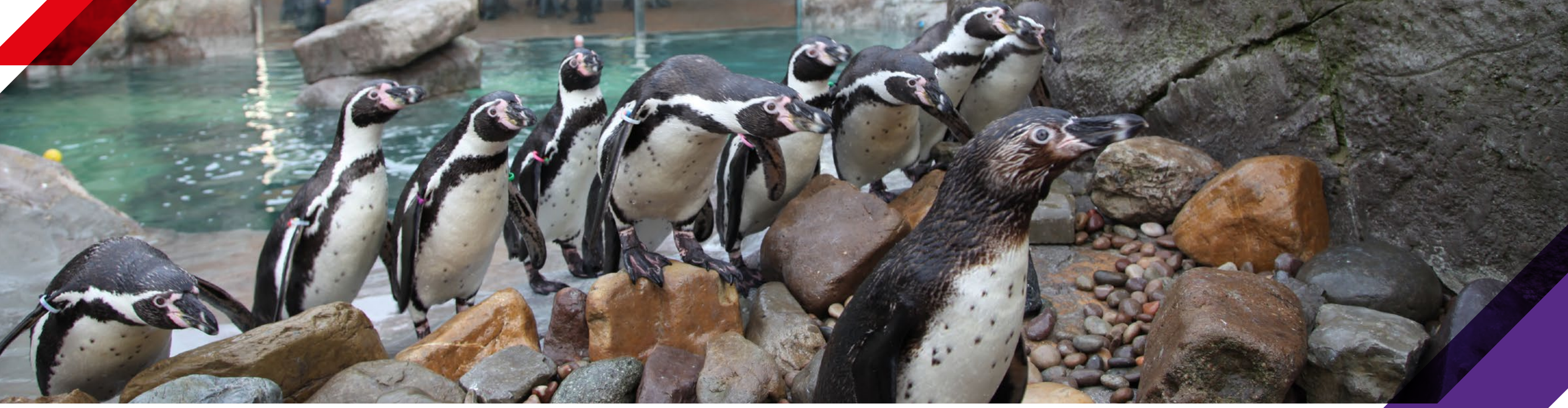
Introduction – 20 mins

1. Ask what the word 'endangered' means to the class and collect their answers
2. Explain the definition of 'endangered' and how endangered animals often become 'extinct' if the correct action isn't taken
3. Using the slide, add impact to this statement by revealing the animals who recently became extinct
4. Discuss the reasons that animals become endangered, first asking for guesses and revealing the answers
5. Using the slides, discuss the reasons why some people don't like zoos
6. Next, introduce the critical role of zoos in conservation by asking 'why do we need zoos?' before revealing the reasons:
   - Research
   - Education
   - Conservation
7. Discuss how captive breeding programmes work, including some of the methods it involves (see teaching notes)
8. Share some of the captive breeding success stories
9. Use the video of Colin from Drusillas to introduce and explain the role of the zoo maintenance engineer
10. Take a moment to explain how STEM careers are available in all sorts of industries and sectors – including animal care

Stretch & challenge

What other types of STEM job would you expect to see in a conservation project like Drusillas or WMSP?

- Research
- Medical (including veterinary)



Main activity – 30 mins

1. Use the slides to discuss the different needs of the following animals, and what is needed for them to be happy and healthy in captivity
    - Ring tailed Lemur
    - Two toed Sloth
    - Humboldt Penguin
    - Green Iguana
    - Rodrigues Fruit Bat
2. Split the class into small groups of 2-4 and run one of the two main activity options

OPTION 1 (if you have access to computer labs)

Instruct them to research the needs of three more **different** endangered animals (of their own choice) focusing on:

- Why that animal has become extinct
- How many are left in the wild/in captivity
- What their natural environment is
- What their needs are – in both the wild and in captivity

Stretch & challenge

OPTION 1

Start thinking about ways that environment can be recreated artificially, including the technology that will help make it possible.

OPTION 2 (if you don't have access to computer labs)

1. Assign each group an animal from the examples above
2. Ask them to think about what they remember from the slides about that animal, and to make notes about:

- Natural habitat
- Diet
- Sociability
- Reasons for being endangered

Ask them to start thinking about how the natural environment of that animal can be simulated artificially.

Plenary – 10 mins

1. Have each group briefly present their findings/considerations
2. Using the slides, discuss the ways that the zoos use technology to recreate their habitats (see teaching notes for additional definitions)

Stretch & challenge

OPTION 2

Start considering the technology that may be required to recreate each natural environment artificially – what do your pupils already know?

Homework

Ask each group to research and select a new endangered animal, ready for the next lesson, focusing on:

- Why that animal has become extinct
- How many are left in the wild/in captivity
- What their natural environment is
- What their needs are – in both the wild and in captivity

Stretch & challenge

HOMEWORK

Ask the groups to include details of existing conservation methods surrounding that animal or similar breeds.

Lesson 2

Introduction – 20 mins

1. Using the slides, briefly recap:
   - Endangered animals and conservation
   - Different animals and their needs
   - Constructed enclosures and the technology used in them
2. Separate the class into the same groups they were in during the main activity in the first lesson
3. Ask each person individually to share which endangered animal they chose to research for their homework
4. Instruct the groups to then discuss each of their animals in more detail, including:
   - Why that animal has become extinct
   - How many are left in the wild/ in captivity
   - What their natural environment is
   - What their needs are – in both the wild and in captivity

Main activity – 30 mins

1. Distribute the 'Smart Conservation Crib Sheet' amongst the groups
2. Run one of the main activity options:

OPTION 1 (if you have access to computer labs)

1. Design a 2D 'birds eye style' 'smart enclosure' for the chosen animal for either Drusillas Park or West Midlands Safari Park, first using graph paper, and then using CAD software in the computer labs (see teaching notes for recommendations)
2. Include details of the tech that will ensure that enclosure is suitable, and label where it will be, with full dimensions
3. Include details as to why, and how, that tech will be used. e.g. 'thermostat to keep temperature ambient at 22 °C', 'spray system set to go off every 10 minutes to keep humidity high'
4. Once the initial designs have been completed, explain that their chosen zoo has been chosen to lead the captive breeding programme for that animal.
5. Instruct them to adapt their designs according to this new information (e.g. 'make it bigger to accommodate more animals, add special breeding areas with more heaters' etc.)

OPTION 2 (if you don't have access to computer labs)

1. Design a 2D 'birds eye style' 'smart enclosure' for the chosen animal for either Drusillas Park or West Midlands Safari Park using graph paper
2. Include details of the tech that will ensure that enclosure is suitable, and label where it will be, with full dimensions
3. Include details as to why, and how, that tech will be used. e.g. 'thermostat to keep temperature ambient at 22 °C', 'spray system set to go off every 10 minutes to keep humidity high'
4. Once the initial designs have been completed, explain that their chosen zoo has been chosen to lead the captive breeding programme for that animal.
5. Instruct them to adapt their designs according to this new information (e.g. 'make it bigger to accommodate more animals', add special breeding areas with more heaters' etc.)

REMEMBER...

Ask the groups to design each adaptation from scratch (both CAD and paper, depending on the options chosen) so they can show their progress in the 'presentation' phase of the lesson.

Stretch & challenge

Add different reasons for adaptions and instruct them to redesign accordingly (using new graph paper if necessary).

- To save space in the zoo, you must integrate your animal with a similar species that would live harmoniously with them (e.g. Ring Tailed Lemurs with Red Bellied Lemurs). Choose the animal, and suggest adaptations to accommodate them
- A film company wants to monitor and record your animal to document the captive breeding process. Where would you set up the cameras?
- Your captive breeding project has won a big grant for its conservation efforts. How would you spend your portion of the money on improving your enclosure?

PLENARY – 10 MINS

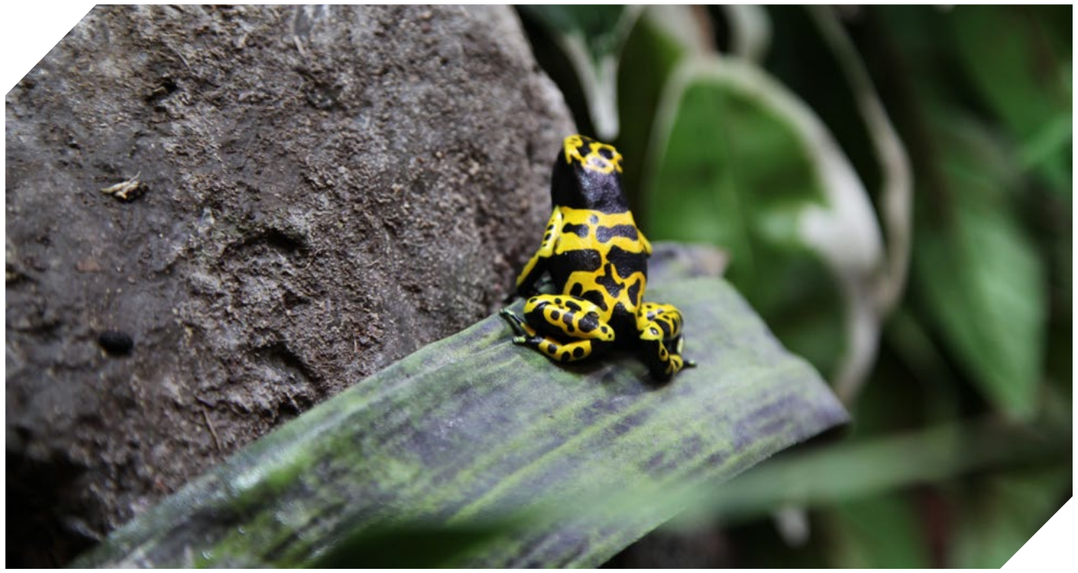
1. Ask each group to present and explain their finished enclosures, explaining which adaptations were made, and the thinking/ reasoning behind them
2. Briefly explain the reasoning behind the phrase 'smart conservation'
3. Using the slides briefly discuss how someone with STEM skills could use them in a zoo
4. Close the lesson by emphasising the importance of each person doing their part in preserving natural habitats, including:
   - Recycling
   - Reducing waste
   - Ethical consumption (e.g. not buying products containing palm oil, only using recycled toilet paper)
   - Putting pressure on government bodies to pass legislation which protects the environment
5. Ask the class what else they can do to help the animals they have specifically been researching

Lesson 3 (OPTIONAL)

REMEMBER...

There are NO slides accompanying this optional lesson.

Running this lesson will depend heavily on the resources and facilities available to you. You are encouraged to take the suggestions and be creative with how the main activity is carried out.



Introduction – 20 mins

1. Using the slides from lessons 1 and 2, briefly recap:
   - Endangered animals and conservation
   - Different animals and their needs
   - Constructed enclosures and the technology used in them
2. Separate the class into the same groups they were in during the main activity in the first lesson, asking them to:
   - Re-explain to the class what their animal is, and what their needs are
   - Re-share the finished designs for their smart enclosures for that animal

IMAGINE

Main activity – 30 mins

OPTION 1:

Use a 3D printer to create miniature 'scaled' models of the enclosures

PLEASE NOTE: this option is only recommended if final designs were completed using CAD software

- Spend a portion of the time explaining:
  - How a 3D printer works
  - What it is capable of
  - How to operate it
- Ensure the dimensions are scaled down to accommodate the capacity of the printer.
- If resources are limited (e.g. you only have access to one 3D printer) either
  - Ask the class to vote on their favourite enclosure during the introduction (with the winner will be selected for printing)

  OR
  - Select the most easily printed enclosure for a demonstration

OPTION 2:

Build a scaled-down model of the enclosures.

- Use easily sourced materials (card, paper, acrylic etc.) and tools
- Ensure the dimensions are scaled down to a comfortable 'model' size

OPTION 3:

Build a scaled-down 'working/moving' model of a certain aspect of the enclosure, using easily sourced materials (card, paper, acrylic, rubber bands, thumb tacs, string etc.) and tools

For example:

- An automatic internal-to-external door/flap so their animal can go inside/outside at will
- A timed feeder (only activates at certain times)
- Automatic outdoor heater (only activates when the animal is present)

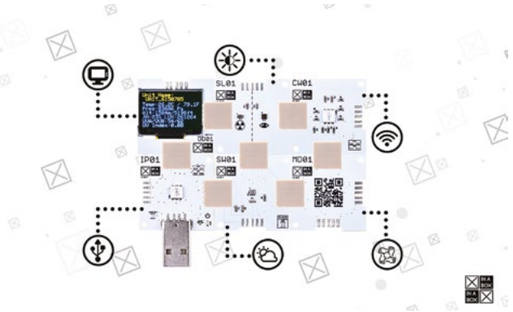
Ask the class to consider what their animal's needs are, and whether the feature will be useful to them, before building it.

OPTION 4:

Build a climate monitoring device using the xinabox STEM starter kit.

This kit measures environmental conditions by collecting data such as temperature, pressure, humidity, visible light, UVA and UVB.

Data can be viewed immediately on the OLED display and is transferred IoT-style by WiFi to an online dashboard. The kit can be built in just 20mins without any soldering or wiring.



To purchase the xinabox STEM starter kit, visit:

uk.rs-online.com and search for stock number **1906040**

Teaching notes

Curriculum links

Definitions

Captive breeding - the process of maintaining plants or animals in controlled environments, such as wildlife reserves, zoos, botanic gardens, and other conservation facilities

Artificial incubation – the hatching of eggs through artificial means (e.g. chicken eggs)

Surrogate incubation/embryo transfer – artificially fertilised cells (i.e. in a petri dish) implanted into the womb of a live animal to gestate (i.e. grow to term)

Cross fostering – using similar non-endangered species to raise offspring from endangered species

Artificial insemination – artificial introduction of sperm into a female's cervix or uterine cavity for the purpose of achieving a pregnancy

Hygrometer – measures the amount of humidity and water vapour in the atmosphere, in soil, or in confined spaces

Hydrometer - measures the relative density of liquids (through buoyancy)

Vivarium - an enclosure, container, or structure adapted or prepared for keeping animals under semi-natural conditions

Main activities (preparation)

Option 1

This option (for both Lesson 1 and Lesson 2) requires access to a computer lab and access to the internet. If running this option, it is recommended you and your class are familiar with basic CAD software.

CAD software recommendations

- Autocad
- Sketchup
- Cad desk

Option 2

This option (for both Lesson 1 and Lesson 2) requires access graph paper, and some level of knowledge of technical drawing. If running this option, it is recommended both you and your class are familiar with both these things.

Biology

Genetics and evolution:

- differences between species
- changes in the environment which may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction

Geography

Locational

Human and physical geography:

- understand how human and physical processes interact to influence, and change landscapes, environments and the climate

Design and technology

Design:

Pupils must

- use research and exploration, such as the study of different cultures, to identify and understand user needs
- use a variety of approaches [for example, biomimicry and user-centred design], to generate creative ideas and avoid stereotypical responses
- develop and communicate design ideas using annotated sketches, detailed plans and (if the aligned activity option is selected) 3-D and mathematical modelling, oral and digital presentations and computer-based tools

Evaluate:

- test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups
- understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists

Technical knowledge:

- understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs]
- apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers]

Instructions for teachers

Lesson 1

Before you start

Decide ahead of the lesson whether you wish to run:

- **OPTION 1** (with access to computer labs, and knowledge of basic CAD software)
- **OPTION 2** (without access to computer labs, but with knowledge of technical drawing on graph paper)

Make the classroom ready to show a presentation and download the slides from the resource pack (set to the beginning SLIDE 2 – Lesson 1).

Resources

- PARKLIFE 2.0 presentation slides
- Screen and projector
- Blank A4 paper
- Pencils
- Erasers
- Computer labs (if choosing **OPTION 1** for the main activity)

Lesson 2

Before you start

Decide ahead of the lesson whether you wish to run:

- **OPTION 1** (with access to computer labs, and knowledge of basic CAD software)
- **OPTION 2** (without access to computer labs, but with knowledge of technical drawing on graph paper)

PLEASE NOTE: it is possible to run either OPTION 1 or OPTION 2 during different lessons, depending on the facilities/knowledge you have available.

Make the classroom ready to show a presentation and download the slides from the resource pack (set to the SLIDE 35 – Lesson 2).

Resources

- PARKLIFE 2.0 presentation slides
- Screen and projector
- Blank A4 paper
- A3 or A4 graph paper
- Rulers
- Pencils
- Erasers?
- Computer labs (if choosing OPTION 1 for the main activity) with appropriate CAD software

To print:

- Smart Conservation Crib Sheet (enough for x1 per group, plus spares)

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