EASTER BUSH SCIENCE OUTREACH CENTRE

Get hands-on with real-life science

Opening a Can of Worms Researcher Guidance

Learning level	Primary: P5-7; Secondary: S1-2
Research themes	Animal Welfare Scientific Method
Duration	2hrs minimum, preferably multiple sessions

See DNA overview:

Participants will be using simple experiments with earthworms to learn about the scientific method. Using the pupil workbook for guidance, individuals or groups will think of their own question and plan their own investigation. Participants will need to use the 3R's and carefully consider the welfare of their worms before starting their experiment. Animal welfare is the major theme of this practical and the pupil book contains examples of animal welfare research at Roslin. **Introduce how you use the scientific method and think about animal welfare in your own research – get creative!**

Learning objectives

P5-P7	S1-2
• To recognise the steps of the scientific method • To understand the 3R's and that animals used in research need to be looked after and protected from unnecessary harm • To carry out an independent science investigation	• To recognise the steps of the scientific method • To understand the 3R's and that animals used in research need to be looked after and protected from unnecessary harm • To carry out an independent science investigation

• Revealing the world of scientific research	• Revealing the world of scientific research

Before the activity:

- Familiarise yourself with the activity protocol and suggested stages below.
- Decide with the school whether you will bring worms, or if the class will collect their own.
- Read over the activity powerpoint presentation. After the case studies section feel free to insert some information about yourself and your research.
- Complete the attached template risk assessment and send to the school, the Health & Safety team (ros48@exseed.ed.ac.uk) and the EBSOC team (ebsoc@ed.ac.uk).

Activity protocol

Exercise	Description	Stage
Designing the question	**Ask pupils to get into groups of three or four, with a maximum of 10 groups.** Using the slides provided explain that we are going to use worms to do a simple practical experiment, and that each group will come up with their own experiment. Introduce the class to the scientific method and SMART questions, then help each group decide what they want to find out and how they will do it. Each student should work through the aim, hypothesis, materials, and methods sections of their workbook. Explain that animals are often used in scientific research and we need to carefully consider their welfare so that they are protected from unnecessary discomfort. Explain how we care for worms and with the students, go through the 3R's pages in their workbook, so that they think about how their method will affect the welfare of their worms.	**1**
Carrying out the experiment	Each group will collect the equipment they need and carry out their experiments independently, with each student recording the results in their workbook. While the groups are working, walk around to answer any questions and ensure they are keeping worm welfare in mind. Once the experiments are finished make sure that all worms are put back into their worm farm, and that all equipment is collected. Everyone who has handled worms or soil should wash their hands.	**2**
Making the poster	After everything has been cleared away encourage students to think about their results, what they can conclude, and whether their hypothesis was right. Students should then be encouraged to think about	**3**

	what they could do differently if they were to do the experiment again, and what other experiments they would like to do. Each group will be given a sheet of card to make a poster detailing their experiment from their aim to method, results and conclusions. Encourage the students to get creative with how they display the information.	
Presenting	Each group should get the chance to present their poster to the rest of the class. They should explain how they went about their experiment and what they found out. At the end of all presentations the class could discuss if there were any things that were noticed by all groups, in reference to the worm, or to the scientific method.	**4**
Learning about research	Explain about the Roslin Institute and how much of our work involves looking at animals. Use the prepared case study of rat tickling to give a real-life example of how scientists use the scientific method to find out about animal behaviour. There are questions at the end of the case study that you can go through with the class. Introduce some of your own research after the case study. Try to show how you use the scientific method, and if you use animals how you think about their welfare.	**5**

The stages and associated slides are a guide only – you can adapt these to the time available, or learning level of pupils you are working with.

Poster making and presenting could be done in a different session to the actual experiment, and could be carried out in a normal school lesson, not necessarily with the researcher.

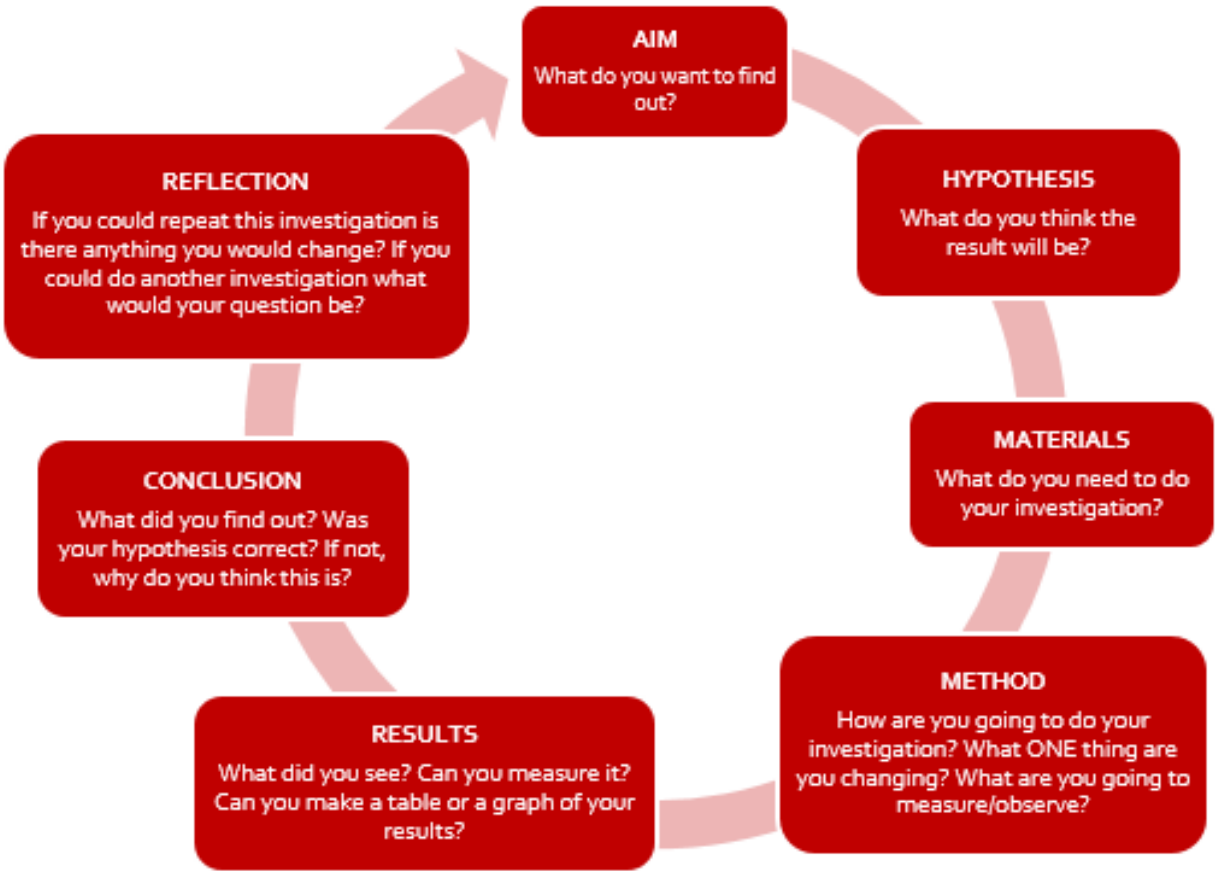
Once you return to EBSOC, ensure that the worm farm is put with the others in the labelled cupboard. If the school has collected its own worms, please release them into the garden. Please wash out the trays used for soil and leave on the draining board to dry. Replenish all consumables used.

SMART Questions and the Scientific Method

A SMART Question is:

- S- Specific - Good investigations are about changing one thing to see what the effect is on another thing i.e. dependent/independent variables
- M- Measurable – Can you measure it*? i.e how far something grows/moves, the time it takes for an animal/person to react/cross a line, the number of times*; or Can you observe it*? i.e defining a pattern, comparing and contrasting*
- A-Achievable - Can it be done in a reasonable time period? Do you have the materials to hand? Are they cheap enough to buy?
- R- Relevant - Is the question subject age/curriculum relevant?
- T – Testable - Is the investigation safe? Is the investigation ethical?

The stages of the scientific method



Earthworm Fact file

What are worms? Worms are animals, they don't have backbones (they are invertebrates) and they are cold-blooded (i.e. they cannot regulate their own body temperature).

How many types of earthworm are there? There are lots of different types of earthworm - in Britain alone there are 13 different commonly found types or species. To discover which earthworms you have collected, use the handy Soil and Earthworm Field Guide Key to Common British Earthworms from OPAL.

Are earthworms important? Yes, they are one of Earth's best decomposers, feeding on decaying plant matter and returning the nutrients to the soil. Worms also turn the soil as they move through it, which is very important for plants, and other living things growing in the soil such as microorganisms. Earthworms could be described as **soil engineers**.

Do worms breathe? Yes, they breathe through their skin, they don't have lungs like humans do. It is important for their skin to be moist to be able to breathe.

Do worms have noses? No, they do not have noses but they have chemoreceptors that can react to chemicals.

Do worms have eyes or ears? No, they do not have eyes or ears but they have receptors on their bodies that are sensitive to light and vibrations.

Do worms have mouths? Yes, they have a mouth at one with no teeth. They have a digestive system that processes the food, similar to our digestive system.

Do worms have a heart? No, they don't have a heart but they do have a circulatory system and something similar to a heart called the aortic arch. If you look closely near the head of the worm, you can see the blood moving through the aortic arch - look for a wave of the segments.

Do scientists study earthworms? Yes, over 100 years ago Charles Darwin studied earthworms, and today scientists are still studying them as they are very important for soil quality and have a big influence on plant growth.

Do scientists on the Easter Bush Campus study earthworms? No they don't, but many scientists on the campus study animal behaviour in livestock animals such as pigs, chickens, quails and cows. Many of the same principles apply to studying animal behaviour, whatever the size of the animal!

What questions can my pupils ask?

This investigation is an ideal opportunity for creative thinking and there are many questions that your pupils could ask and investigate safely with worms. We've come up with some examples below, but please don't be limited by them.

1) **How long is a worm?**

   Pupils use the ruler to measure the length of their worms. They record all of their results and calculate the average length. Please ensure that the worms are handled for a minimal time and that they are handled very gently.
   Teaching prompts: *How long do you think the worm is? What are the best units to measure in?*

2) **Do worms prefer wet or dry soil?**

   Cover half the tray with dry soil and the other with wet soil, place the worm on the boundary so that it can feel both soils. Cover with the card and wait for 5 minutes. Record the outcome.
   Teaching prompts: *How will you know if the worm prefers wet or dry soil? Can you measure this? Is it important to test more than one worm?*

3) **Do worms prefer light or dark?**

   Using the torches and a piece of card, cover half of the tray with the card and shine the torch on the other half. Place the worm on the boundary. Record the outcome.
   Teaching prompts: *How will you know if the worm prefers light or dark? Can you measure this? Is it important to test more than one worm?*

4) **Do worms react to coloured light?**

   Using the torches and coloured cellophane attached to end of the torch, pupils can test if the worms react differently to red, blue and yellow light. Record the outcome.
   Teaching prompts: *How will you know if the worm reacts to the different colours of light? Can you measure this? Is it important to hold the torch the same distance away each time? Is it important to shine the torch for the same amount of time? Is it important to test more than one worm?*

5) **Where are worms most sensitive to touch?**

   Using a swab, pupils can touch the worm along its body at two or three points e.g. the head, middle and tail. Record the outcome.
   Teaching prompts: *How will you know if the worms reacts to your touch? Can you measure this? Is it important touch it with the same amount of pressure? Is it important to touch it for the same amount of time? Is it important to test more than one worm?*

6) **Which types of food do worms prefer?**

   Place a selection of 4 different foods at different edges of the tray, place the worms in the middle and cover the tray with card. Wait for 5 minutes and record the outcome.
   Teaching prompts: *How will you know if the worm prefers a certain type of food? Can you measure this? Is it important to put the same amount of food/type/consistency? Is it important to test more than one worm?*

7) **Do worms have a sense of smell?**

Using a swab, pupils dip the swab in liquids that have different smells (e.g. water, lemon juice, vinegar, mustard water) and hold it near to a worm. Note: the worms should **never** be directly touched with these liquids.

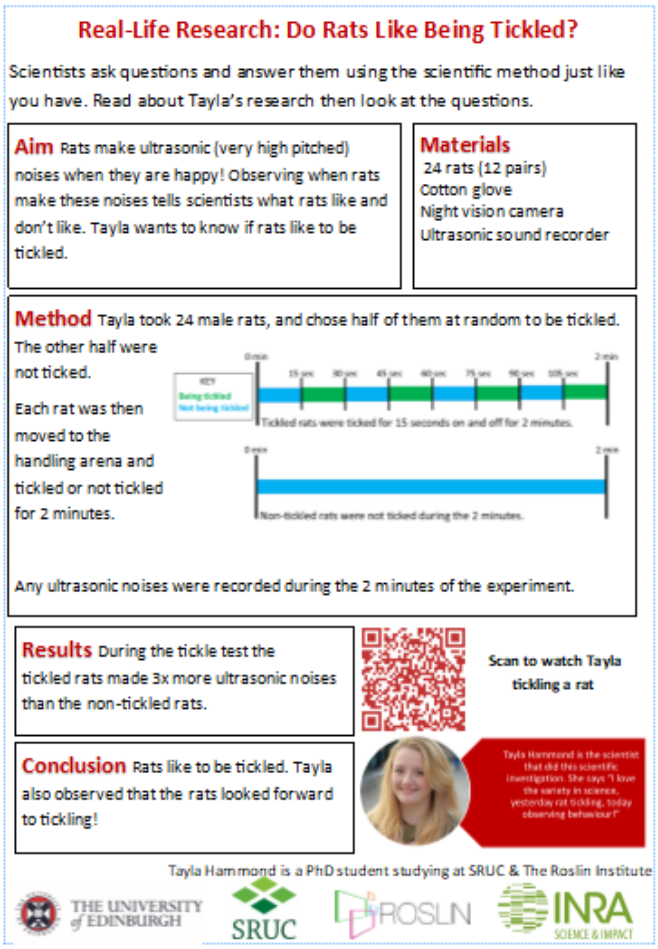
Teaching prompts: *How will you know if the worm reacts to a smell? Can you measure this? Is it important to hold the swab the same distance away? Is it important to present the smell the same amount of time? Is it important to test more than one worm?*

8) **Are worms sensitive to different sounds?**

Place the worm at one end of the tray. Make a sound outside of the tray close to the worm. Record the outcome.

Teaching prompts: *What different sounds can you make? What can you use? How will you know if the worm is affected by the sound? Can you measure this? Is it important to test more than one worm? Is it important to make the sound for the same amount of time?*

Real-Life Research: Do Rats Like Being Tickled?



Overview: Scientists ask questions and answer them using the scientific method just as you have. Pupils read about Tayla's research then look at the questions.

Answer key:

1) What activities do you think rats do that make them happy?
Play, eat, cuddle

2) Why do you think Tayla kept the rats in pairs?
Rats are social animals, so keeping them in pairs ensures that their life in the cage is as similar to their natural life as possible. It gives them the opportunity to play and socialise with their partner.

3) What part of the scientific method is missing? Can you write it?
Hypothesis - students' own answers.

4) How many rats were tickled?
12 rats were tickled (out of 24 total).

5) Why did Tayla only tickle some of the rats?
The 12 rats that were not tickled are the control for the experiment. Without these rats Tayla would not be able to tell if the rats made the ultrasonic noises because of tickling.

6) Why do you think it is important to understand positive emotions, like happiness, in animals?
Students' own answers