Magnificent moths!

Clarysly Deller describes creative ways of teaching evolution by natural selection using moth proboscis length

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For some years, I have been involved in a Dramatic Science project at Oxford Brookes University with Professor Deb McGregor and Dr. Wendy Precious.

The project developed dramatic techniques to facilitate children's learning (McGregor & Precious, 2015), including the creation of a new dramatic monologue as an introduction to a lesson to support the development of understanding of evolution and inheritance.

Dramatic duologue

Teaching the topic of evolution can prove daunting to teachers, and finding practical activites to cement children's understanding can be tricky. Children often have established ways of thinking about the natural world and changing their minds can be a slow process (Taber, 2017). Using models and analogies to scaffold learning is thought to be an effective method for developing creative thinking skills (Maybin, Mercer & Stierer, 1992). This can allow pupils to generate new perceptions, so facilitating a change of ideas and growing a new understanding of alien or difficult concepts (Daud *et al*, 2012).

In this article, I will describe a lesson idea to support teachers in delivering an engaging lesson to illustrate the process of natural selection. The activities support the children in recognising that living things have changed over time and encourages them to identify ways in which animals and plants are adapted to suit their environment. The lesson also gives children creative but concrete models to support the acquisition of abstract ideas. I used this lesson with some children in a Staffordshire primary school prior to running a worksop at PSEC 2019.

Creative ideas inspired by Darwin's observations of the differing proboscis lengths in butterflies and moths formed the basis of the lesson/workshop to support the teaching of concepts such as change over time, variation and natural selection. I formulated the idea of using Darwin and his research into moths and orchids while reading an article on the subject. It cited a letter that Darwin wrote to his friend Joseph Hooker in 1862, in which he exclaimed over an orchid specimen received from Mr. Bateman: '*Good Heavens, what insect can suck it?*' (Beccaloni, 2017). Darwin went on to predict that a moth would be discovered with a 30cm-long proboscis that could reach the nectar at the base of an orchid with such a long nectary. This idea supported the development of Darwin's theory of evolution by natural selection. The moth itself was only discovered many years after Darwin's death.

The lesson highlighted for children how changes in environment that cause habitat loss affect the populations of insects that rely on particular food sources. By 'becoming' the insects, they could find out how easily they could get nectar from flowers with nectar tubes of differing lengths. Through modelling in this way, the children experienced one of the effects of habitat change on a population of insects. These activities supported a growth in children's understanding. An understanding of how scientists worked in the past, and the challenges they faced, also grew from the immersive activities.

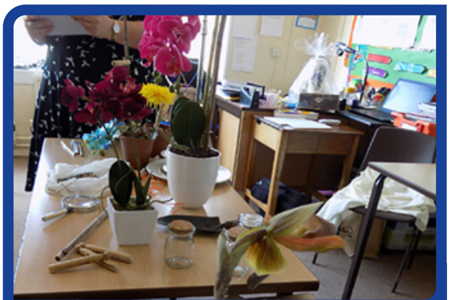
The lesson

Materials needed:

- Short party blowers (cut to the length of the short 'orchid' plastic bottles)
- Long party blowers
- 'Orchids' made from plastic bottles, with varying nectar tubes (cut the bottom off a 2L plastic bottle, add petals around the cut end made from cardboard. Create some that are around 15cm long and some around 20-25cm long)
- Disaster card – tropical cyclone/deforestation
- Nectar points (counters)

Lesson hook:

The lesson begins with a dramatic monologue, setting the scene and transporting pupils back in time (with the help of a few props) to Darwin's house.



On the table

The children then begin to take on board some of the skills and attitudes held by Darwin. They discuss what qualities he needed and perform a tableau to demonstate these, so putting some of their new ideas into practice.

Tableau

Children are then given further ideas, using video clips, about how this specific moth feeds from the orchid (youtu.be/OMVN1EWxfAU).

The children were then transported to a rainforest (playing rainforest sounds and imagining what it might be like in a rainforest). I fashioned orchids with varying nectary lengths from plastic bottles, and prepared proboscises of differing lengths using party blowers.

Bottle orchids

The children were then set a challenge:

Observation: Some children in role as Darwin observe what is happening, using the skills elicited in their tableau, watching and analysing the moth activity.

Enquiry question: How does the length of the proboscis affect how each moth feeds?

Activity: Some children as 'flowers/orchids' hold their bottle and check whether the moth proboscis tip can reach the nectar at the base of the nectar tube.

Moth and orchid

Some children as 'moths' fly around to feed – and gain a 'nectar point' each time their proboscis hits the bottom of a different flower.

Moths feeding

30-second activity, then observers feed back.

Summary:

Explain that the different lengths of party blowers mimic the variation of proboscis length within a population of moths. These specific proboscises allow moths to reach the base of flowers with differing nectaries.

Reproduction and pollination:

Then, the children have another attempt at feeding and see how many nectar points each moth gets. Are there any patterns? Can they see how moths can both feed and then reproduce if healthy enough (enough nectar points), when their proboscis (party blower) reaches right to the bottom of a flower?

Disaster! Tropical storm/deforestation:

Introduce a disaster event where short nectary flowers are destroyed, then repeat the feeding scenario several times. What do the observers see now? Can you start to see changes in the number and variety of different moths?

Discussion:

What have the children noticed about the population of moths? Here, the children start to voice their growing ideas about natural selection, as they see that certain moths cannot get enough food to survive, while others feed well and can reproduce. This causes the population of moths to change over generations, those with long proboscises becoming more common.

Summary:

Certain moths will have proboscises that are more advantageous than others, enabling them to feed sufficiently to thrive and therefore reproduce, whereas others will die out, as their proboscis is too short to reach the nectar. Over time, the population of moths will have a higher frequency of these successful mouth types. Over generations, the population evolves.

The class could be shown a framework for evolution by natural selection, discussing each step in relation to the activity:

1. Individuals in a population show variation.
2. In certain conditions, some pre-existing variations are favourable.
3. Individuals with those variations are reproductively more successful.
4. Those variations become more frequent in the population.
5. Over many generations, the population evolves.
6. As conditions change, other pre-existing variations are favoured.

Plenary:

Questions can be aired in the plenary and during discussion around this process of change, where children articulate their new learning.

In 1862, Charles Darwin was sent an orchid from Madagascar with a 30cm nectary. What could this mean, do you think? What would you have thought about this as Charles Darwin?

In 1991, a flower with a 40cm nectary was discovered in Madagascar. What can we predict will be found to pollinate this flower?

This activity has been found to facilitate excellent learning when completed with a class of children. Their knowledge of natural selection and the reasons why populations may change was significantly increased. Children were engaged and enthused, generating successful learning and an ability to work like scientists. I hope that you will be inspired to try this out in your school.

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The online CPD unit Dramatic Science can be freely accessed at: pstt.org.uk/resources/cpd-units/dramatic-science

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