

Creating Science – Adaptation, Environment, and the Mystery of the Mellits

How did so many different forms of life end up on earth?

#CreatingScienceAdaptation

Suggested Outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Biological Sciences 1: Living things live in different places where their needs are met.
- Biological Sciences 4: Living things, including plants and animals, depend on each other and the environment to survive.
- Biological Sciences 5: Living things have structural features and adaptations that help them to survive in their environment.

Science as a human endeavour

- Nature and development of science 3: Science involves making predictions and describing patterns and relationships (ACSHE050)

Cross curricular outcomes

Visual Arts

- Years 3 and 4 Content Descriptions: Use materials, techniques and processes to explore visual conventions when making artworks (ACAVAM111)

Science vocabulary words

Tier 1 (Everyday words)

- Life
- Living.
- Environment.

Tier 2 (Dual meaning)

- Adaptation. While this word is quite similar to its non-science context, in the current context it specially refers to the way a species will change over time in response to changes in their environment. It does not mean how they change behaviour, or how some species will moult a coat or add a layer of fat as the seasons change (humans do get fatter towards winter). It refers to changes which are only measureable across generations; as the children who are

better suited to survival have more children than their less 'adapted' siblings. Over time, the changes can add up to significant differences between descendants and ancestors.

- Adaption and Adaptation mean the same thing.

Warning

- Scissors and cutting implements. Please exercise all appropriate caution.

Preparation

- Construction materials.
- Cardboard tubes.
- Pipe cleaners.
- Sticky tape.
- You may want an object to represent your original Mellit, and upon which you can add limbs, etc.; such as a cardboard cup.
- The environmental areas; Desert, Forest and Arctic. Bring sand, ice and water, some indoor plants, as well as pictures of the animals that inhabit these beautiful places. A hot air dryer may also be helpful to experience 'desert air'.

Disposal

Plan the end life of your mellit before you make it;

- Will you make it from reusable parts?
- Or do you intend to use materials that will allow it to last forever?
- Sometimes the wisest thing is to make your mellit a temporary feature of the environment. Make it out of materials so that it can be pulled apart and the materials used for other things later on, such as pipe cleaners, unbroken cups, and reusable Blue Tac.

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is well suited to this age group. Children at this age can have difficulty with focus. Avoid tangents if you're attempting to make a key point.

Middle:

You will need to increase the challenge rating of the activity by insisting on some grounded research and cited evidence.

Teen:

Have students building anatomically correct and biologically plausible creatures is possible at this year level.

You might even like to increase the challenge with unnatural environments, such as heavy pollution, or other planets such as Mars.

Learning Intent (student friendly)

'We are learning to' (WALT) – appreciate how animal bodies can change in order to adapt to a new environment.

Success criteria

'What I'm looking for' (WILF) – a biologically plausibly Mellit adapted to its new environment.

Student learning goals

Help students make a self-monitored learning goal for this lesson, such as 'find out why rabbits have long ears' or 'find out how desert life can change a life forms body'.

Evidence of learning

How will you know when the learning goal is achieved?

Not only will students be able to build a Mellit with at least three features for their new environment (such as limbs, teeth, eyes, pelt, etc.) but the students will be able to give a written or oral explanation for these adaptations.

Engage

Play "rumours": students sit in a circle, and one student is selected to whisper a phrase to the student next to them. This rumour is passed along until the final student, who announces the message, and everyone compares it to the original phrase. Perhaps you could try "Animals will adapt over time to their new environment."

Display an imaginary animal, such as the grassland Mellits.

"Long ago, the little imaginary animals known as the Mellits lived in the grasslands. They hid in the long strands of grass and ate the seeds and stems of grass. One day, a new animal came to the grasslands called a Krall, and they loved to eat Mellits.

"Thankfully the Mellits were very good at running away. But, as you might guess, not all Mellits were the same – some were tall, and some were short. Some were fit, and some were not fit at all!

“So, as you might also have guessed, some of the Mellits got eaten more often – basically those Mellits that weren’t as good at running away as the other Mellits.

“This meant that only the fit, tall Mellits tended to survive long enough to have kids of their own.

“And, I’m sure it’s no surprise, the kids tended to be taller and fitter too. But the Krall always got the slowest of them as well.

“Over time, this made for some very fit, very fast Mellits. The Krall soon found it hard to keep up, and most Mellits got away. This is an example of adaptation across lifespans.¹”

Explore

Expand on your imaginary story:

“Remember the little imaginary Mellits? Millions of years ago they were very happy living together, running around, eating leaves and grasses, avoiding Krall, and generally having a nice time. One day there was a terrible storm which blew the mellits far and wide across the world:

1. Some of them floated away to the cold South Pole.
2. Many of them blew away to the equator, where it rains a lot, and so it soon was covered in a thick, hot, and very rainy rainforest.
3. The remainder ended just below the equator, where the hot, dry air made everything into a dangerous desert.

“Mellits had a hard time surviving in the new, strange areas. In fact, most of them died in the first few years! But just enough of them survived to make new Mellits. However... each of the groups of Mellits had to change and adapt to survive in their new homes, becoming three separate species.”

- ⇒ What characteristics do you think each race of Mellits needs to evolve in order to survive in their new area?
 - What is the environment like? How will they stay comfortable?
 - What will they eat? How will they get it?
 - What wants to eat them? How will they survive?
- ⇒ Build your mellit. You might like to research other animals that live in your environment to see what kinds of adaptations nature already has created.

¹ This is the key principal in evolutionary theory; that those individual animals which have traits that allow them to survive longer than their siblings are those that will have kids that can have kids, and their traits will be encouraged in a population. However, you may note that this is an example of ‘microevolution’ – minor changes, not Macroevolution, which encourages the idea that a large number of micro changes can add up to dramatic differences, so dramatic that it may even account for all the diversity among all the species on earth today. You are welcome and encouraged to explore the full theory of *evolution by natural selection* at your own leisure.

Explain

Explain: as each generation of Mellit was born, some of them survived, and some of them died before they could make new Mellits. Just like in a game of rumours, every generation of Mellit was a little different to the last one. Those that had the best chance at surviving in their new environment were the ones likely to have children. And since not all their children survived, only those that were best suited at surviving would grow up to have children of their own.

1. The cold ice caps require special adaptations.
 - a. It's cold! Animals need to evolve a way to keep warm! Many animals from the area are round with short limbs, which helps their bodies keep whatever heat they make. A thick layer of fat often insulates their bodies and helps keep them warm (such as polar bears, whales and penguins). Of course, they can evolve to operate at very cool temperatures, but that tends to make them very slow (like sharks and krill), and the sharks need *another* adaptation to give them a sudden speed boost when trying to capture warm blooded seals. Another adaptation is to leave for an entire season when it's too cold (like birds).
 - b. It's icy. Animals need to evolve ways of staying safe on ice, with broad, wide feet (like polar bears and penguins).
 - c. The water is salty! Some animals can make do, but others have special adaptations to filter out the extra salt in the water (like whales).
 - d. There are things that want to eat other animals, such as killer whales, dolphins, sharks, seals, and penguins (if you're a fish). How will the Mellits survive? Some species survive by have so many children they can't all be eaten (i.e. fish and krill), while others just have to rely on being able to get away (i.e. penguins).
2. The rainy rainforests are full of life.
 - a. There are trees. Everywhere. So to survive animals need to be able to navigate trees well, either by flying above them (eagles), climbing through them (monkeys), or hiding really well. They also won't want to be too large or cumbersome (like elephants).
 - b. It's warm. So they won't want to be too fat or covered in thick fur, since it's already pretty warm there.
 - c. It is easy to find food, there's a lot of it. They don't need to be very clever or fast to find food, usually (like sloths).
 - d. The abundance of life means there are lots of dangers. They need to be able to hide very well (like chameleons), be very clever to know the dangers (like monkeys), or be so dangerous yourself that everyone wants to leave them alone (like some frogs or butterflies, which have bright colours which reminds predators which animals to leave alone!)
3. The burning deserts present many challenges.
 - a. Heat is hot! They'll need to adapt a way to keep cool! Some animals burrow under the sand on a hot day, including spiders. Some have dark skins to help them radiate out the heat during the day and to warm up quicker in the morning, such as humans. Some have long, tall legs that keep the rest of their bodies away from the worst of the heat on the burning sand (like emus).

- b. Food is scarce. They'll need to change to get by on less, becoming very small (like desert rats), learn to store their food (like camels), or learn to hibernate until the rain comes (like toads).
- c. Things will want to eat them. In some places it's just so hot that there aren't many things that want to eat you until you are too dead to care (like vultures). But some predators might hunt you like dogs, lions or wolves. Some animals just get very good at hiding (rats) or are just too big to attack safely (like camels).

- ⇒ Choose the most interesting environment and predict what Mellits will look like. Next, construct your prediction, being ready to describe at least two adaptations you think your Mellits may evolve.
- It's often simple just to base your predictions on the animals already successfully living there.

Elaborate

Discuss as a group what the Mellits may look like.

Ice (the Antarctic)

- Furry and fat – to conserve heat energy. Small ears.
- Small yet powerful eyes, to protect against the glare, but to spot prey and predators.
- Fat – with a built in food storage for hard times.
- Webbed feet. Otherwise they'd be stuck on the ice at all times, and there's not much food out there.
- Streamlined, so that they can get to the food fast (probably krill).

Rain (a rainforest)

- Amazing sense of smell, to detect food and predators in the rainy, crowded jungle.
- Fabulous hearing, same reasons.
- Average eyesight.
- Big claws to hang on to the trees and move quickly.
- Not very fat, or thin. Varied diet of fruits and insects all year around.

Fire (a hot and dry desert)

- Lanky and tall, to keep away from the burning desert sands.
- Great claws and snout for building burrows in the sands.
- Great sense of smell for finding prey.
- Great hearing to avoid predators.
- Poor eyesight – there's not much to see out here.
- Ability to store water during drought.

Changes to behaviour

You may also want to cover the BEHAVIOURS that creatures can change and adapt in order to survive, such as;

- Learning to hibernate when food is scarce.
- Working in teams, or at least hanging out in a crowd so if something attacks, your personal survival chances are improved.
- Finding shelter when the environment is at its most extreme, such as burrowing away from the scorching sun, or hiding under the snow during a snowstorm.

I.e. the Adaptation of Rabbits

We can use environment to determine features and behaviours of an animal, ie, Rabbits

1. Have large ears to pick up subtle sounds.
2. Have nervous and cautious personalities, very easily startled. They also will often not leave the familiar burrow without pausing to sniff for potential threats, even if they've left it a thousand times before.
3. Have large eyes for seeing danger, placed on the sides of their heads to scan a broad range of their environment for trouble, including the sky.
4. Have developed the 'thump' reflex to warn burrow buddies of impending trouble.
5. Have a fur coat to keep warm. It sheds to help keep them cooler at other times of the year.
6. Have a very dangerous protective attitude towards their home burrow. They may bite if they are in their 'home' and aren't approached carefully!
7. They enjoy the company of other rabbits, but will flee for their own lives if threatened. It's usually every bunny for itself!

What about humans?

What environments and lifestyle are human bodies adapted for?

- Eyes out front, not the side. We are hunters.
- Two legged for greater endurance and mobility in running down prey.
- Long finger digits, with a precision grip for manipulating tools and power grip for using weapons.
- And literally millions of other adaptations. Can you think of others?

What about the races of humanity?

- Pale skin in colder climates to help with vitamin D creating in the skin.
- Taller, darker people from the equator to help stay cool.
- Shorter, stouter people in colder climates to help stay warm.
- Sickle cell anaemia assisting with malaria resistance.
- Excellent lung capacity and eyesight in the Australian aboriginal for long distance hunting.

You might even find it entertaining to explore some of the historical beliefs in science regarding the adaption of human races – some ideas were quite unsupported by evidence, such as brain capacity.

But is this all good news?

No – but knowing this science can help us be better prepared.

It also means that:

- Some germs are more resistant to antibiotics than others. If you don't wipe them all out by finishing your course of antibiotics, there's a 100% chance those germs that survive will be able to breed more antibiotic resistant germs. *Are we accidentally creating a super germ?*
- If you only squash the house spiders that you can see, the sneaker, hidden ones will survive – making house spiders sneaker and more inclined to hide themselves.
- Some adaptations are no longer needed in a healthy modern society – like wisdom teeth. Great in the past when teeth fell out often, not needed now when we can keep most of our teeth most of our life, to the point where most people rip out their extra teeth!

Evaluate

- ⇒ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Success criteria

- ⇒ Review the Learning Intentions of this lesson with students. Was it met?

At the end of each class, review the learning objective and see how we did. Ask:

- Did you achieve your learning goal?
- What did *you* learn?
- What worked to help you achieve it?
- What might you do better next time?
- (If needed) where can you go for extra help or information?

Assessment

Prior learning:

Bring in an animal or life form, and discuss its needs for survival. Ask: How has its body developed to help it get those needs?

Formative:

As students are learning, help them self-monitor their own learning and achievements.

Be sure to watch out for the following common alternative conceptions:

- Adaptation does NOT INVENT – it only CHANGES. Adaptation only ever works to change what it has; it does not make new things. Mollusks blown to the arctic might develop thicker

fur, webbed feet, and keen eyes. They will not develop scales like fish, gills, or helicopter propellers for flying with.

Summative:

Help students consider ways they can communicate their new understanding to others, just as scientists need to do.

During the lesson, have each student fill in the worksheet *Handout: Adapting to Live*.

Have each student present their Mellit in an oral presentation, and discuss:

1. What adaptations did they choose for their creature, and why?
2. What other creatures display those adaptations nowadays, and why?
3. (advanced) If the environment suddenly changed AGAIN, so that it became one of the other environments (perhaps due to global warming) what do you think the new Mellits would look like after a while – given that adaptation only adapts, not invents?

So what?

Our bodies are adapted for a certain kind of environment and lifestyle, can you tell which?

Animal species can change to survive in new environments.

Creating science

As we made Mellit bodies to survive in new environments, we learnt that:

Science understanding

- Biological Sciences 1: Living things live in different places where their needs are met.

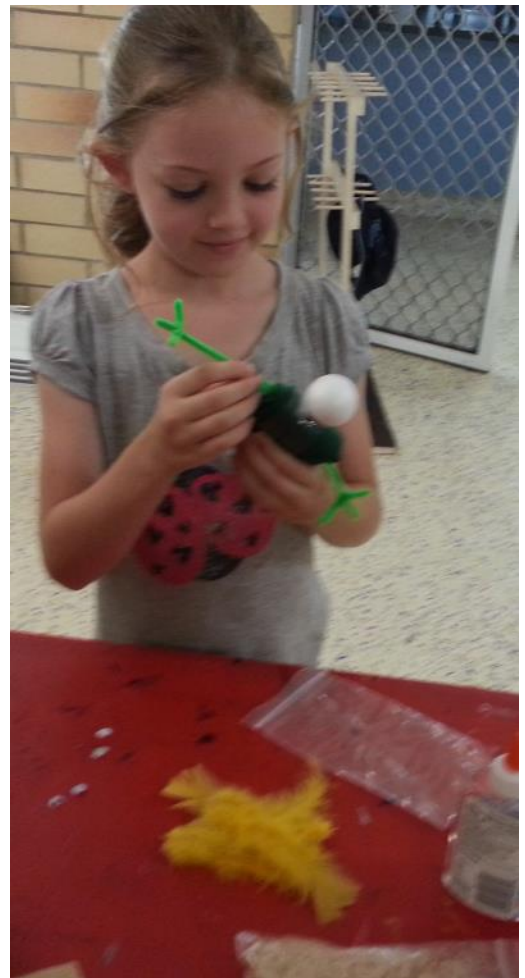
Science as a human endeavour

- Nature and development of science 3: Science involves making predictions and describing patterns and relationships.

Tips from the masters



This arctic meerkat is ready for the snow!



A feathery rainforest meerkat with long, clutcy claws!



This desert meerkat has long spindly legs to keep away from the heat, and wide, soft feet for making sure it doesn't sink too deeply into the sand.

Handout: Adapting to Live!

Write down or draw what ADAPTATIONS creatures develop to live safely in their environment:

Life in the desert

Life in the rainforest

Life in the Antarctic