



STEM AMBASSADORS



BIOMIMICRY (COPYING NATURE)

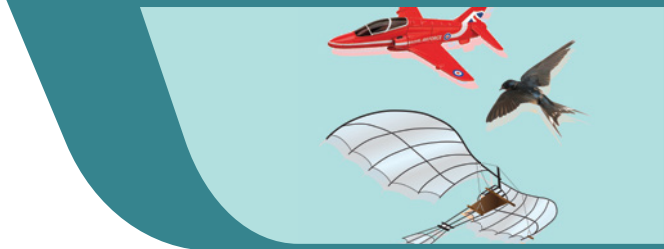
PREP PACK FOR VOLUNTEERS

Suitability:

This activity would suit volunteers who have experience of supporting STEM sessions in schools.

EXPERIENCED





Objective

The object of this activity is to **illustrate how science and technology mimic nature in its design.**






Information to share with teachers

This session reinforces aspects of the KS2/3 Science and Design & Technology National Curriculum around:

- ★ Scientific method
- ★ Design and testing
- ★ Evaluation

Design and Technology: Key Stage 2

Promoting links between the school and the RAF (things to say)

-  How the activity can help dispel myths about the RAF and illustrate available opportunities.
-  Broaden horizons about careers and options.
-  Help to enthuse and engage students.
-  Raise teacher awareness of what the RAF do.
-  How this activity can help the school develop closer links with RAF volunteers.

Activities in schools

Preparing to run the activity in a school

Typically teachers work to a lesson plan. Lesson plans detail the basic structure of the session, timings for each section and contingency plans for more and less able pupils. An example lesson plan is included in this pack.

Preparing yourself and agreeing timings, level of involvement for the school, for you and your colleagues

Make sure you get to the school in good time, allowing plenty of time for preparation and setting the room and your materials out. Check with your school link on what materials are provided and what you need to bring. If you require worksheets or photocopying, agree this with your school link well in advance of the session. Allow plenty of time to clear up at the end and make sure you have thought about a contingency plan if anything goes wrong. Identify the year group and level to pitch the activity at.

Most STEM Ambassador activity would typically be with years 5 – 9 (ages 9 – 13) and would cover aspects of the National Curriculum for Key stages 2 and 3.

The school science curriculum, part of the National Curriculum is detailed and schools would not expect you to know about this. However, you might like to take a look at some of its content to familiarise yourself with the areas covered.

National curriculum in England: science programmes of study

Schools run dedicated 'Career Day' events. You may be asked to incorporate a STEM session into these events. Take along career-linked resources where possible to hand out after the activity.



Planning this activity

This activity has been designed to illustrate how science and technology mimic nature in its design. Examples shown to the group should illustrate how animals have adapted to their environment in terms of specialisation e.g. camouflage, changes in the body to reflect heating and cooling conditions, mobility (such as from tree to tree) and grip on smooth surfaces.

Examples include:

- ★ Flying squirrel – wing suit
- ★ Beetle/crab – armour/exoskeleton
- ★ Sycamore seed – helicopter rotors
- ★ Sticky buds – Velcro
- ★ Bats – radar
- ★ Snakes – heat vision
- ★ Chameleon – adaptive camouflage

Examples of biomimicry in the RAF could include:

- ★ Dandelion clocks – parachutes
- ★ Exoskeletons – body armour
- ★ Foxes - night vision
- ★ Snakes – heat vision

This activity requires planning in terms of becoming familiar with the content of the session and being confident in providing examples of biomimicry in the Royal Air Force and elsewhere.

RESOURCES REQUIRED

- 🔗 [Slide/laminated photographic examples](#)
- 🔗 [Print out for 'Biomimicry pairs' card game](#)

- + Pencils.
- + Papers.
- + Rubbers.

- 📄 Powerpoint presentation 'Biomimicry' that accompanies this Prep Pack.



Assessing risks associated with the activity

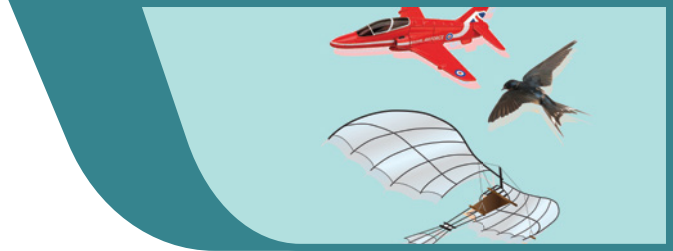
The organiser (typically the school or other host organisation) of the activity is responsible for the health and safety of the young people on their site or property. However, because you as the STEM Ambassador also have a duty of care you may be asked by the teacher or organiser to contribute to their risk assessment. Discuss the activity with the organiser (school) and ask them to provide a copy of their risk assessment.

Risk assessment examples

Your school contact should be aware of other risk assessments used for activities in school, which could be adapted for this activity. If they are unsure of the risks involved in running practical STEM activities in school you could direct them to relevant resources produced by experts in the field. [STEM Learning](#) have lots of resources/templates and guidance on this. The link below provides details of actions they can take to manage risk in their school, along with some templates for STEM-related activities.

🔗 [A balanced approach to risk](#)

As this STEM Ambassador Prep Pack details your activity and all the resources required, the school may find the pack useful in helping them to construct an appropriate risk assessment.



ID on the day

Visitors to schools may be asked for their current DBS Certificate or the corresponding Certificate Number. Schools may also ask for some form of current photo identification if a DBS Certificate is not produced. Schools will typically issue a visitor ID at reception for each separate visit to the school. Visitor ID if issued, must be worn at all times whilst on site. You should always expect to be working alongside a member of school staff where children are involved. It is not good practice for a visitor to be left alone with a group or individual children. STEM Ambassadors are reminded that the use of student personal data, photographs, videos or other information about students is not permitted and must not be put on social media.

Differentiation for more able and less able pupils:

More able

Include examples of where multiple biomimicry can be seen in each application.

Less able

Request examples of biomimicry that may have already been mentioned previously in the session and maybe be encouraged to think of other examples.

Logistics

Schools are secure sites and access may be restricted. Ask your school contact before you visit about getting onto the site, where to park and where to report to. Schools may not provide lunch so it may be advisable to bring your own refreshments and snacks.

Parking at some schools can be difficult. Check with your schools contact about the availability of visitor parking.

Handouts for pupils

 [Slide/laminated photographic examples](#)

 [Print out for 'Biomimicry pairs' card game](#)

Additional resources

If you are interested in adapting or enhancing this activity we've identified some additional online resources to help you with this. Click the weblinks below to find out more.

 [Biomimicry - Tutor notes](#)

 [Smart Skin - Royal Academy of Engineering](#)

 [What is biomimicry](#)  YouTube

 [Podcast '30 animals that made us smarter'](#)

 [Examples of nature-inspired design](#)

Running the activity: lesson plan

Session length: 50 minutes

🕒 5 minutes



Introduction to Biomimicry, definition and examples from nature using laminated photographs.



- ❓ Ask students to look at slides 2 and 3 and to think of biomimicry examples.
- ★ Air-traffic control tower - shape taken from lotus leaf to protect from environmental conditions (rain, wind etc.).
- ★ Humming bird - shape of wings and rotation used for aircraft design
- ★ Bird's nest stadium in China - based on strength in construction of bird's nests.
- ★ Termite towers - solid construction used where else?

🕒 20 minutes

Pairs game – students work in small teams to turn over cards to make pairs of biomimicry comparison (card sets provided). The twenty cards make up 12 pairs of biomimicry pairs.



- ★ In exactly the same way that a plant takes energy and 'power' from the sun, so do solar panels - converting the sun's heat and power into electricity. The processes are slightly different but the principle is the same.
- ★ A technology company in America has designed a way of making energy out of algae.
- ★ They breed the algae to grow larger than normal and stop it from being able to reproduce.
- ★ They then lay them out in the desert sun in tubes and the algae grows creating energy.

Sycamore seeds pair with ...



- ★ The way that sycamore seeds glide through the air was one of the ideas used when helicopters were first developed.
- ★ Helicopters are obviously far more advanced than sycamore but the basic principle is the same.
- ★ So why are sycamore seeds designed like this?
- ★ To stop the seed falling under its parent tree and therefore being denied light and water the seed wing catches the wind taking it miles away from its parent therefore giving them a better chance of survival.

Whale fin pairs with ...



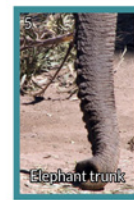
- ★ The whale's fin is incredibly strong and powerful, so a team of designers copied it to help swimmers cover greater distances with minimal effort.
- ★ It does this by making the wearer swim like a fish.
- ★ It is the same way that mermaids swim.
- ★ This motion gives each movement more power and saves energy whilst increasing speed.

Flying squirrel pairs with ...



- ★ The flying squirrel can leap and glide through the air from tree to tree to find food and escape predators.
- ★ Their habitat tends to be in areas with very high trees, which give them the height needed in order to glide.
- ★ Skydivers now use this technique to glide through the air and gives them more control over direction whilst giving them much greater speed.

Elephant's trunk pairs with ...



- ★ An elephant's trunk doesn't have any bones in it, which makes it super flexible.
- ★ Engineers in Germany have developed this artificial trunk to enable them to do the same thing - moving delicate objects around the lab with safety and speed.
- ★ Elephant's trunk doesn't have any bones in it, which makes it super flexible.
- ★ The trunk is therefore made out of muscle, this robotic arm copies the structure of these muscles to make a new form of robot arm.

Shark pairs with ...



- ★ Sharks move around water effortlessly and with great speed.
- ★ Marine biologists explored how the skin of the shark moved in the water and looked at how the skin felt and was structured.
- ★ A swimsuit was designed that mimicked the sharkskin and swimmers now claim to be able to swim more efficiently than before.

- ★ It does this by breaking up the flow of water around the body by having a rough texture.
- ★ This is the same as a shark as they have particularly rough skin, which is common for sea creatures.



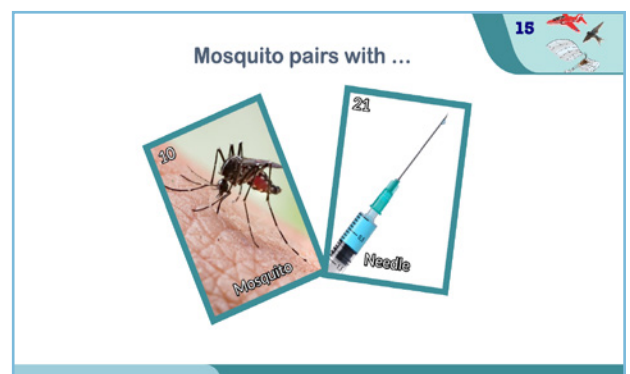
- ★ The honeycomb structure used by bees is very, very strong and stable.
- ★ It can withstand great pressure and weight without collapsing.
- ★ That was just what the architects behind the Eden Project in Cornwall needed - a strong structure that could withstand everything the elements could throw at it!



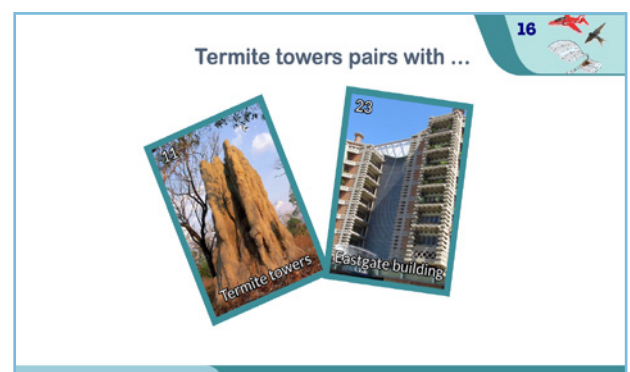
- ★ Velcro has incredible sticking power.
- ★ Well that power comes from nature!
- ★ Burrs have tiny twisted spikes on them that make them really hard to remove from your clothes if you brush by them.
- ★ In nature they attach to animal fur carrying the seeds far away from their parent plant.
- ★ The inventor of Velcro came up with the idea after taking his dog for a walk and seeing the way that the burrs stuck to his dog's coat.



- ★ They did this because it reduces wind resistance and makes the train move faster.
- ★ The design has perforated or rough edges which makes the train quieter.
- ★ This part of the design was taken from the way owls fly silently.



- ★ A mosquito bite can appear out of nowhere because you don't feel them happening.
- ★ That's because tip of the mosquito's mouth is composed of several moving parts that work into skin with the minimum of fuss—and the minimum of pain.
- ★ This led researchers to develop a needle that uses the same principles to go into the skin and you hardly feel it!



- ★ Termite towers are great at keeping cool because of the way that termites make them to take advantage of air flows.
- ★ This led designers to build the Eastgate Building in Harare along similar lines.
- ★ Most of the cooling system in the building is based on natural airflow from the top of the building (colder air is brought down to the base of the building to keep everyone cool).



- ★ The Gecko has a special way of climbing upwards – using special 'hooks' in its feet to help it cling on to surfaces.
- ★ This is what the designers of the climbing kit used to help them to scale towers and buildings.

20 minutes

Design your own biomimicry application. This could be a machine that uses different animal or plant examples. Or it could be an imaginary plant or animal that has special properties that we could use in science and technology.



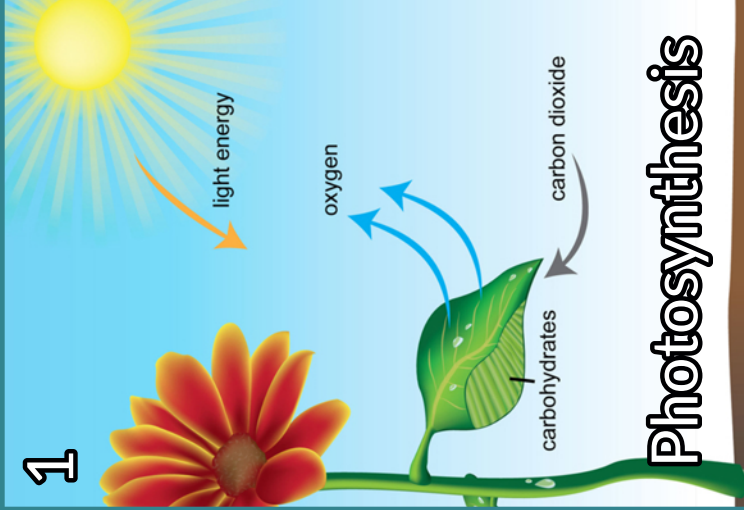
5 minutes

Plenary – discussing students' designs and hand out prizes.











9



Kingfisher

10



Mosquito

11



Termite towers

12



Gecko

13



Eden Project

14



Velcro tape

15



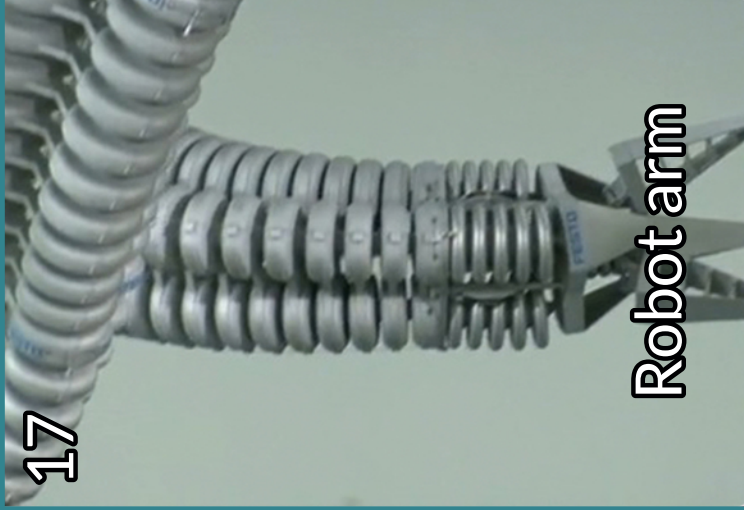
Wing suit

16



Mono fin





17

Robot arm



18

Solar panels



19

Helicopter



20

Swimsuit



21

Needle



22

Bullet train



23

Eastgate building



24

Wall climber

