Section 1: Hello

Hello, my name is Alex. Nice to meet you!

I'm a **neuroethologist**. That means I study animal **brains and behaviour**. The type of animals I'm most interested in are insects. Especially the ones that can fly!

My connection with science began when I was quite young. While collecting apples one day, I found what I thought was a fairy in the oldest apple tree on my family's farm. I didn't tell anyone at the time because I didn't want anyone to bother her. But a few years later I learned something that made me realise I didn't need to keep it a secret anymore. I learned there are animals called stick insects, and shockingly, they are not fairies. This is what my fairy was, a stick insect. You might think that I was disappointed by this news, but I was excited to finally understand the magic and mystery of my apple tree fairy. This was my first "Eureka-moment" and it is still my favourite part of being a scientist. Every day I get to **learn and discover** something new. I even sometimes have moments where, just for a little while, I am the only person in the entire world who knows or has ever known whatever discovery I have just made.

Section 2: Fly like an insect

Different insects like dragonflies, moths and even stick insects all have their own special types of wings that are best suited to their needs. I want to understand how these wings allow the insects to fly so well. When creating airplane wings, engineers will look at how the air moves around it, to make sure it lifts up, and this is known as **aerodynamics**. Investigating insect wings is more complicated than just thinking about aerodynamics though. This is because insects have brains and they can also feel. In fact, most insect wings are covered in tiny hairs and **sensors**, so that they can feel what their wings are doing and the air around them.

Insects have been around and able to fly for hundreds of millions of years. With that much practice it's easy to see why they are such skilled fliers. If we can understand and copy how insects fly, we would then be able to build **flying machines** that are more efficient and agile.

However, working with insects can create problems that wouldn't happen with machines like airplanes or drones. As insects have brains, they can use them to make decisions. Sometimes they can decide to NOT take part in the experiments that I design. To be a neuroethologist sometimes you have to be quite a patient person, because if your animal is not behaving you might have to wait a while for them to complete the experiment!

You also can't ask an insect what it is thinking or feeling, so instead I use electrodes to record their brain's activity. If you ever thought being a brain surgeon sounded difficult, imagine doing it with an insect brain! I do this to see how the brain's activity changes when the wings bend and flutter in response to the **aerodynamics** they experience during flight. When wind hits the wings, the tiny hairs and sensors are activated like little on/off switches all over the wing. The brain activity I record contains all the information that those sensors detect. I can tell what the insect cares about by looking at how their brain activity changes when their wings bend and move.

Despite the challenges, we hope that our research will help to build better flying machines. But my personal goal is also the **gaining of knowledge**. Carrying out research just to discover and understand is very important on its own. Some of the most well-known inventions, from penicillin to plastic, were discovered by accident. To make sure we make the most of research, we don't just want to focus on what it can create, but must also be driven by passion, creativity and curiosity.

Section 3: Your challenge

You will need:

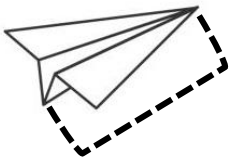
- Pencil
- Colouring pencils
- 3x A4 paper sheets
- Scissors
- Ruler
- Recycling from home (Cereal boxes, bottle tops, yoghurt pots etc.)

Activity 1

1. Use the instructions at the end of this sheet to make 3 different paper planes.
2. Try throwing each plane 3 times. (You might want to do this outside in a park or garden where there is more space.)
3. Watch how the planes **glide** and fill in the table below to see how wing and body size and shape might affect aerodynamics.
4. Use this information to give you some ideas for activity 2.

	Wingspan (cm)	Body length (cm)	Which flew the furthest? Write - 1st, 2nd or 3rd			Which do you think flew the fastest? Write - 1st, 2nd, 3rd			Did it do any loops or tricks? Write - Y or N		
			Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
Plane 1											
Plane 2											
Plane 3											

Wingspan
(widest point)



Body length
(front to back)

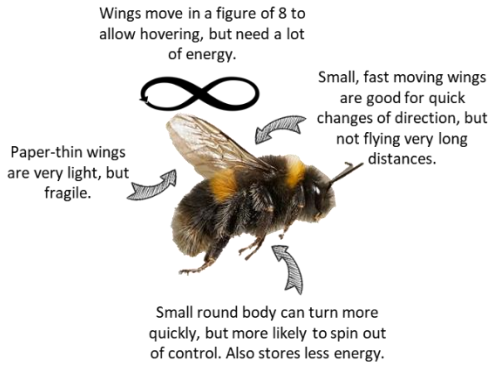
Did you know: Animals glide to save energy while flying. Some birds can even sleep while gliding! But many insects are too small to glide.

Activity 2

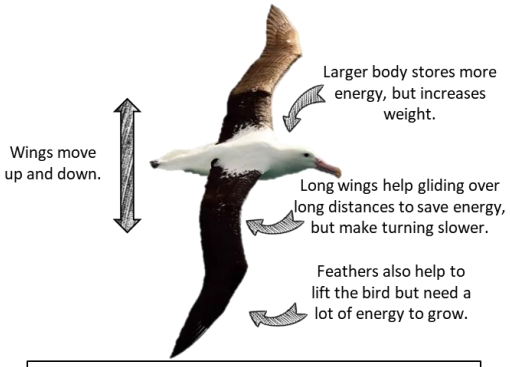
Now you're an expert in aerodynamics, try designing your own flying machine! Use the questions below and animal information on the next page to help you decide your design. Then draw a picture of your flying machine in the box below.

Think about:

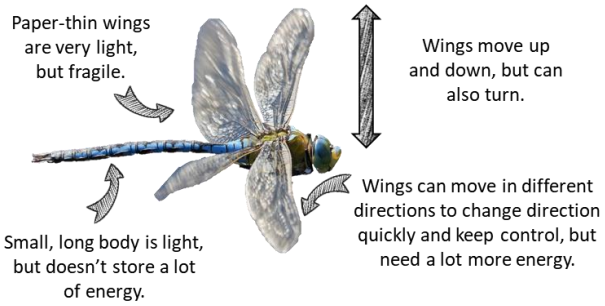
- Do you want it to do a particular job?
- How far would it need to fly and at what speed, fast or slow?
- Does it need to turn quickly?
- Will it need a lot of energy?
- What size wings and body might be best?



Bumblebee
Flies quickly over short distances and can change direction quickly. Cannot glide to save energy.



Albatross
Flies slowly over very long distances by combining flying and gliding to use less energy, but cannot change direction quickly.



Dragonfly
Flies quickly over short and long distances and can change direction quickly. Can also glide to save energy, but needs a lot of energy to fly.

Draw your flying machine design here:

Activity 3

Now you can take your drawing and use recycled materials from around your house to make a model of your design! **You do not need to make your model fly or glide.** It is an example of what your machine would look like so you can show other people!