Explore the world of bat conservation through the national curriculum

Teachers' notes

4. FLIGHT

Relevant areas of learning and experience:

Science and Technology, Maths and Numeracy, Language, Literacy and Communication, Art and Design

Factual

Flight within vertebrates has only evolved three times: bats, birds, and in the pterodactyls. Flying uses a lot of energy (metabolically costly) and bats have learned and evolved to deal with this.

What are the wings?

The wings are formed from two thick membranes that joins their fingers – a bit like the skin between human fingers. The fingers themselves cannot be moved in the same way that human fingers can flex but the hand can be opened up, a bit like an umbrella. The membrane extends along the arms to the side of the body and down to the legs. Sandwiched between the membranes are blood vessels which help to keep the membranes healthy – the membranes can easily be torn and are often damaged, but they repair quickly. The membrane in many bats extends and covers the tail enabling it to control flight, a bit like a brake, but it also can be used to help catch insects.

How do bats fly?

The action of the wing generates lift and thrust. Lift counteracts gravity, keeping the bat up. Thrust overcomes drag, which is the friction generated by the body moving through the air. The down stroke achieves the power of flight. If thrust and lift are not sufficient, the bat falls to the ground. The amount and proportion of lift and thrust is influenced by the shape of the wing. Bats with long narrow wings tend to be fast flyers whilst those with broad wings fly more slowly but are more agile and can make sharp turns. The amount of lift can also be changed by movement of the arms and legs so changing the camber, or curvature of the wings.

Energy demands

Flying uses up a huge amount of energy and to provide that power, the heart rate has to increase to anything in the order of 1000 beats per minutes in flight. At the same time as flying, bats also have to echolocate and these echolocation calls need to be synchronised with the beating of their wings. In addition, the mass (weight) of bats changes throughout the year, especially when female bats are pregnant or carrying their young about. This high energy demand means that bats need a lot of food but in temperate areas such as the UK there are not enough insects flying for bats to be active all the year, so they need a way of saving energy when food is short. See *Bats through the year*.

Other Curricular activities

TECHNOLOGY: Design and make a bat kite. Think about the best material for lightness and strength. Design and make a bat costume. Work out a way of making the wings of the right proportion.

For discussion:

What are the advantages of flight?

- Allows bats to cover long distances quickly
- Allows long-distance commuting between roosting and foraging sites
- Can have large foraging area
- Can make long seasonal migrations
- Flight gives access to new food resources, largely free from competition
- Allows them to escape from predators

What else might wings be used for?

Bats use their arms and hands for other functions.

- to walk, scuttling along the ground
- to climb
- to swim
- to reach out with fingers to catch insects
- as radiators, helping them control their temperature
- to shelter and protect their young
- a raincoat

Project work:

1. How much food would you need if you were a bat?

Flying uses a huge amount of energy, so bats need lots of food. They may eat over a third of their body weight on a good night.

- Choose a bat that occurs in the UK and find out how much it weighs and what species of insects it feeds on. Select one type of insect and find out how much a single insect might weigh. From this work out how many insects a bat would need to eat each night if it was to eat a third of its body weight every night.

How many sandwiches would be equal to a third of *your* weight? Could you eat that much in a day? This is for one bat – what would it be like for a roost of say 150 bats. What would that tell you about the insect populations and the habitats?

2. The study of bats as flying mammals adds a new dimension to the broader topic of flight.

- Draw life size outlines of British bats using the British Bat table. Measure and estimate the wing areas. Comparing the species describe the wing ratio – to calculate this, divide the wingspan² by the wing area. (b^2/s). This is the aspect ratio and it is a mathematical way of describing wing ratio. Long narrow wings have a high aspect ratio, short broad wings a low one.
- Compare and contrast the human skeleton to a bat skeleton. Discuss similarities and differences and how these relate to the different life styles.
- Find out about other animals that fly, and how their wings differ from those of bats - birds, insects, what else? Find out about flying squirrels. Do they really fly? What other mammals glide? Do they have wings? Study pictures of wings, both from the natural world and man-made. Consider the shape of each and relate to use or way of life. Watch birds to see how the shape of their wings affects how they fly.

- Compare a bat's movements with a ground mammal of a similar size. Consider how each would walk, climb, catch and eat food, find shelter.
- Find out about early attempts of people to fly. Why did they not succeed? What about the pioneers of flight and their flying machines?

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