Eagle Inspired Engineering

Would planes be better if they were more like birds?

Make model planes and test them! Use your new knowledge to make adaptations and see if you can measure differences in the results. This session plan is a follow up activity to watching a recorded Workshop (27 min) or Lightning Talk (10 min).

Scientists	Shane Windsor, Senior Lecturer in Aerodynamics, University of Bristol Jonathan Stevenson, Research Associate, University of Bristol Richard Bomphrey, Professor of Comparative Biomechanics, Royal Veterinary College Jim Usherwood, Professor of Locomotor Biomechanics, Royal Veterinary College
Video links	Recorded workshop (27 min) Lighting Lecture (10 min)

Discover how studying bird flight could be the solution to more environmentally friendly types of plane. Students will be introduced to some of the researchers involved in analysing the science of how birds fly and will be able to watch footage of some of the lab tests they have conducted to help them answer the big question **'Would planes be better if they were more like birds? '**

Objectives

SPEAK framework

- Skills: To learn about the process behind biologically-inspired aircraft design by making a paper plane that is modified by assimilating information from scientists at the Royal Veterinary College and University of Bristol.
- Place: To know that the RVC and Bristol are sites of leading biosciences research
- Emotion: To enjoy the session!
- Attitudes: To increase understanding of bioscience careers through meeting scientists
- Knowledge: National Curriculum Links for Key Stage 3

Scientific attitudes

- Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility.

Experimental skills and investigations

- Make predictions using scientific knowledge and understanding.
- Make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements.

Analysis and evaluation

- Present observations and data using appropriate methods, including tables and graphs.

Biology: The skeletal and muscular systems

- Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles.

Physics: Forces

- Forces as pushes or pulls, arising from the interaction between 2 objects.
- Using force arrows in diagrams, adding forces in 1 dimension, balanced and unbalanced forces.
- Forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water.
- Forces measured in newtons, measurements of stretch or compression as force is changed.

Planning and preparation

Equipment per student

- A4 paper
- Scissors
- Rulers
- Instructions for the glider
- Template for the glider (print PDFs)

Time	Activity
0 - 10 min	**Introduction**

First part of recorded workshop covers:

- Amazing flight abilities of birds
- Future aircraft – manned and unmanned
- What is bio-inspiration?
- How we found out birds use their tails differently from aircraft.

Alternatively a more concise overview of how birds use their tails and how their wings act as suspension systems can be seen in the Lightning Lecture.

Time	Activity
10 – 25 min	**Hands on activity:** Build a paper bird glider NB. This section can be expanded in duration depending on pupils' age and level of detail in recording

Introduce the task: to make a paper bird glider, and to improve it through modifications.
For example, you could modify the tail by bending it up to a higher angle, but try out whatever you like!

- How could we measure improvements? Discussion points:
  - Definition of improvement and relate back to birds.
  - Measurement options e.g., ruler, using squares on floor tiles in class.
  - Reliability.

- How will you record your results?
  Each student makes a simple glider which consists of folding and cutting a single sheet of A4 paper – see instruction sheet above.
  Students will then gently hand launch gliders to see how they fly and make small modifications/adjustments to show how the tail of a bird/aircraft effects its stability (these gliders fly very slowly – they will not fly if thrown like a paper dart).

- Class graph - use IWB graph paper and agree axes with class, to record data points of class flight attempts e.g., group types of modification by using the same colour.
  (Collecting this data from individuals and plotting it would make a good activity for 6th form STEM volunteers)

Time	Activity
25 - 45 mins	Discussion & summary

- If you watch the recorded workshop scientists will explain:
  - How we found out that birds wings act as a suspension system.
  - Live demonstration of suspension system.
- What does the graph show?
- What did you find out?
  Ask pupils to explain which adjustments were most effective and why, to a partner.
  3 pupils then share with class.

Conclusion: show pupils where to find out more information to follow up;
e.g., University of Bristol, Royal Veterinary College: Junior or Teen Vet Club