LOCATION:	TARGET AGE GROUP:
Classroom	KS2
TARGET GROUP SIZE:	**DURATION:**
10-20 (scale resources for larger group)	Min. 1 hour (ideally 1.5 hrs)

PLPS CITY SCIENCE STARS

Fixture 8: On the Wing

SUMMARY:

Pupils will learn about the aerodynamic forces that act on planes during flight by linking engineering with nature. Pupils will learn how wings generate lift and how bird species have adapted different wing forms to achieve different functions such as speed or energy-efficiency. Pupils will learn how football stadiums consider natural solutions to modern problems, such as using birds of prey to ward off pigeons. Pupils will measure the distances and air-times achieved by the different paper plane designs and analyse them in a graph to draw conclusions.

LEARNING OBJECTIVES:

1. To learn about the aerodynamic forces that allow for flight
2. To learn how engineers often look to nature for efficient solutions
3. To measure multiple factors, calculate new ones and to draw conclusions from graphs

PRIOR LEARNING AND LINKS TO KS2 NATIONAL CURRICULUM:

- ✓ Pupils will be learning about the effects of gravity and air resistance on objects.
- ✓ Pupils may be learning about different types of birds and their modes of life.
- ✓ Pupils will not yet be learning how to calculate speed from distance and time (KS3).

PREPARATION AND RESOURCES:

- ✓ This workshop works best with the use of a computer and projector or a computer-linked smartboard to display the 'ON THE WING' PowerPoint slides. If none are available, printouts could be used instead, but these will be less engaging and less environmentally friendly.
- ✓ 'ON THE WING' Excel file.
- ✓ On the Wing report sheet inside their lab book.
- ✓ Paper with foldable designs.

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ACTIVITY PLAN:

Introductory activity

1. Discuss how engineers sometimes look to nature for solutions to modern problems. Link this to the use of peregrine falcons to deter pigeons from football stadia.

Main activity (small groups of 3/4 students)

1. Explain how different birds have adapted different wing shapes for different styles of flight. Use peregrine falcons and Andean condors as examples: falcon wings are well-adapted for speed; condor wings are well-adapted for energy efficiency.
2. Demonstrate how to fold paper to make different airplane designs based on these birds. If there is enough time, let each pupil make both designs, otherwise let them pick one design to make. You can also let the pupils create their own design but advise them on what is required for them to fly (e.g. wings, symmetry).
3. Allow the pupils to practice throwing their planes so that they are familiar with how they work and ensure that they keep throwing angle and power the same between throws.
4. Once all the pupils are ready, let them throw their paper planes in an appropriate location. Ask pupils to measure the time that their planes spend in the air using a stopwatch. When the pupils collect the planes, ask them to measure the distance achieved using a tape measure or to count their steps, then add these measurements to the ON THE WING Excel spreadsheet.

Plenary activity (pairs)

1. Demonstrate how to calculate speed from distance and time using the DST triangle and ask the pupils how to solve simple equations.
2. Show the pupils their data in the form of graphs using the Excel spreadsheet. Ask them what the results show us and what this tells us about different wing designs and flight styles.
3. Ask them to work in pairs to think of other engineering solutions that are based on nature (e.g. helicopters based on seeds, spider silk inspired armour).
4. Briefly review the learning objectives and propose the take-home challenges.

TAKE HOME CHALLENGE IDEAS:

- Prompt children to show their family/friends how to make the paper airplane designs at home and also test designs of their own that might improve the distance or air-time achieved.
- Prompt them to research about the achievements of prominent engineers (e.g. the Wright brothers, Hedy Lamarr, Roma Agrawal) with their parents/family.

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TASK/ASSESSMENT DIFFERENTIATION:

✓ **Minimum student goals:**

- Make and throw a paper airplane (with support if needed) and think about how the form matches the function

✓ **Target student goals:**

- Make and throw a paper airplane, then measure time/distance and analyse the results

✓ **Further goals:**

- Look at the birds and design their own paper planes that represent different flight styles

PUPIL MONITORING AND EVALUATION:

- Following the plenary activity, ask the students how they think their designs are linked to their flight performance.

DELIVERY NOTES AND ADDITIONAL SCIENTIFIC INFORMATION::

Flight tips:

- Try to make sure that the condor planes have their wings tilted up like a V, as this will prevent them from flipping over in the air.

Vocabulary:

- Aerodynamics, lift, thrust, gravity, air resistance, bio-inspired engineering, adaptation, evolution.