FROST SCIENCE

Field Trip Guide

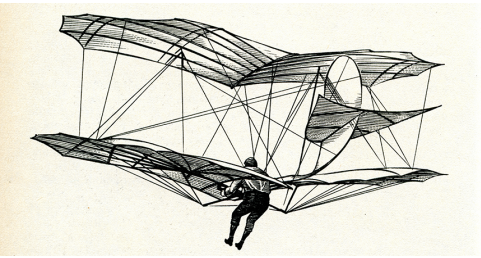
Feathers to the Stars
Grades 6-8

Contents

Questions? Ready to book your field trip? | Please visit: www.frostscience.org/fieldtrips

Teacher Resource Guide

Flamingo in flight



Early flight design drawing

Space shuttle launch

Overview

Students will explore the evolution of flight, from dinosaurs to the future of space travel. Along the way, they will learn how natural flight has inspired human flight. They will also learn how human flight has developed with new innovations and discoveries in many fields of science, technology and engineering.

Educational Standards

6th Grade

Big Idea 1 - The Practice of Science

- SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.

Big Idea 13 – Force and Motion

- SC.6.P.13.2 Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

7th Grade

Big Idea 15 - Diversity and Evolution of Living Organisms

- SC.7.L.15.2 Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.

8th Grade

Big Idea 1 - The Practice of Science

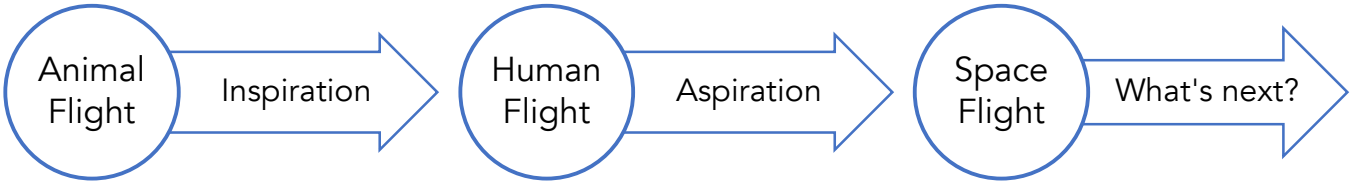
- SC.8.N.1.5 Analyze the methods used to develop a scientific explanation as seen in different fields of science.

Big Idea 5 - Earth in Space and Time

- SC.8.E.5.10 Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.

Background Information

"Through research, inspired humans can overcome any challenge."
Dr. Jorge Perez-Gallego
Feathers to the Stars Exhibition Developer



From feathered dinosaurs to space travel and beyond, *Feathers to the Stars* is a journey over millions of years, from the distant past, to the present day, and into the future. The exhibition has three areas to explore: inspiration from nature, manned flight, and space travel. In each area, students will discover how nature has played a role in inspiring man-made advances in science, technology and engineering that have allowed us to travel the sky and explore the universe.

Looking back at feathered dinosaurs, students can explore the principles of how flight first evolved in nature, leading to the many flying creatures of today. Next, students can explore the trial and error of early pioneers in flight and the basic physics principles of flying. Lastly, students can explore the progress humans have made to travel off of our own planet and project where we may be going in the future.

Feathers to the Stars Exhibition Key Questions

- How do animals fly?
- How do humans fly?
    - How are human and animal flight connected?
- What makes space flight different than flight on Earth?
    - What's next?

Pre-Activity

See pages 5 - 13 for pre-activity instructions and presentation.

Field Trip Experience

All Museum field trips are a three-hour experience, offered Monday through Friday, beginning at 9:30 a.m. or 10:00 a.m. Each field trip includes three experiences of the teacher's choice and time for lunch. Upon arrival, the teacher will be provided with a specific schedule for his/her visit based on the three chosen experiences. Additional information regarding field trip logistics is provided in the field trip package that each teacher will receive upon booking a field trip.

During the field trip, students will encounter a variety of experiences. To enhance these learning opportunities, facilitator cards are provided at arrival for all teachers and chaperones who would like to use them (please see pages 24 - 26 for a sample). The facilitator cards include prompting questions, additional content, and exhibition location maps which show where in the exhibition one can find content related to that card. Additionally, a student guide that corresponds to the exhibition prompting questions are available in this document on pages 22 - 23. Please print a student guide for each student in advance of your arrival to the museum, and bring pencils; student guides and pencils will not be provided by Frost Science.

Post-Activity

See pages 14 - 21 for post-activity instructions and presentation.

Select Recommended Extensions

Grade 6: Down with Gravity Inquiry and IMRaD Lab Report
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/133764
Grade 7: Bird Feet: What do they mean?
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75988
Grade 8: Mars Rovers
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/37917

For further exploration of the topics, please see the resources below.

1. Compare and contrast "jet-propulsion" of animals (e.g. octopus or squid) to human-made rockets.
   Octopus Example: https://www.youtube.com/watch?v=bEo0-0_oLxE
2. If computer use is available, an interactive activity around the forces of flight can be found here: http://howthingsfly.si.edu/media/forces-flight

Pre-Field Trip Activity: Zoom In
(A Visual Thinking Routine)

Overview
Students will participate in an activity to prime their curiosity and imagination around how flight evolved in nature. In Zoom In, students examine different parts of an image as they are revealed (piece by piece) to identify how the details contribute to the larger story the image tells. Students make observations and formulate ideas about the connections and comparisons of the different components of the image to learn about the evolution of flight in nature.

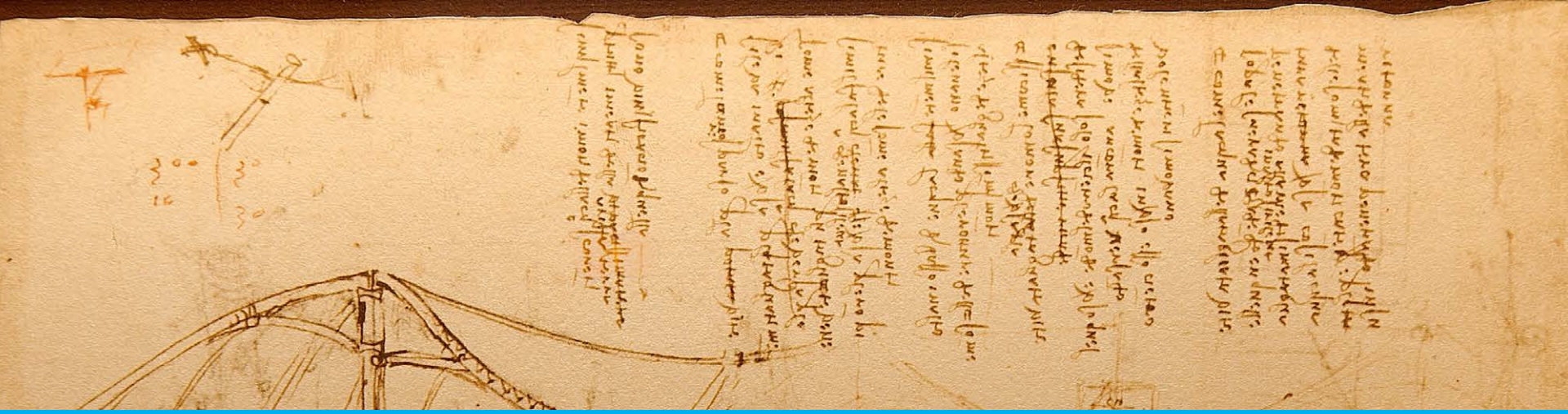
Objective
Students will make observations to build an explanation and interpretation of how flight evolved in nature.

Materials
- Computer, white board and projector
- *Feathers to the Stars* Grades 6-8 Pre-Field Trip Presentation (pages 6 - 13)

Activity Steps
1. Test the presentation on your computer: open the document, go to "View" on the menu bar, then click the full screen option ("Enter Full Screen" or "Full Screen Mode").
2. Use the presentation to guide the activity.
3. Conclude with a class discussion about the revealed image (see page 13).

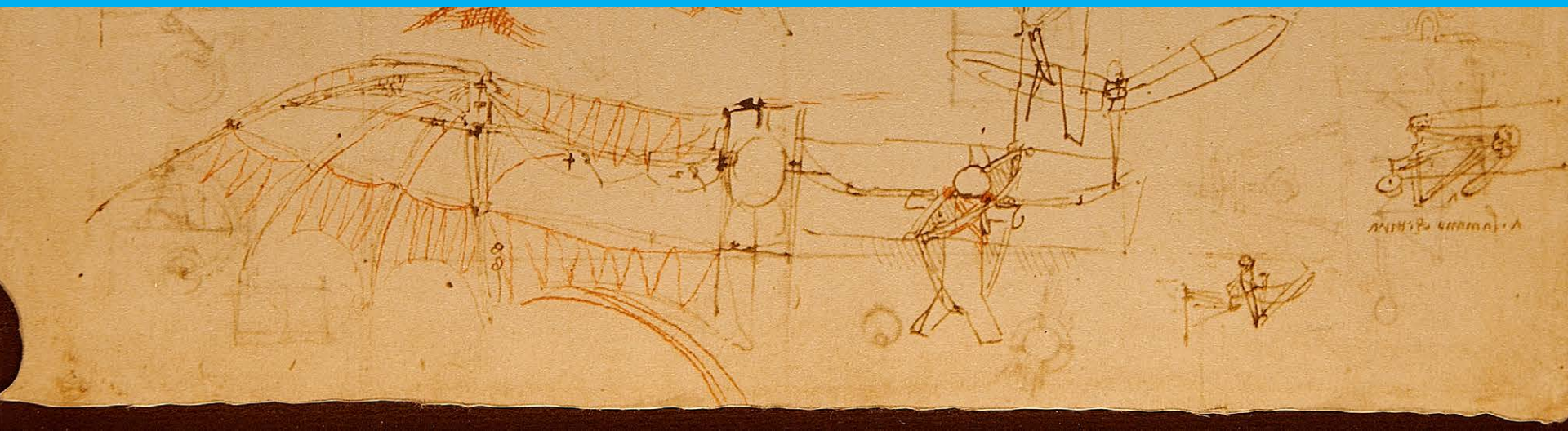
Helpful Information
Scientific Facts Related to the Evolution of Flight
- Feathers evolved over time from simple to complex structures.
- Not all feathers are flight feathers - some are for display or for warmth.
- Several types of animals have evolved flight over time, including insects and birds (and the now-extinct pterosaurs and most recently, bats).
- Flight evolved over time as adaptations allowed animals to jump, glide from trees, or fly.
- Flight capabilities allowed some animals the advantages of a faster method of transportation, to search for and capture prey or other food, or escape predators.

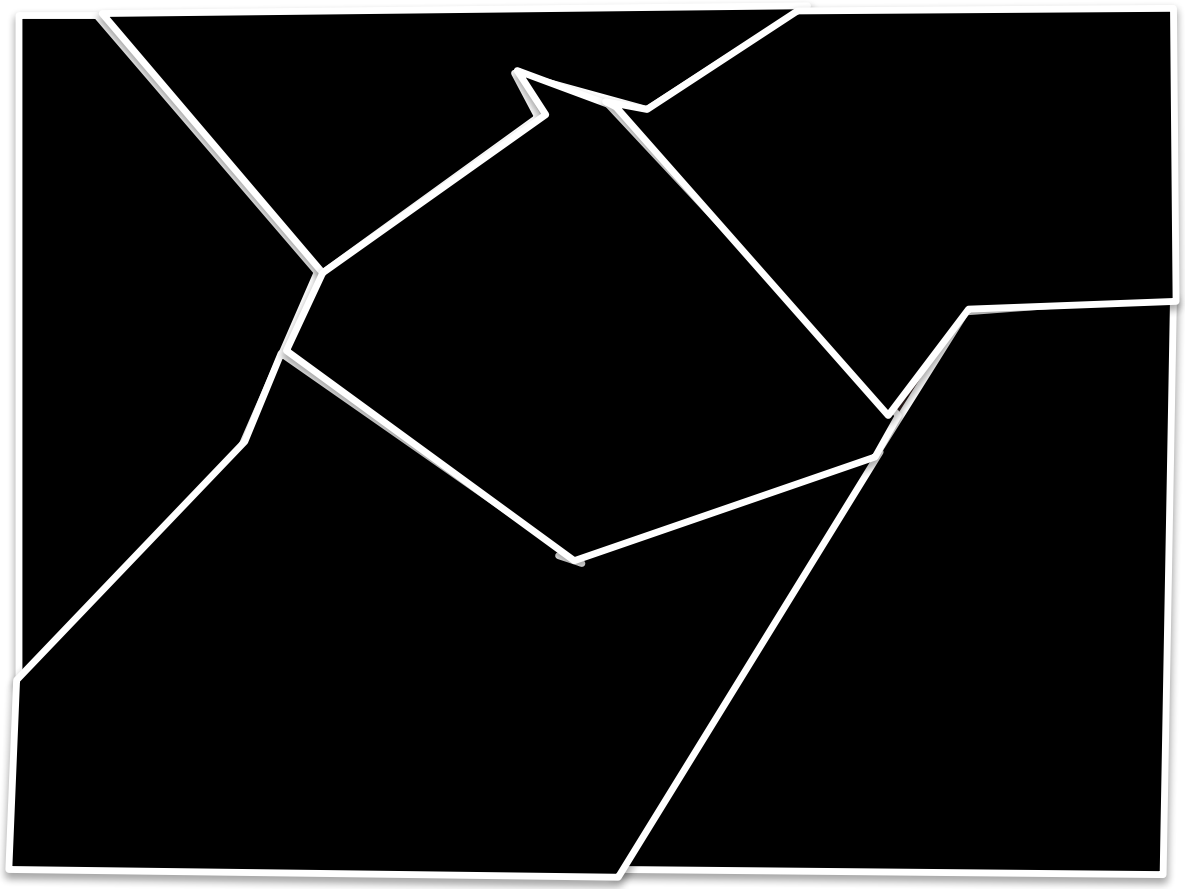
Additional Questions for Further Discussion with the Image
- What features allowed certain animals to fly (e.g. flight feathers, hollow/lightweight bones)?
- How do we know that dinosaurs are ancestors of birds (e.g. fossil evidence shows similar features, presence of feathers)?



Frost Science | Feathers to the Stars Pre-Field Trip Activity | 6TH – 8TH Grade

ZOOM IN





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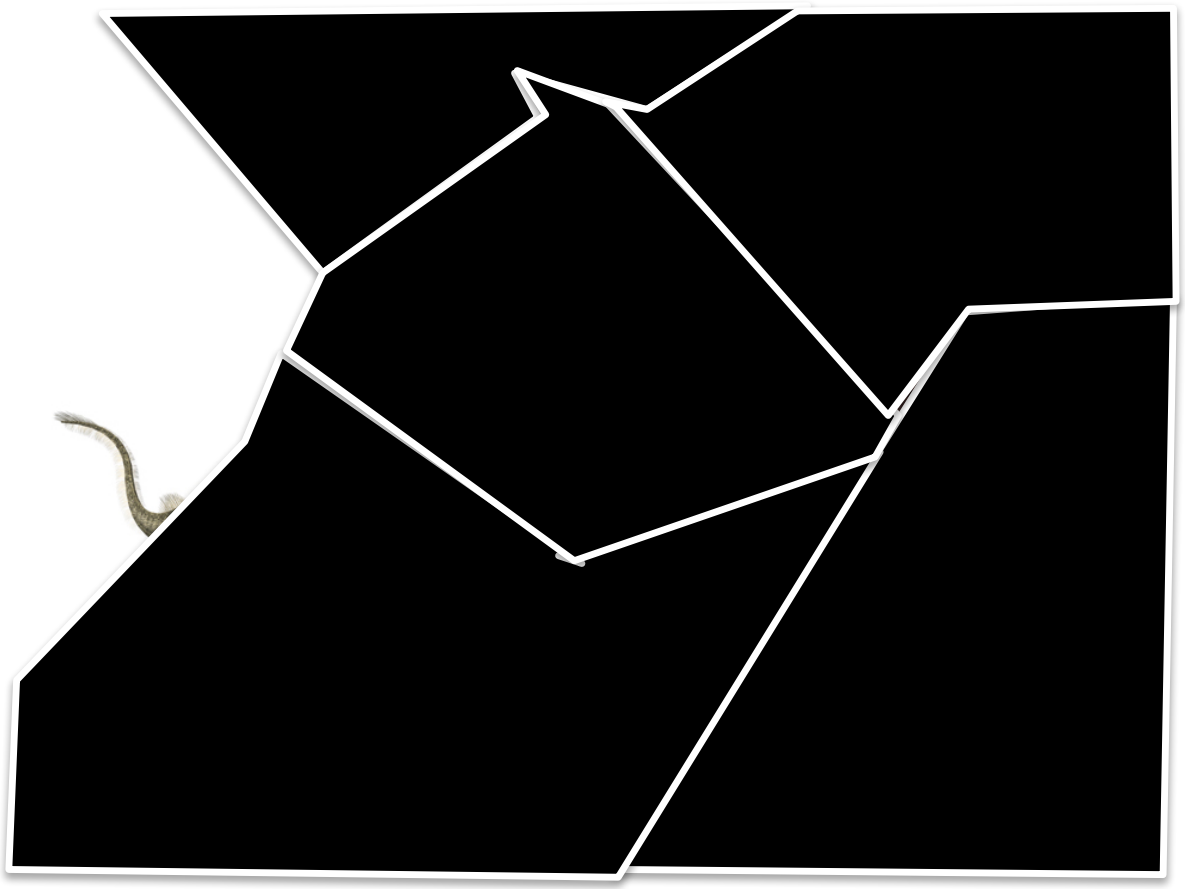
What do you see or notice?
What does this make you think about?



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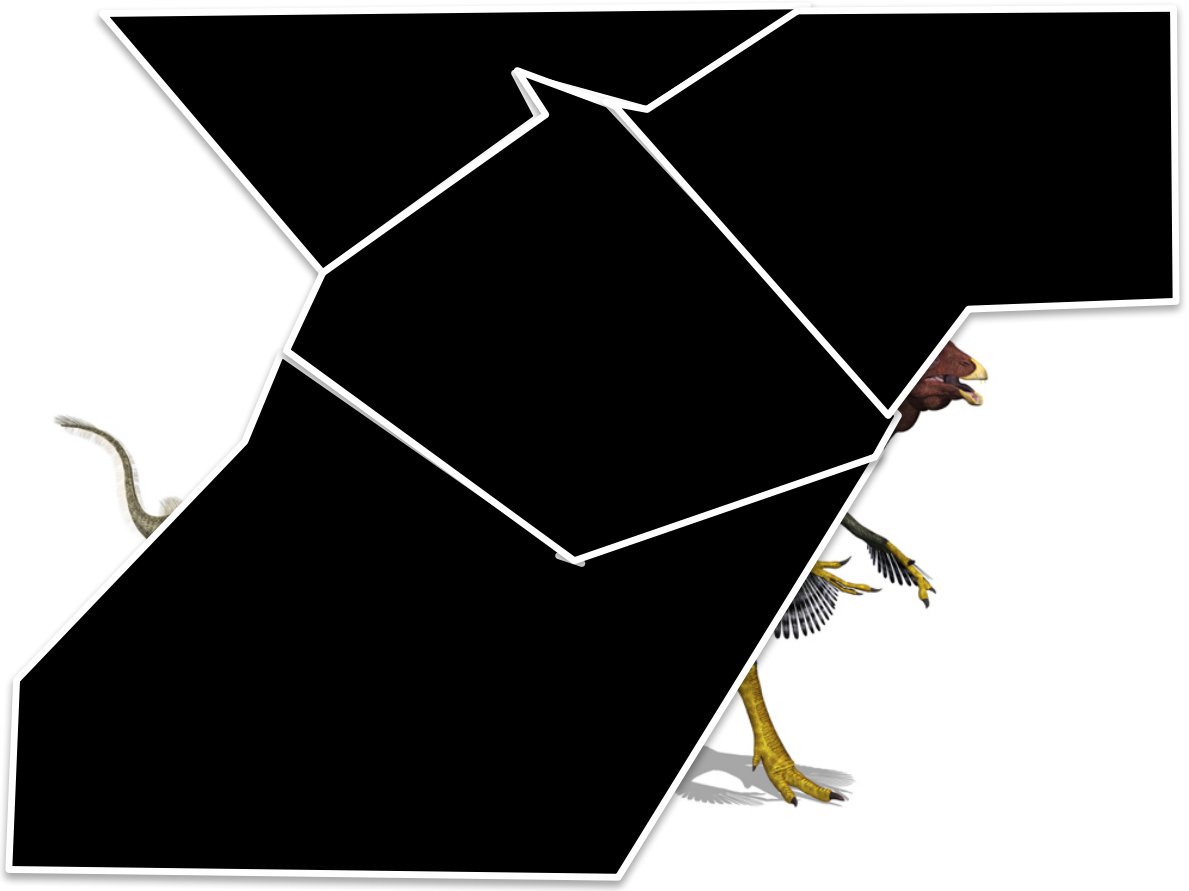
Name what you see or notice.
How do you think this is related to the first piece?



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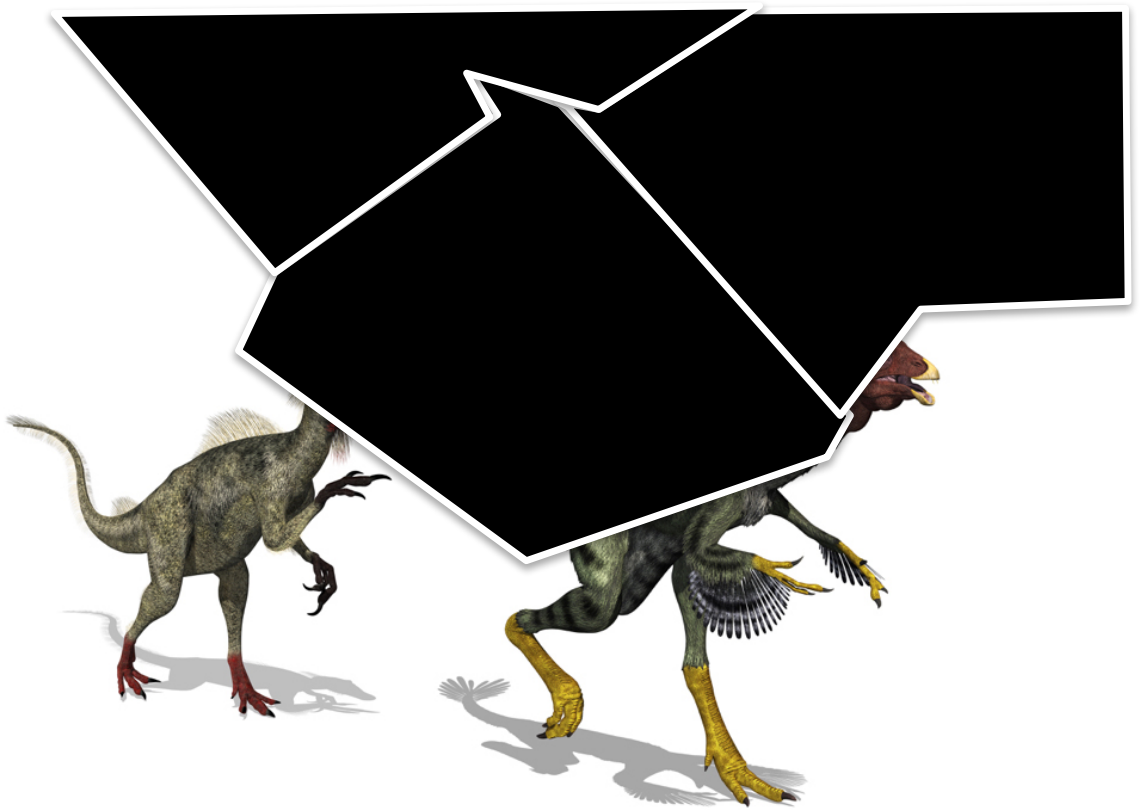
What do you notice now?
How has your thinking changed?



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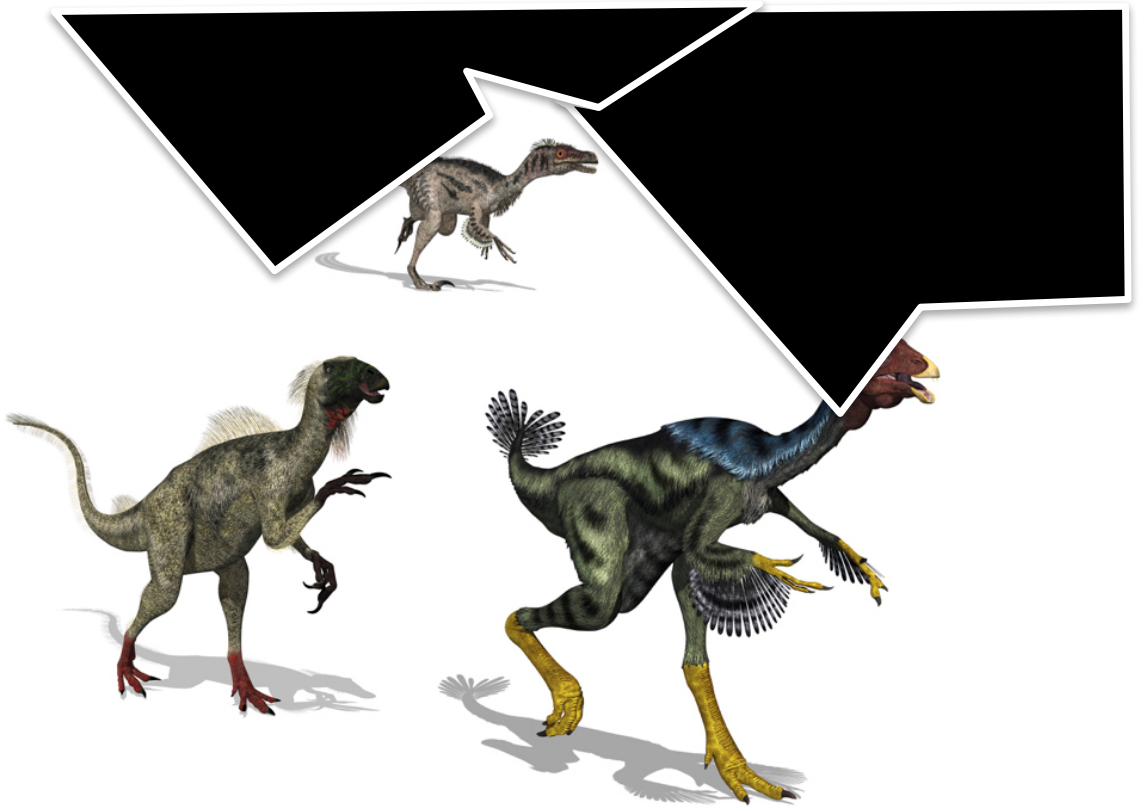
What is revealed now?
What story do you think the image will tell?



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What do you think the last piece will reveal?

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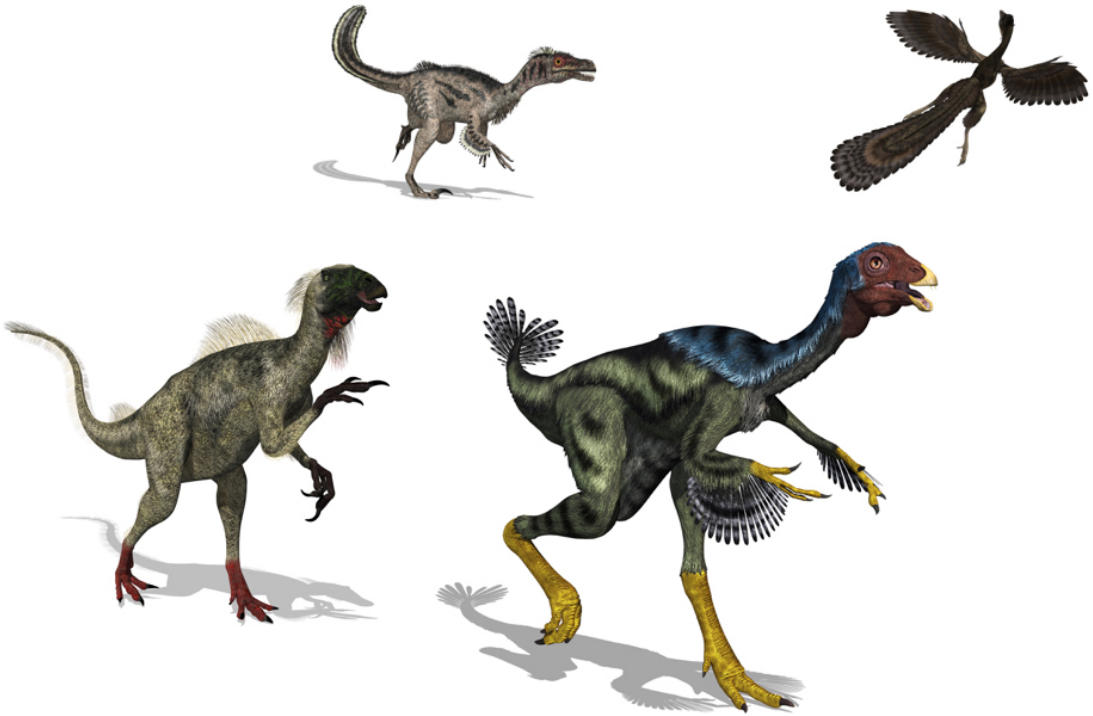
How has seeing the overall image changed your thinking?
How do you think the image relates to the process of science?
What questions do you still have about this image?



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Post-Field Trip Activity: Generate-Sort-Connect-Elaborate (GSCE): Concept Maps

(A Visual Thinking Routine)

Overview

After the field trip, students reflect on what they explored and what they learned. Students will complete the Generate-Sort-Connect-Elaborate (GSCE): Concept Maps Visual Thinking Routine. This activity helps students generate connections among different ideas and uncover the mental models students have developed during their experience. Students will share and explain their concept maps in small groups or with the whole class.

Objective

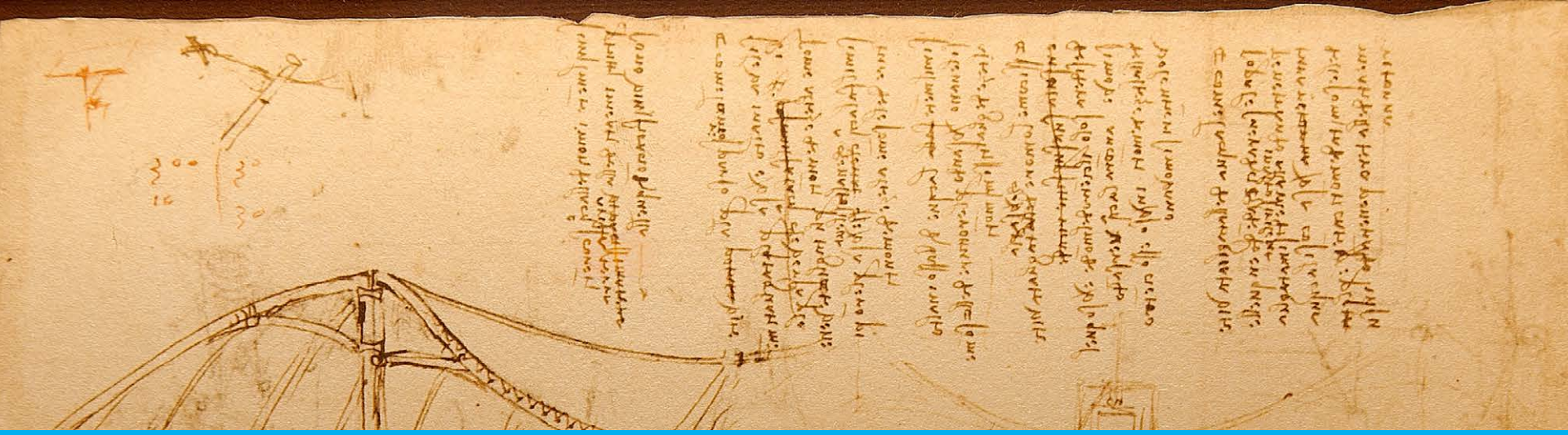
Students will reflect on their experience at Frost Science and generate connections related to the evolution of flight.

Materials

- Computer, white board and projector
- One piece of poster paper per student group
- One piece of paper for each student
- *Feathers to the Stars* Grades 6-8 Post-Field Trip Presentation (pages 15 - 21)

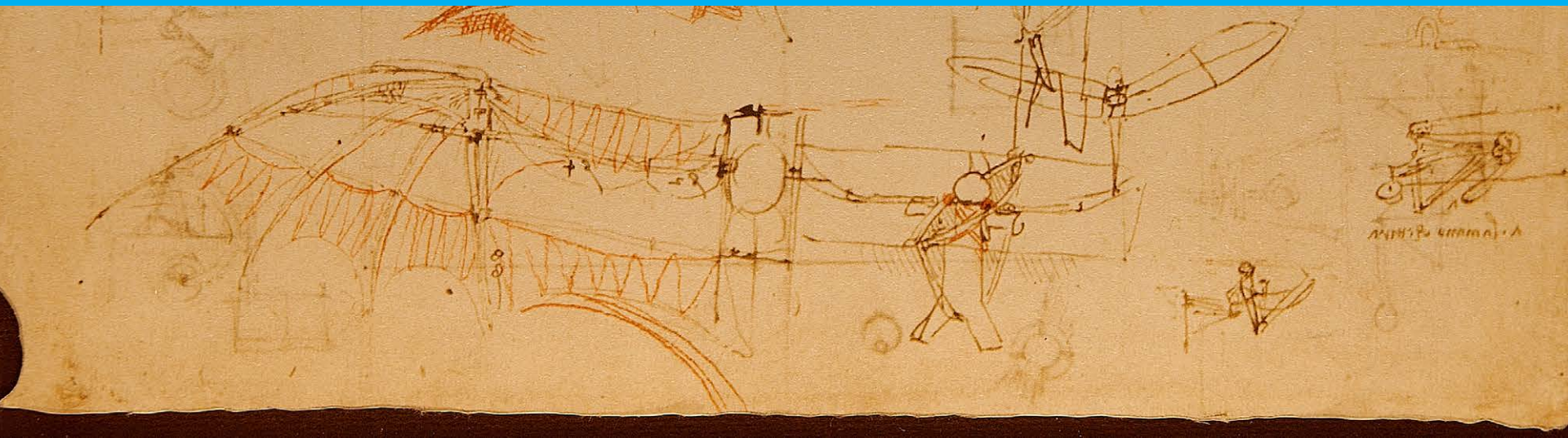
Activity Steps

1. Test the presentation on your computer: open the document, go to "View" on the menu bar, then click the full screen option ("Enter Full Screen" or "Full Screen Mode").
2. Use the presentation to guide the activity as needed.
3. On the piece of paper, ask students to list at least five words/phrases they associate with the word "flight."
4. Create groups of 5 or less students. Give each group one piece of poster paper. On the poster paper, have students write the word "Flight" in the center of the paper.
5. Have students work in their groups to write the words/phrases they brainstormed onto the poster paper. The words/phrases that they think are more central to the topic of flight should be written towards the center of the poster paper around the word "flight," and those less relevant towards the edges of the poster paper.
6. Have students draw lines to connect the words or phrases that they think have something in common. Have students write a sentence on each line that explains how they think the words or phrases are connected.
7. Have students expand their concept map by adding new words/phrases and their connections to other words/phrases.
8. Once completed, have students share their concept maps to the whole class. Please see a sample chart on page 21 for reference.
9. Conclude with a class discussion about the topic of flight.



Frost Science | Feathers to the Stars Post-Field Trip Activity | 6TH – 8TH Grade

CONCEPT MAP



Write down five words or phrases that come to mind when you hear the word…

Flight

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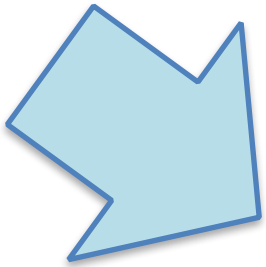
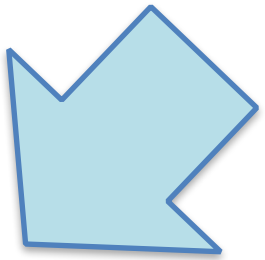
Place words and phrases that are central to flight closer to the starting phrase.



Birds



Flight

Airplanes

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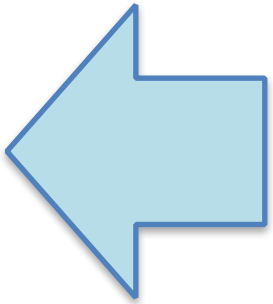
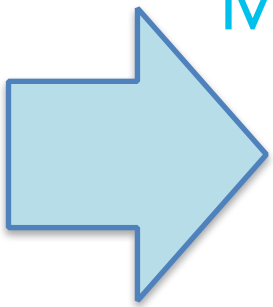
Place words and phrases less central to flight around the edges of the paper.



Birds

Flight

Mars



Airplanes

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Draw lines to connect two words or phrases.
Write your explanation of how they are linked.

Mars

Birds

Flight

Observing birds inspired humans to build airplanes.

Airplanes

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Keep adding words, phrases, and connections to complete your concept map.

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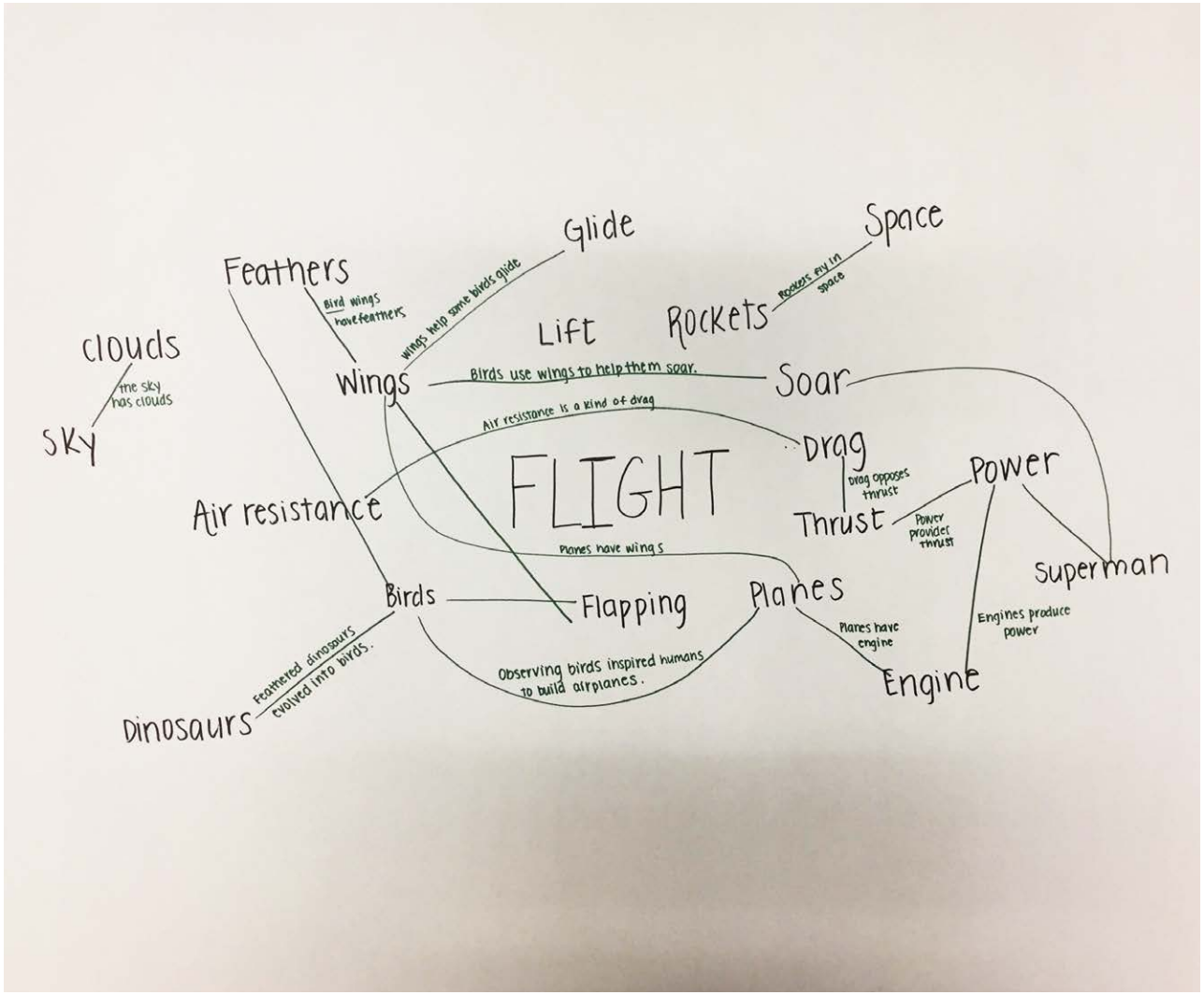
Sample Post-Field Trip Concept Map



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FEATHERS TO THE STARS

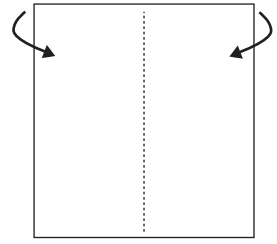
6TH - 8TH Grade Student Guide

Hi, future engineers! We need your help to design the future of flight.

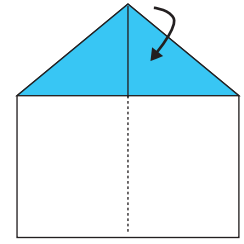
Your mission is to complete the activity on the back of this page, then make, test and improve the design of your paper airplane.

Make a paper airplane and show your aeronautical engineering design skills!

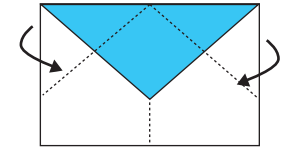
The Basics



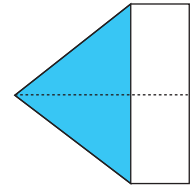
1. Fold paper in half length-wise.



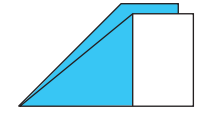
2. Fold down the upper two corners to meet the middle crease.



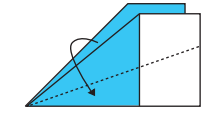
3. Fold down top triangle.



4. Repeat step 2 by folding the upper corners to meet the middle crease.



5. Fold in half at the middle crease.



6. On each side, fold down the top flap so that the angled edge meets the middle (bottom) crease.

Make It Your Own

7. Test your airplane. How well did it go?

8. Make adjustments to improve your design.

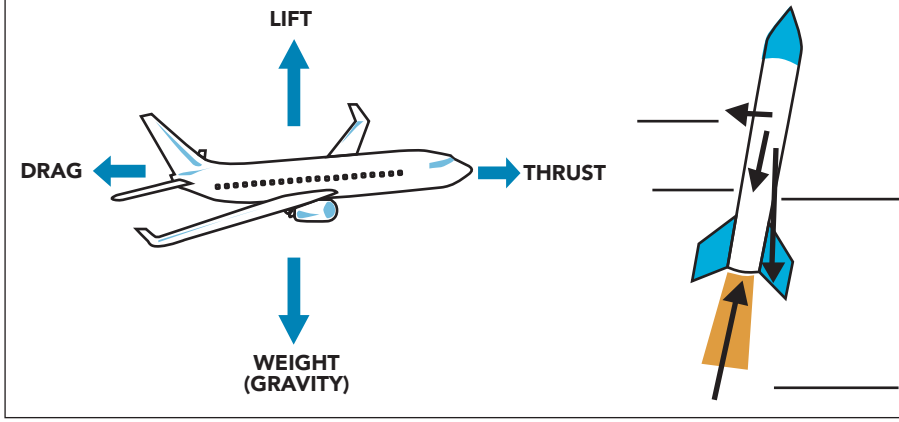
9. Test again. Did your airplane fly better?

A

Find an animal and mechanical object that have similar ways of flying. Draw them below. Then compare and contrast how they are able to fly. Did the mechanical object successfully mimic what happens in nature?

B

Look at the four flight forces that are labeled on the airplane below. Now label the four missing forces on the rocket as it lifts off!



C

Astronauts and pilots work in teams with people of different skills.

What types of skills and knowledge would be helpful for a team member to have in order to improve flight in the sky or in space?

CHECK IN

Animal Flight

Say:

"Flight has evolved in different ways in the animal world, and we can see the evidence by observing insects, pterosaurs, birds, and bats."

Explore and use the Student Guide

Discover the features that allow animal flight.

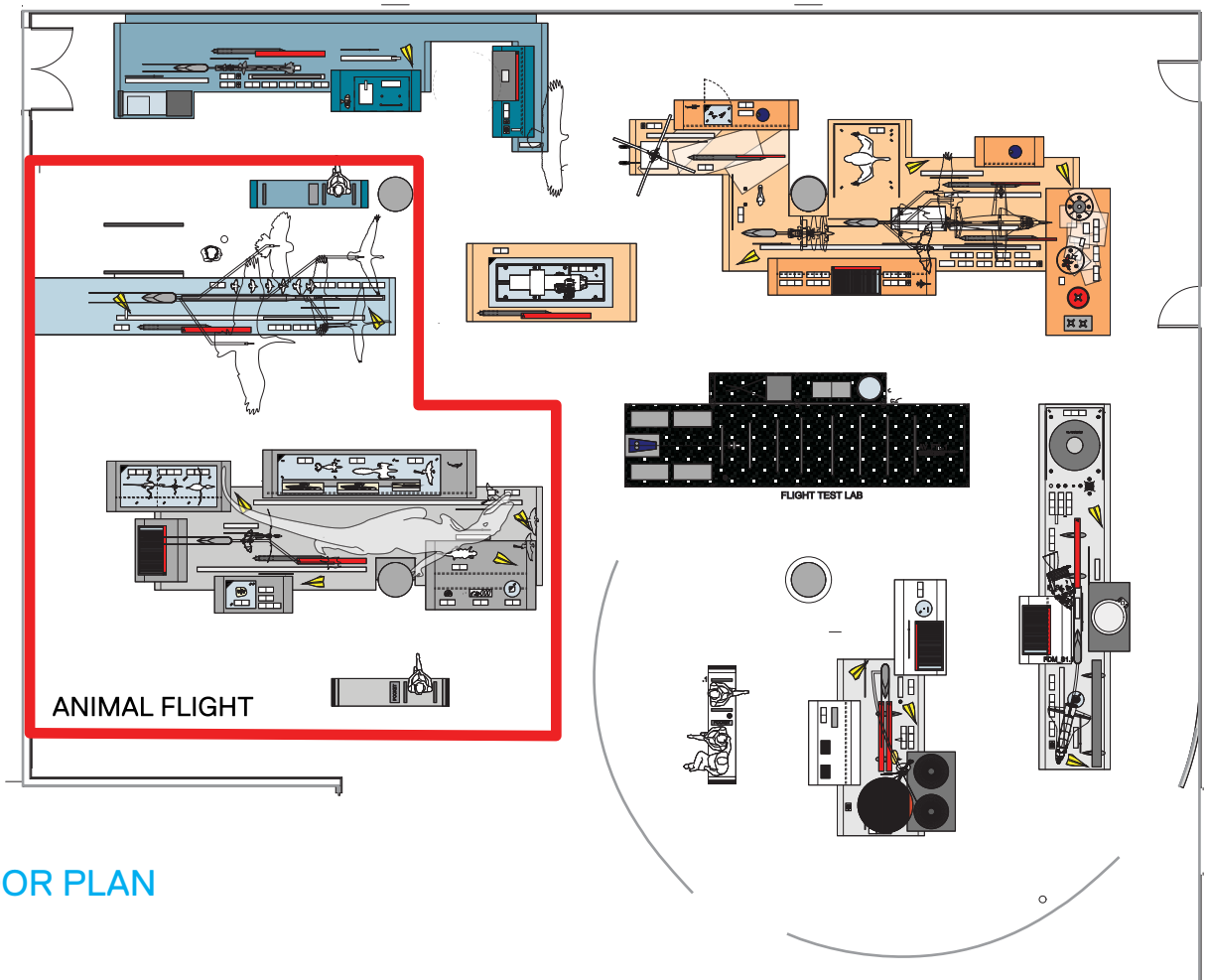
Discuss:

How do animals fly?

Some possible answers include…

- *Lightweight **wings** attached to muscles on insects*
- *Long flight **feathers** on birds*
- ***Skin** stretched over **long fingers** like the bat*
- ***Hollow bones** that make a bird's body light*

FROST SCIENCE | FEATHERS TO THE STARS FIELD TRIP



FLOOR PLAN

CHECK IN

Human Flight

Say:

"Humans were inspired by birds to fly in the sky."

Explore and use the Student Guide

Discover the different ways humans fly.

Discuss:

How do humans fly?

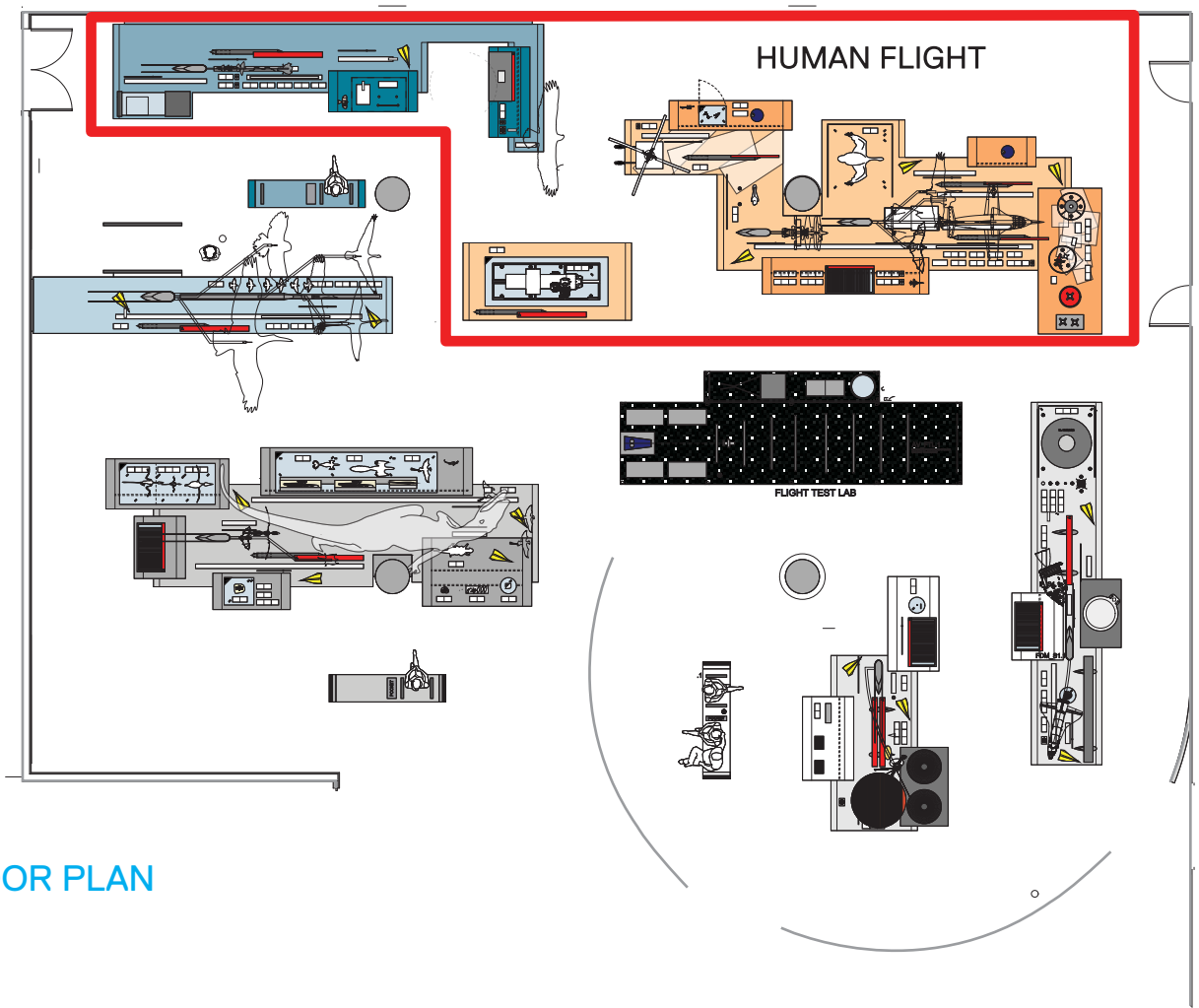
Some possible answers include…

- *Providing **lift** by changing the wing shape*
- *Using the **thrust** of an engine to move forward*
- ***Gliding** through the air like birds*

What is a connection between how humans and animals fly?

Some possible answers include…

- *They both use wings to get **lift**.*
- *Both are affected by **gravity** and **drag** from the atmosphere (air).*
- *They use **thrust** to move forward.*



FLOOR PLAN

CHECK IN

Space Flight

Say:

"Nature provided the inspiration for humans to find ways to fly. Finding ways to fly in space, without examples from nature, was our next big challenge."

Explore and use the Student Guide

Explore how humans get to space and the differences between Earth and space flight.

Discuss:

What makes space flight different from flight on Earth?

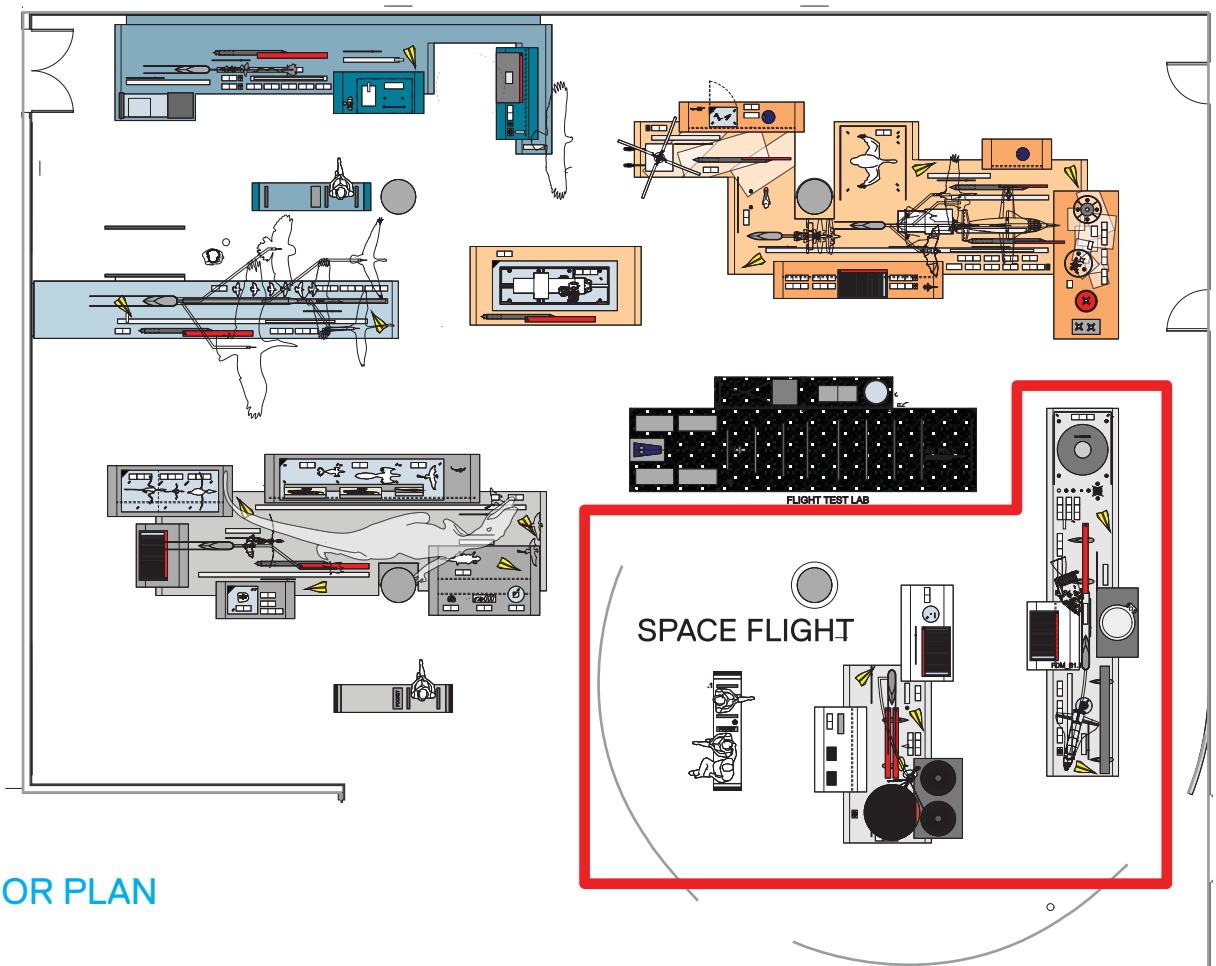
Some possible answers include…

- ***Without air**, the laws of aerodynamics don't apply.*
- *There is nothing to imitate from nature.*

What's next?

Some possible answers include…

- *Find ways for humans to visit another planet.*
- *Make airplanes go farther, faster, or greener (solar, hydrogen fuel, etc.).*
- *Have airplane wings move like birds.*



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