EXPLORE BIOMIMICRY

Grades 4-8: Day 3

STUDENTS EXPLORE NATURE'S AVIATION

WELCOME (5 min)

Introduction: Welcome your students. Be friendly.

MEDIA (20 min)

WATCH A A VIDEO ON FLIGHT

Objective: Students watch a video about flight with a simple demonstration of a paper wing.

Say: **Airplane wings are made from aluminum because aluminum is strong and lightweight. Watch how the shape of the wing is the most important feature that makes it fly. Can you notice how a wing must be shaped to help it create lift for an aircraft?**

Watch the video and discuss:

How Does A Plane Wing Work?
https://www.youtube.com/watch?v=ufeky6EIXQ4

Ask: **What special shape made the airplane wing fly?** Example: It was flat on the bottom but curved on top.

EXPLORE (20 min)

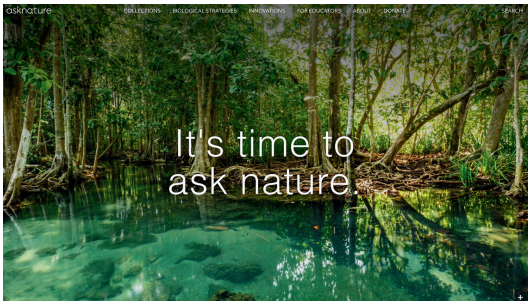
EXPLORE ASKNATURE.ORG

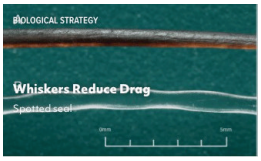
What you'll do:

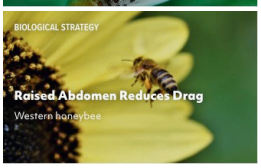
On the smart board or laptop, open the website asknature.org
Ask students to help formulate a question or challenge they have encountered during flight month.

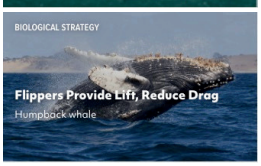
Say: **We are going to take a challenge we might have faced and ask a very powerful question—how would nature solve this?**

Type in a key word in the "Search" tab (upper right) and a grid will appear. Try searching words such as "**lift**," "**drag**," "**fly**," and "**flight**." Select and skim through a few items from the collections to ignite students' curiosity. Note: If students have access to devices, they can explore independently as well.









DRONE TIME!

(60 min)

Materials:

- Mini-fliers
- Printed cards

MEDIA

(5 min)

STEM MOVIE AND QUIZ

(20 min)

LEARN ABOUT BIOMIMICRY APPLICATIONS

Objective: Students will actively engage with biographies of STEM innovators to practice reading comprehension, critical thinking, and discussion skills, while learning how scientists use nature and creativity to solve real-world problems.

What you'll do:

1. Form a Circle & Read: Students stand in a circle. One student or the teacher reads a scientist's information card aloud.
2. Ask a Question: The teacher or reader asks one comprehension or discussion question about the scientist.
3. Pass & Answer: Students raise their hands to answer. Pass the mini flier to a student who will read their answer aloud.
4. Repeat & Reflect: Continue with the remaining questions for that scientist, then move to the next scientist. Wrap up with a short discussion about what students found most interesting or inspiring.

GLIDE LIKE A SQUIRREL

Say: **In the spirit of learning from Nature's wisdom and finding guidance in unexpected situations, we will be looking at two animals today as nature's aviators—not flies or birds, but whales and squirrels!**

Students watch this media about flying squirrels:
How the Flying Squirrel Soars
https://www.youtube.com/watch?v=C7DbGl36AWA

EXPERIENCE A GLIDER'S JOURNEY

Watch this video and talk about the quiz questions below.
Hang Gliding Above the Ocean in 360°
https://www.youtube.com/watch?v=ryElcmW4lpY

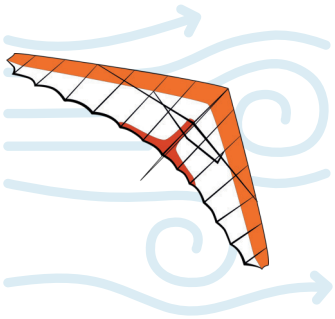
Note: *You can use the arrows in the top left corner to change your immersive view.* Here are some questions or use your own!

1. What do you think the instructor means when he says, "A glider is pretty much always falling to Earth?"
2. Do gliders need to wait for a windy day? Why or why not?
3. Does pointing the nose down make the glider go faster or slower?

4. How did the glider turn right?
5. How long was the world record glide?
6. Is it a good idea to glide near the coast? Why or why not?
7. Where would you be excited to go hang gliding?

STEM GAME

(20-30 min)



TWO MYTHS AND A FACT

Objective: Students listen to a prompt with 2 myths and 1 fact. They discuss amongst themselves and try to identify the myth. Use the rounds below to help lead an interactive discussion.

Round 1 Statements

1: Gliders can stay in the air forever if they catch enough wind.
2: The Wright Brothers' first flight was only gliding.
3: Gliders rely on rising air currents to stay in the air.

Answer: Statement 3 is the fact. Explain: Gliders stay in the air by using rising air currents, helping gain altitude without an engine.
Explain Statement 1: Even though gliders can ride air currents to stay in flight for long periods, they eventually lose altitude and need to land. Explain Statement 2: The Wright Brothers experimented with gliders before achieving powered flight, but their first successful flight that made headlines was notable because it used an engine, not just gliding.

Round 2 Statements

1: Gliders cannot change direction once they are in the air.
2: Pilots can control a glider by adjusting the angle of the wings and using air currents.
3: Only birds can glide in the wild.

Answer: Statement 2 is the fact Explain: Pilots control a glider by adjusting their direction.

Explain Statement 1: Gliders are not just passive objects drifting through the sky. Pilots can steer them by adjusting the control surfaces and using different types of rising air.
Explain Statement 3: Some insects can glide, and many other animals—including flying squirrels, sugar gliders, and even some species of fish and frogs—can glide through the air to escape predators or travel between trees.

Round 3 Statements

1: A paper airplane is a type of glider.
2: Gliders are best made out of materials like solid gold or metal.
3: Any airplane can glide just as well as a glider even if its engine is turned off.

Answer: Statement 1 is the fact. Explain: A glider is any aircraft that flies without an engine, and since a paper airplane only relies on air resistance and gravity, it counts!

MEDIA
(40 min)

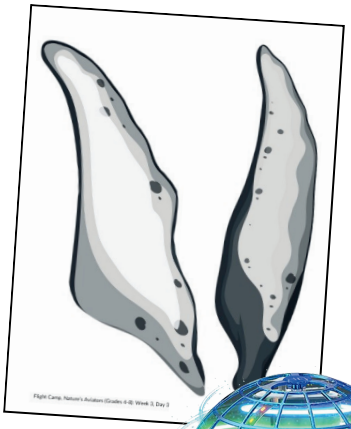
Materials:

- Scissors
- Paper
- Mini-Flier (optional)
- A thin book, piece of cardboard, or something to use to fan air.

WHALES AND WIND

Say: How could learnings from a whale help windmills or, more broadly, improve aircraft design. Let's explore further.
Students watch this very short video. The link should be queued in to skip the first 30 seconds.

What Can a Humpback Whale Teach a Wind Turbine?
https://youtu.be/FMG5Ah1g8rM?t=30



Do an experiment:

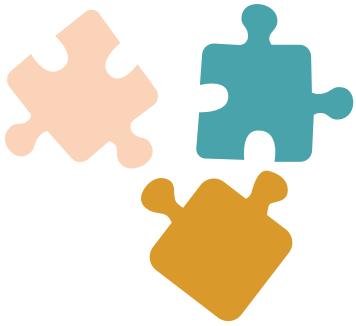
1.Cut out the whale fins from the handout.
2. Hold each paper fin in a stream of air. Use your drones, fan a book, or just blow to create a stream of air.
3. Ask students to observe: **Which flipper wobbles more?**

Extension:

Use scissors and paper to experiment with the leading edge of a wing. Cut additional pieces of paper with different edge profiles like the whale flipper. Make bumps and waves of different shapes and sizes to see which make the paper wobble less. Experiment with different types of paper too (construction paper, computer paper, cardstock, recyclables or whatever materials you can find.)

PUZZLE TIME
(60 min)

Materials:
- Puzzles



USE THE SCIENTIFIC PROCESS: COMPLETE A 500 PIECE PUZZLE

Objective: Students use the scientific process and group work to tackle a large, 500 piece puzzle.

Prep beforehand:
Set aside a corner of the room or table to store this puzzle as students will begin solving it today then come back to it on Day 5.

Instructions:
1.Say: When you're solving a big puzzle, you are curious, patient, and organized, just like a scientist. Follow these scientist steps to solve your puzzle.

Step 1: Collect your data
Turn all your puzzle pieces picture-side down. It is important for scientists to begin by collecting all the raw data, even before they know how it fits.

Step 2: Sort and Observe — Organize your data
Now flip the pieces back, and start sorting. Put all the pieces that have a flat edge in one pile. These will be your corner and edge pieces. Scientists organize materials by putting it into piles.

Step 3: Build the Border
Study the picture on the box and begin to build the edges. Use all the flat sided pieces and build the frame. In science, this is called defining the problem or boundaries.
Say: You've taken very important steps today! If you aren't done with the border yet, that's okay. We will come back to this in a couple of days and finish our puzzle. Note: Store any remaining flat-edged pieces in a separate baggie and push the work in progress puzzle to the side.

METRICS

STEM MEDIA

4-PS3-4.
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

DRONE TIME

3-5-ETS1-2.
Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

GLIDER QUIZ

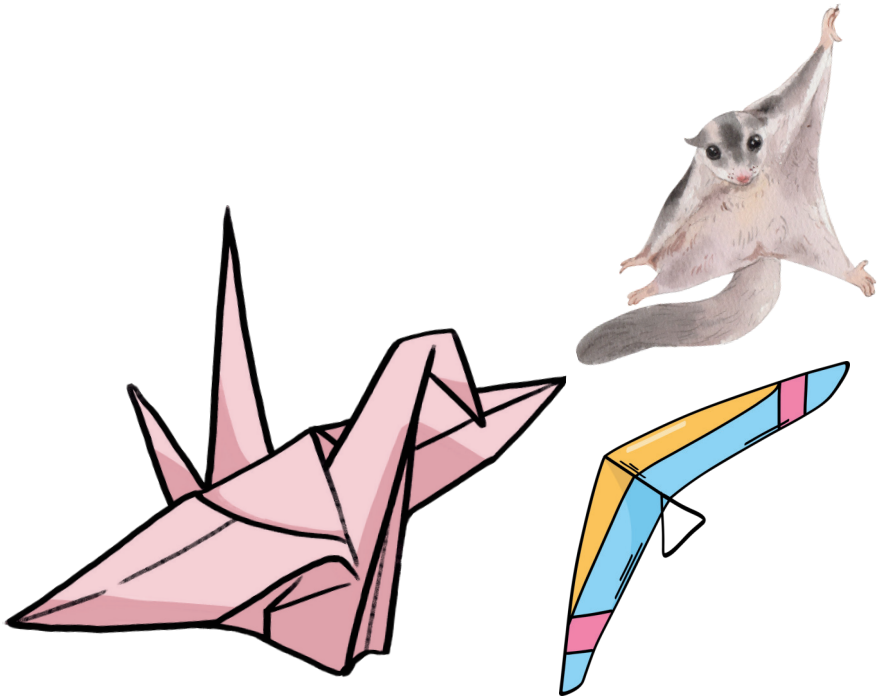
3-PS2-2.
Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

FIN STABILITY TEST

3-5-ETS1-3.
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

PUZZLE TIME

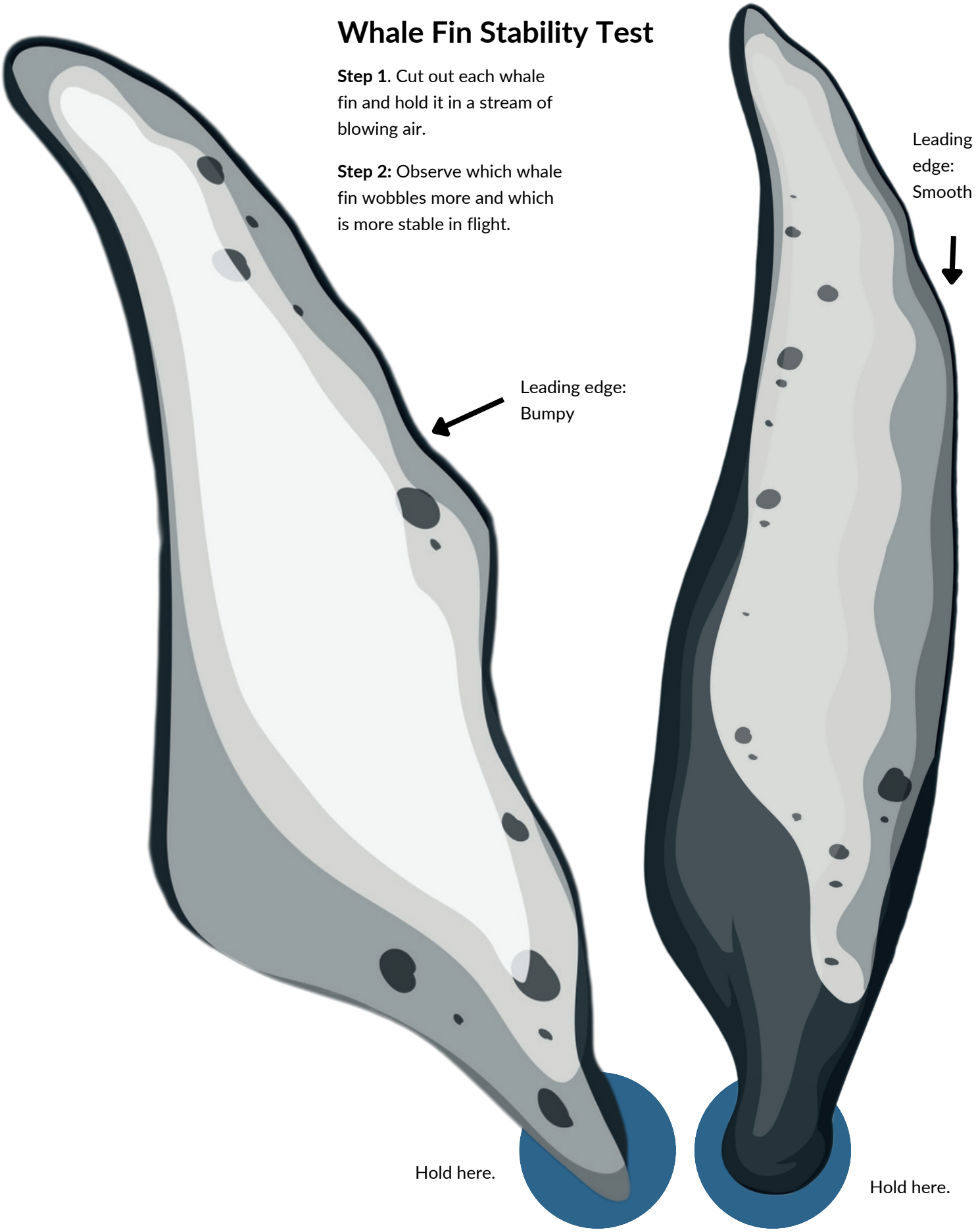
Crosscutting concept: Students understand the way the puzzle pieces are shaped contribute to their position and function as a larger piece of the puzzle.



Whale Fin Stability Test

Step 1. Cut out each whale fin and hold it in a stream of blowing air.

Step 2: Observe which whale fin wobbles more and which is more stable in flight.



Sophhie Harker

Sophie is a British aerospace engineer who has worked on spaceplane concepts and hypersonic aircraft that travel faster than the speed of sound! When she was 16, she visited the Kennedy Space Center and wanted to become an astronaut, but wasn't sure how. When she met Dr. Helen Sharman, the first British person in space, she decided to study Math and become and engineer. She does a lot of problem solving in her career, and she says: "I investigate are whether an aircraft concept is going to fly or not and then, if it does fly, how far, how fast and what can we do to improve its flying abilities?"

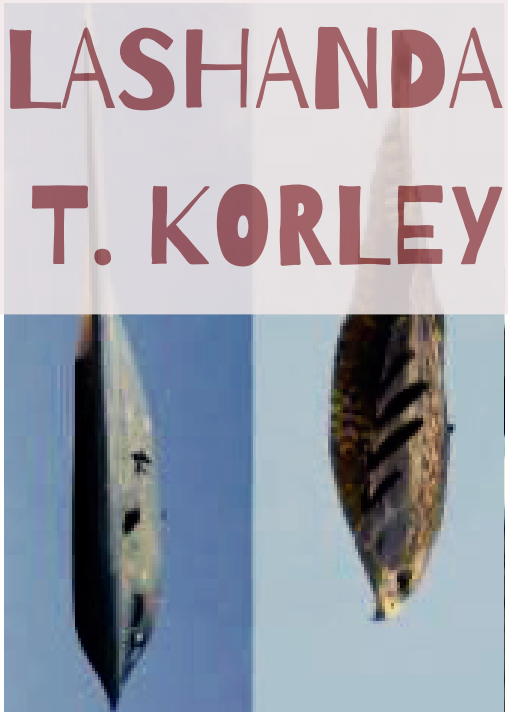
Questions:

What inspired Sophie to want to work in space and become an engineer?
Example Answer: Visiting the Kennedy Space Center and meeting Dr. Helen Sharman, the first British person in space, inspired her.

Who is Dr. Helen Sharman and why was meeting her important to Sophie?
Example Answer: Dr. Helen Sharman was the first British person in space. Meeting her helped Sophie decide she wanted to study math and become an engineer.

What kind of work does Sophie do as an aerospace engineer?
Example Answer: She investigates whether aircraft concepts can fly, and if they can, she looks at how far and how fast they fly and how to improve them.

LASHANDA T. KORLEY



A bird's wings aren't the only thing scientists and engineers can learn from when designing aircraft! Lashanda looks at insect wings, seed pods and even our muscle tendon systems to choose materials for flight that can respond and flex as they fly. She designs materials that can change shape with moisture or be layered to behave like wing membranes (the thin, stretchy skin that helps some animals fly).

Her work with materials that are lightweight and strong is opening up new possibilities for aircraft skin!

Questions:

What kinds of things does Lashanda study to design aircraft materials?
Example Answer: She studies insect wings, seed pods, and human muscle tendon systems.

What are wing membranes, and why are they important in her work?
Example Answer: Wing membranes are thin, stretchy skins that help some animals fly. Lashanda designs materials that behave like them to improve aircraft flight..

What qualities does Lashanda try to give to the materials she designs?
Example Answer: She makes them lightweight, strong, and able to change shape or flex as they fly.

Claire always said “Biomimicry is about copying nature to solve a human problem or challenge.” She traveled the world from South Africa to study and research different ecosystems and founded BiomimicrySA to bring together a team of scientists working on their own nature-inspired projects. She spent the rest of her life working on a water filtering technique inspired by nature, as well as teaching students and other scientists how to find nature-inspired solutions because she believed nature has billions of years of experience in testing ideas that work and last. She was fascinated by the flying capabilities of dragonflies!

Questions:

What is biomimicry, according to Claire?
Example Answer: Biomimicry is copying nature to solve a human problem or challenge.

What did Claire do to study nature and biomimicry?
Example Answer: She traveled the world to study different ecosystems and founded BiomimicrySA to work with a team of scientists on nature-inspired projects.

What kind of projects did Claire focus on during her career?
Example Answer: She worked on a water filtering technique inspired by nature and taught others how to find nature-inspired solutions.

Cynthia Sung

Cynthia is inspired by origami. She works with foldable robotics. She designs aerial vehicles with foldable wings! With her team, she makes machines that can fold themselves, change shape, fly or adapt—all inspired by her studies of the structures of birds, seeds and insects. She says origami structures have a good strength to weight ratio, which means they can carry heavy loads and be made efficiently.

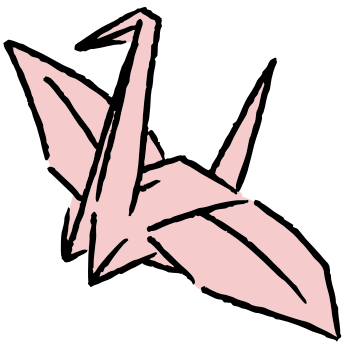
Her work helps the world understand how to make smarter, more efficient flying robots.

Questions:

What inspires Cynthia in her work?
Example Answer: Origami and the structures of birds, seeds, and insects.

What does Cynthia design?
Example Answer: She designs foldable aerial vehicles and robots that can change shape, fold themselves, and adapt

Why are origami structures useful for flight?
Example Answer: They have a good strength-to-weight ratio, meaning they can carry heavy loads while staying lightweight and efficient.



Karen is a student in the United Arab Emirates who used to study in a German school in Iran. She has designed a biomimetic air jellyfish! Karen was inspired by how jellyfish contract their bells under water to push and glide, so she built a lightweight device that moves the same way in air. Her work is an example of how even the techniques animals use to move through the water can be used to inspire engineering innovation in flight!

Questions:

Where is Karen from and where did she study?
Example Answer: She is a student in the United Arab Emirates and used to study in a German school in Iran.

What kind of device did Karen design?
Example Answer: A biomimetic air jellyfish that moves like a jellyfish but in air.

How did Karen get the idea for her design?
Example Answer: She was inspired by how jellyfish contract their bells to push and glide through water.