Every (STEM) Hero Has A Story!

for

Summer Reading

AT NEW YORK LIBRARIES

Cornell University is an equal-opportunity, affirmative-action educator and employer.
Every (STEM) Hero Has A Story!

Welcome! The following lessons are a brief glimpse into the stories of heroes who have made a mark on our lives with their accomplishments in STEM. In particular, in the areas of Ornithology (birds), Trees, Bridges, and Airplanes. Connecting with the 2015 “Every Hero Has a Story” Library theme, we have compiled lessons in each of these areas broken down into 4 categories. The target age group is children in grades K-2. There will be an activity connection for those youth in grades 3-6 available upon request.

Based on Feathered Friends Activities at www.birdsleuth.net/Pennington
Book: Olivia’s Birds, Saving the Gulf, by Olivia Bouler
Lessons by the Cornell Lab of Ornithology.

Lesson 1: Birds, True or False?
Students will confirm what they know (and dispel some myths) about birds via this active “True or False” game.

Lesson 2: Meet Three Feeder Birds
Students will be introduced to a variety of birds that might visit local bird feeders and learn about their traits.

Lesson 3: Take It Outside
Participants will take what they learned in the first 2 lessons and go on a bird-watching adventure either at a feeder or just in the local environment if there is no feeder available.

Lesson 4: Oil Spill Clean-Up
Youth will create a miniature oil spill. They will then experiment with a variety of materials to discover how effective different materials and methods are in cleaning up an oil spill.

Adapted from SERIES Curriculum, University of California, 1990.

Take-home Activity: Birding in Your Neighborhood
Participants and their families will take a walk or sit quietly to look and listen for birds considering several questions.
**Part 2: Trees and Conservation**

Book: *The Camping Trip That Changed America*, by Barb Rosenstock

**Lesson 5: Tree-mendous Fun**
In Activity 1, youth will learn how to tell a tree’s age by counting its rings. In Activity 2, youth will learn about the products that come from trees.

**Lesson 6: Where Did the Rain Go?**
Students will do an experiment where they compare what happens to rain with and without trees.

**Take-home Activity: Live Tree Homes**
Youth will take a closer look at trees in their yard or local park to discover what plants and animals live in them.

**Part 3: Building Strong Bridges**

Book: *Twenty-One Elephants and Still Standing*, by April Jones Prince

**Lesson 7: File Card Bridges**
Participants will be introduced to designing a simple bridge and testing how much weight it can hold using file cards and pennies.

**Lesson 8: Making Stronger Bridges**
Youth will learn to build different types of bridges and test them out. Engineering concepts will include beam bridges, arch bridges, truss bridges, and suspension bridges.

**Take-home Activity: Bridge Identification Game**
Youth will identify bridges in their lives and discuss with their families what kind of bridge they are and what is different about them.
Part 4: Airplanes and Flight

Book:  *Wee and the Wright Brothers*, by Timothy R. Gaffney

**Lesson 9: Awesome Airfoils**
The airfoil shape allows the air above the curved surface to move faster than the air below. Youth will experiment with folding paper airplanes for the best flight.

**Lesson 10: From Nose to Tail**
Participants will play games to help them learn the parts of an airplane and what they do.

**Take-home Activity: Family Flyers**
Youth and their families will experiment further with making paper airplanes using two different kinds of paper airplane plans and looking for ways to make them fly smoother and further.

“Every Hero Has a Story”

Overview – Ten 15 - 45 Minute Lessons to Mix and Match

- Lesson 1: Birds: True or False? ..........6-7
- Lesson 2: Meet Three Feeder Birds ..............7
- Lesson 3: Take It Outside ........................8
- Lesson 4: Oil Spill Clean-Up ....................10
- Lesson 5: Tree-mendous Fun ...................12
- Lesson 6: Where did the rain go? ..............16
- Lesson 7: File Card Bridges .....................21
- Lesson 8: Making Stronger Bridges ............23
- Lesson 9: Awesome Airfoils ....................25
- Lesson 10: From Nose to Tail ..................28
Sample Schedule for five 1 - 1.5 hour Workshops

“Bird Day” Lessons 1, 2 & 3

“Oil Spill Clean Up Day” Lesson 4

“Tree Day” Lessons 5 & 6

“Bridges Day” Lessons 7 & 8

“Airplanes Day” Lessons 9 & 10

Other Ideas:

For each topic, there is a family take-home activity sheet to extend the learning.

Ask parents to shop for activities and bring supplies.

Offer activities for older youth offered in the science kits obtained from local CCE 4-H County Offices.

Read the Book: Olivia’s Birds, Saving the Gulf, by Olivia Bouler

Lesson 1: WHAT MAKES A BIRD A BIRD?

Based on the Feathered Friends lessons at www.birdsleuth.net/Pennington.

Big Idea

These activities provide a “bird’s eye view” of what defines our feathered friends and introduces the idea of feeding birds while getting students on track to becoming enthusiastic bird experts.

Learning Objectives

- Students will be able to name the features that make birds unique.
- Students will be able to identify three common bird species.

Lesson 1: TRUE or FALSE?

Students will confirm what they know (and dispel some myths) about birds via this active “True or False” game. If possible, set up a large space (outdoors, gym) or your classroom with “True” and “False” sides at opposite ends of the space. Invite students to run (or walk) from side to side depending on whether they think the statements you read are true or false. At the end of each statement, be sure to reveal the correct answer and if possible give an example. For examples visit www.birdsleuth.net/Pennington.

Basic Statements

1. All birds sing.
2. All birds fly.
3. All birds have two wings.
4. Birds lose and replace their worn or damaged feathers.
5. Birds have thick, heavy bones that provide the structure they need to fly.
6. Birds have poor eyesight.
7. Birds have heartbeats that are slower than humans.
8. All birds lay eggs.
9. Most birds eat worms.
10. Birds are the only living animals that have feathers.


Before You Start

Visit www.birdsleuth.net/Pennington to find background information and links to photo, video, and sound resources used in this lesson. We recommend you visit this site ahead of time to quickly orient yourself. Decide where you will conduct the “True or False” activity, and prepare to take students outside.
Challenging Statements

1. All birds migrate.
2. Birds are vertebrate animals.
3. All birds are warm blooded.
4. All newly-hatched baby birds are covered in downy feathers.
5. Male and female birds of some species look different.


Extension for More Advanced Groups

You can extend the True/False activity by asking the students to defend their choices. If the group is split, ask each side to defend why they think they are right. Make it an option for students to consider their peer’s arguments and change their choice at any point during the debate.

Lesson 2: MEET THREE FEEDER BIRDS

Introduce these bird species one by one to your students.

CHICKADEE             MOURNING DOVE             DOWNY WOODPECKER

Place a picture of the first bird on the board, or project one from the Cornell Lab’s All About Birds website; allaboutbirds.org.

As you show each species, ask:

- Have you ever seen this bird before? Where did you see it?
- Do you know what its name is? How would you know it’s a __________?
- Do you know what sound it makes? What does it sound like?

Make a list of descriptive words the students use to describe each species on the board. If you can, add to the students’ experience by exploring each bird’s species account in All About Birds: you can show videos, hear sounds, and see more photos of each of the species. Ask students to try to mimic the sounds of the birds, especially the chickadee by saying “Chica dee dee dee.”

After all birds have been introduced, show the students all three birds together, and ask:

If we saw/heard these species outside, how could we tell them apart? (How are they different?)

What do all birds have in common? Which feature is unique to birds? (FEATHERS!!)
Through these activities, students will essentially come up with their own list of “What makes a bird a bird?” Highlight the key points that all birds have feathers, two wings, two legs, hollow bones, beaks, and lay eggs.

**Lesson 3: TAKE IT OUTSIDE!**

Now that you've learned the names of three common feeder birds (and what they look and sound like) take your students on a bird-watching adventure at the feeder for as little as 5-10 minutes. Try to find the three species, but if you don't, look and listen for other birds and other animals. Focus on the similarities and differences between the species you see. How do they look different? Sound different? Behave differently? Become more aware of birds, their behaviors, and their habitats. Now is a great time to get children in the habit of watching wildlife quietly! Visit the website to find tips about keeping students engaged and organized on trips outside.

**Take it Home!**

Educators, keep students thinking about and observing birds at home by printing out the following pages (for a single two-sided copy) and sending them home with students. Invite the whole family to join the fun of watching birds!

Print the following page for each child to take home and let the education continue!
TAKE HOME ACTIVITY

Parents and Guardians - Your child has learned about wild birds in school, and this sheet is designed to offer more information and activities for your family to enjoy wild birds.

WHAT MAKES A BIRD A BIRD?

Birding in Your Neighborhood

Look for birds on a walk in your neighborhood, or sit quietly for 10 minutes to look and listen for birds. Consider the following questions:

a) How many birds did you see?

b) How many different kinds of birds did you see?

c) Did you see any of the 3 species below?
CHICKADEE      MOURNING DOVE      DOWNY WOODPECKER

d) What were the birds doing?

e) Can you find a bird that is making noise?  ____Yes  ____ No

If you’d like, use the back of this page to sketch one of the birds you see to share with your classmates!

Cool Fact!

IF IT HAS FEATHERS, IT’S A BIRD!

Birds are the only living creatures with feathers. Feathers are made of keratin, the same protein that makes up bird beaks, lizard scales, mammal hair, human fingernails, and animal hooves and horns! Feathers help birds fly and keep them warm and dry. The color patterns of feathers, called “plumage,” can help birds stay camouflaged or find mates.

Cornell Lab’s Book of the Month

WHAT MAKES A BIRD A BIRD?, by May Garelick

Beautifully illustrated, this book sparks the imagination and teaches more about bird basics.
Lesson 4: OIL SPILL CLEAN-UP

Every year Americans use about a billion gallons of motor oil - and about 350 million gallons of it winds up in the environment. Some experts estimate that about 40% of the pollution in our waterways is from used motor oil. Over 2 million tons of used motor oil ends up in our rivers and streams each year. When used motor oil is poured into the ground, it can seep into the water supply - a single quart of motor oil can pollute 250,000 gallons of drinking water. Accidents such as the gulf oil spill addressed in “Olivia’s Birds” is in addition to that.

**Materials you will need:**

Dish pan (1 for each team of 3-6 participants)
Plastic table clothes (enough for each team’s table)
Sesame Oil (vegetable oil would be an alternative, but would not be as visible)
Eyedroppers or small spoons to measure how much oil is put in the water
Straw, dry grass, leaves, (a handful for each team)
Cotton balls
Styrofoam pieces
Twigs/sticks/or straws and string (to make a containment boom)
Straws (to blow bubbles under the oil)
Sand (to sprinkle on the surface)
Dawn Dish Detergent (to disperse the oil)
Paper towels
Newspaper
Optional: pieces of wood, fake fur, feathers, cloth, etc...to add to your oil spill)

**Advance Preparation**

Obtain all necessary material; be sure to cover the work areas with newspaper and/or disposable table clothes.

Suggested group size would be 3-6 participants

Explain to participants that they will be creating a miniature oil spill. They will then experiment with a variety of materials to discover how effective different materials and methods are in cleaning up an oil spill.

Divide the participants into teams.

1) Give each team a dishpan ½ filled with water.
2) Ask each team to predict what will happen when the oil is spilled on the water. Record predictions.
3) “Spill” the same amount of sesame oil into each pan. I would suggest about 1/8th of a cup.

4) Ask each team to think of ways to contain and/or remove the oil from the water using the available materials.

5) Assign each group a different method of clean-up/removal. (they will probably want to try them all).

6) Let each team work together to clean up/remove the oil from their pan.

7) Discuss the results as a group at the end.

Optional:

Repeat the activity adding rocks, shells, feathers, etc. to the water. How does this affect the cleanup?

For youth grades 3 and up, make them use toothpicks rather than their hands (more to scale).

Questions to ask…

Observing: What did you observe when you put the oil in the water? How many senses did you use to observe? What else did you observe?

Comparing: What were the advantages of each of the methods you tried for removing the oil?

Relating: What methods did you use to clean up/remove the oil from the water? How well did they each work? What worked best? Why?

Inferring: Would any of the methods you used have a negative effect on the environment? What would happen to the animals in the environment if you were to use your methods with an actual oil spill? How would the spill be different if it was a million gallon spill in an ocean?
Part 2: Trees and Conservation

Read the book *The Camping Trip That Changed America*, by Barb Rosenstock

Lesson 5: TREE-MENDOUS FUN

Credit: *Science Dicovery Series, Book 1*, by the State University of New Jersey, Rutgers 1995-2003. Written by James Nichnadowicz and Mary Lou Mayfield (adapted from “From Bark to Nuts” curriculum written by Baer & Nichnadowicz, May 1995. Revised April 2003.)

**Activity 1- Be a Stump Detective:** Youth will understand how to determine a tree’s age by counting its rings and how the rings tell a story about the tree’s life.

**Materials needed:**
Crayons
One photocopy of a tree cross section per student (see Appendix #1A)
Handout “How to Count a Tree’s Rings” (See Appendix #1B)
1 tree cross-section (if available)

Directions:

1. Discuss information about tree rings from the “Did You Know?” section.
2. So youth can relate to human age to tree age, ask them how old they think the oldest living person is? Then, the oldest living tree? Who lives longer?
3. How can we tell how old a tree is?
4. Show the tree cross section and give out the photocopies.
5. Using the cross section, explain how a tree makes a new ring each year. These can be used to tell a tree’s age.
6. As an example, start in the center of the cross section and count outward to a selected students age. Youth enjoy doing this out loud and as a group. Have them count the rest of the rings to discover what the age of the tree is.
7. Ask children, “Are you getting bigger each year?” (yes). Some years, though, they may grow a lot taller(4-6 inches) and others only an inch or so. We can tell in which years a tree grew the most by looking at the tree rings. Have them find the widest ring and the narrowest by measuring the sections with a ruler. Have them color the widest ring on the photocopy.
8. Have each youth count from the center and color in the ring that is his or her age.
Master Copy of Tree Cross Section
How to Count a Tree's Rings

one year ring

one year ring plus a two year ring

three year old tree

Science Discove ly Series
Volume 1
Activity 2: The Guessing Game  Youth will understand that many objects we take for granted are made possible because of a tree.

Before the meeting:  Familiarize yourself with the supplies listed below.  Collect as many of them as possible.

Materials needed:
Cork form a bottle- bark of a cork tree
Cinnamon sticks- bark of a cinnamon tree; let kids smell these
A coconut- one of the world’s largest tree seeds.
Cocoa seed- used to make chocolate (you can order your own cocoa seed free from Hershey at 1-800-468-1714)
Walnut
Maple Syrup- sap of Sugar Maple tree (note: this does not hurt the tree)
Paper- trees are ground up and then pressed flat to make paper
Balloon- made from the sap of a rubber tree.
Baseball bat- made from the wood of an Ash tree
Tea- leaves of a tree grown in China, India, Africa, and other warm places
Root Beer (empty can)- roots and bark of a Sassafras tree
Cola (empty can)- seeds of a Cola Nut Tree
Pencil- made from the wood of a Cedar Tree
Mouthwash (empty bottle)- extracts from evergreen trees are used to flavor it
Coffee Beans- seeds of a tree grown in tropical countries in Africa and central and South America. (Brazil grows more coffee than any other country in the world.)

Directions:
All items on this table come from trees. Pick up items one by one. Pass them around so children can feel and smell them, and guess what they are; then discuss how each item comes from a tree. Ask children what other things we eat that come from trees (fruit, nuts).

Lesson 6: WHERE DID THE RAIN GO?
Participants will do an experiment to discover how tree’s leaves help the ground below absorb rainfall.

Materials needed:
Large cake pans, one per group of 3-5 participants.
Smaller cake pans that will fit inside the larger cake pan and leave room around the edge. 1 per group of 3-5 participants.
Potted plant for each group that has large leaves and/or looks like a tree. Poinsettia is one example.
“Sprinkling” watering can for each group
2 cup measuring cup

Place the smaller cake pan bottom side up inside the larger cake pan and place pan so it is tilted (put a magazine under one edge of the larger cake pan). Using the watering can “Rain” one cup of water onto the smaller cake pan using the sprinkling water can. Time how long it takes for all of the water to roll off the smaller pan. Pour the water from the larger pan into a measuring cup to determine if all the water rolled off the smaller cake pan.
Get a small potted plant that looks like a tree. Do the same experiment again with the potted plant set on top of the smaller cake pan (still inside the larger cake pan). Pour the water from the watering can onto the plant. Time the water for the same amount of time as the first experiment. After the time is up, pour the water from the large cake pan into the measuring cup to determine how much of the water rolled off the plant/smaller cake pan.

Questions to ask….

Where does the water go that is sprinkled onto the plant?

Why is the speed of the water in the rain/sprinkler slowed down by the plant before making it to the plastic sheet?

Why are forests important to us because of their absorption capacity?

If you planted a garden on a rooftop in a city, what might happen?

---

**Did You Know?**

Rainfall is part of the water cycle. It begins as water vapor in the atmosphere, which condenses on small dust particles before falling to Earth in some form (ex. Rain). Some of the water falls directly on the ground, on vegetation and trees in a forested area or on urban structures and streets. Some of the rain that lands on trees never makes it to the ground, but stays on the leaves and evaporates back into the air. Some runs down the leaves, stems, twigs, and trunk to the ground.

The rainfall that lands on urban areas runs quickly off of surfaces like brick and concrete that do not have any ability to absorb it. It runs into the gutters and drainage ditches and into water bodies, like creeks, rivers, and lakes. Forests along bodies of water such as lakes and streams benefit water quality by cleaning chemicals or soil out of the water before it enters them.
TAKE HOME ACTIVITY

Live Tree Homes

Materials needed:
Live, healthy trees
Hand lens
Copy of the Live Tree Homes Activity Guide

Live trees provide homes for many animals and plants. Hawks, woodpeckers, squirrels, bats, grosbeaks, and robins all make nests in trees. Many smaller animals such as insects also inhabit trees. Plants, such as lichens, mosses, and algae, make their homes on the trunks and branches of trees. Fungi may live on the bark, in the wood, on the leaves, and on the roots. This is called a Microhabitat.

Trees provide food, water, and shelter for a wide variety of living things.

What to do:

1. Using the worksheet “Live Tree Homes Activity Guide” choose a tree to examine.
2. Identify the different microhabitats on the tree. Together, describe the leaves and bark. Does the top of the tree provide a microhabitat that is different from that provided by the bottom of the tree? Does the bark seem more moist in certain areas, such as inside the furrows or on the north side? Are there scars on the tree where the bark is different?
3. Can youth find any animals or plants on the leaves or bark? On what parts of the leaves or bark are they living?
4. Can youth find any signs, such as holes in the bark, that insects or birds live inside the tree?
5. Are there signs that animals are living at the base of the tree or in the top of the tree?
6. Examine lichens, fungi, algae, mosses, and insects with your hand lenses.
7. Compare your findings for different types of trees.

Section 2. Tree Homes

Activity 4: Live Tree Homes

Live trees provide homes for many animals and plants. Hawks, woodpeckers, squirrels, bats, grosbeaks, and robins all make nests in trees. Many smaller animals, such as insects, also inhabit trees. Plants, such as lichens, mosses, and algae, make their homes on the trunks and branches of trees. Fungi may live on the bark, in the wood, on the leaves, and on the roots.

Trees provide many different microhabitats for plants and animals. Microhabitats are small living sites or places that supply food, water, and shelter for plants and animals. The leaves, bark, and roots of a tree provide different foods, moisture conditions, and shelters and are therefore inhabited by different plants and animals.

For example, the leaves and bark of a tree provide many different microhabitats for a variety of insects. Some insects mine, or burrow, into leaves by eating the leaf tissue; these are called leaf miners. Leaf-eating beetles also live on leaves. Leaf-roller caterpillars make homes by rolling leaves into a cylinder. Other insects, such as scales and aphids, live on the bark. Bark beetle larvae live underneath the bark.

The trunk of a tree offers several microhabitats, which differ in the food, water, and shelter they provide. For example, the north side of a tree is generally wetter than the south side because it is not exposed to the warm sun. That is why you often find more mosses, algae, and lichens growing on the north side.

Different kinds of trees may provide different microhabitats. For example, a tree with smooth, thin bark, such as American beech, will attract insects that pierce the bark to get sap, such as aphids or scales. A tree with a deeply furrowed bark, such as an oak, provides many sheltered hiding places for large insects and spiders.

In this activity, you and the youths in your group will explore the plants and animals living on a live, healthy tree.
What Youth Discover

- Many different organisms live on a tree.

What You Need

- live, healthy trees
- hand lenses, if available
- copies of the Live Tree Homes Activity Record for each group member

What to Do

1. Hand out a copy of the Live Tree Homes Activity Record to each youth.

2. Have each youth or group of youths choose a tree to examine. Encourage your group to choose different kinds of trees, such as a broad-leaved and a conifer species.

3. Have the youths identify the different microhabitats on the tree. Have them describe the leaves and bark. Does the top of the tree provide a microhabitat that is different from that provided by the bottom of the tree? Does the bark seem more moist in certain areas, such as inside the furrows or on the north side? Are there scars on the tree where the bark is different?

4. Can the youths find any animals or plants on the leaves or bark? On what parts of the leaves or bark are they living?

5. Can the youths find any signs, such as holes in the bark, that insects or birds live inside the tree?

6. Can the youths find any animals or signs of animals living at the base of the tree? At the top of the tree?

7. Have the members of your group examine lichens, fungi, algae, mosses, and insects with their hand lenses.

8. Have each youth complete the Live Tree Homes Activity Record.

9. Have the youths compare their findings from different trees.
IN TENTIONALLY BLANK PAGE
Part 3: Building Strong Bridges

Read the Book: Twenty-One Elephants and Still Standing, by April Jones Prince

Lesson 7: FILE CARD BRIDGES

Materials needed:

4 to 6 books (enough to make 2 stacks the same height)

A package of file cards

300 to 400 pennies (loose or in rolls)

Scissors

What do I do?

Make 2 stacks of books with a gap of about 4 inches between them. Make sure the stacks are the same height.

Lay one file card over the gap between the books. About 1/2 inch of the card should be resting on a book at each end. How many pennies do you think you can pile on this flat bridge before it falls into the gap - 5? 10? 100? Try it and see how close your guess was.

Without adding anything to the file card, try to make your bridge stronger. How could you change a file card to make it stiffer? What happens if you fold the card in half? If you make an arch? How about if you fold the card into pleats?

Make a bridge, then test it to see how many pennies it will hold. Some of your bridges may hold a few pennies before falling down. Others may be stronger, but the pennies may slide right off. And some bridges will probably hold a lot more pennies than you'd think.
How many pennies can my file-card bridge hold?
You may find that a file-card bridge can hold more pennies than you'd think! Here are the results of the file-card bridges that the Science-at-Home Team built.

A roll of 50 pennies weighs 132 grams—that's a little more than 41/2 ounces.

How many kinds of bridges are there?
You might think that bridges come in an infinite variety of forms. But if you get right down to the structural elements of a bridge, there are really only three kinds: beam spans, arch spans, and suspension spans.

The simplest kind of bridge is a beam bridge. A log that has fallen across a river makes a beam bridge. So does a board laid across a puddle, or a span of steel laid across a body of water, or a file card laid across two books. A beam bridge relies on the stiffness of the building material. If the log across the river sags, it doesn't make a very good bridge.

Arches have been common features in buildings since 1,000 B.C., but they didn't appear in bridges for another thousand years. Roman roads, built at the height of the Roman Empire's power, were often supported by stone arches.

Suspension bridges, like the Golden Gate Bridge in San Francisco, rely on a cable or rope for their support. Each end of the cable or rope must be anchored to the bank—tied to a tree, a boulder, or (in modern suspension bridges) a massive block of concrete called an anchorage. The cable or rope pulls on the anchors, but as long as they don't move and the cable or rope doesn't snap, the bridge is stable.

What kinds of bridges can I make with my file cards?
Using just your file card, you can make two of the three different kinds of bridges. When you lay a file card across two books—even if you've folded the card into pleats first—you've made a simple beam bridge. If you cut slots into the card, tuck the flaps under the edges of the book covers, and push the books slightly together, you'll make an arch bridge. We haven't figured out how to make a suspension bridge out of a file card, though. If you come up with a way to do it, please let us know!
Lesson 8: MAKING STRONGER BRIDGES

Youth explore why bridges are shaped differently. Students distinguish between beam, arch, and suspension bridges and learn how bridge designs counteract and redirect forces and motion.

**Materials needed:**
Books to serve as “Abutments”
5” X 8” index cards
Pennies to serve as weights. (at least 35 per group)
2 Double Dutch jump ropes (or other rope approximately 10 feet long)

**Beam Bridges**- Goes straight across from one side to the other. (picture a board across a stream)

Find out the least number of cards needed to support 5 pennies, 10 pennies, 20 pennies, and 35 pennies.

Did everyone get the same results? What was the relationship between the number of cards and the amount of weight it supported? Why would it be important to build a bridge with the least amount of materials possible?

How about a Truss Bridge? Similar to a beam bridge but with folded cards (like an accordion) between the straight cards to offer more support. How many pennies did it hold?

**Arch Bridges**- Find out the maximum number of pennies an arch bridge will hold with two and then three cards. Arch Bridges have “arched” cards underneath a straight card provided added support.

**Suspension Bridges**- Bridges that use support from posts at the end and a wire or chord spanning the length of the bridge.

Using two ropes, have two youth hold the two ropes about 5 feet apart facing each other (side by side) with the rope over their shoulders (the ends loose behind them) so that the ropes are parallel to each other. Then have other students sit in a row along the rope and gently pull down on the center of the rope. How hard was it to pull the rope loose?

Do again, but have additional youth holding the end of the ropes standing behind the youth with the rope over their shoulders so that they can give additional support. Have the kneeling youth pull down again on the rope in the center. How difficult was it to pull the rope loose? Was there any difference in the span of the “bridge”? How would this be helpful for a longer span (wider river).
TAKE HOME ACTIVITY

Car Ride Bridge Identification Game

As you drive to and from school, on vacation, around town, etc. Pay attention to the bridges you cross. What categories do they fit into? Beam Bridge, Arch Bridge, Deep Beam Bridge, Truss Bridge, or Suspension Bridge.

- Suspension Bridge
- Deep Beam Bridge
- Arch Bridge
- Truss Bridge
Part 4: Airplanes and Flight
Book: “Wee and the Wright Brothers”
by Timothy R. Gaffney

Lesson 9: AWESOME AIRFOILS
Main Idea
The airfoil shape allows the air above the curved surface to move faster than the air below. Fast moving air has a lower air pressure than slow moving air. The higher air pressure below the airfoil creates lift that overcomes gravity and allows objects to fly.

Motivator
The first U.S. coast-to-coast airplane flight was in 1911; it took 49 days!

Pre-Activity Questions
Before you start the activity, ask the students:
- Describe the shape of an airplane wing.
- Can you think of other things with a similar shape? (Examples: propellers, sails)
- Have you wondered why people say that airplanes “lift off”? (See vocabulary: lift)

Objectives
- Understand why an airfoil shape facilitates flight.

Learning Standards
(See Matrix)

Common SET Abilities
4-H projects address:
- Predict
- Hypothesize
- Evaluate
- State a Problem
- Research Problem
- Test
- Problem Solve
- Design Solutions
- Develop Solutions
- Measure
- Collect Data
- Draw/Design
- Build/Construct
- Use tools
- Observe
- Communicate
- Organize
- Infer
- Question
- Plan Investigation
- Summarize
- Invent
- Interpret
- Categorize
- Model/Graph
- Troubleshoot
- Redesign
- Optimize
- Collaborate
- Compare

Supplies
- Piece of paper (8 ½ in. square works well)
- Cellophane tape

Activity
1. Fold paper diagonally, leaving a 1 inch (2.5 cm) space along edges.
2. Fold bottom edge up about 1 inch (2.5 cm).
3. Bring outside points of base together, tucking one inside the other (bend, don’t fold) and secure with tape.
4. Grasp airfoil at the apex – the point farthest away from the folded base —and throw as if throwing a baseball, overhanded.
Science Checkup — Questions to ask to evaluate what was learned

- Compare the shape of this airfoil to the shape of an airplane wing.
- Which side of the airfoil was in the downward position? (The airfoil side with the apex is heavier and is kept in the downward direction by gravity, which stabilizes its flight.)
- Can you imagine why this shape is important? (See vocabulary: airfoil.)

Extensions

- Try throwing the airfoil underhanded as in a softball pitch.
- Try larger pieces of paper.
- Draw an airplane that has its wings curved upward and joined together.

Vocabulary

**Airfoil**: Streamlined structure that is flat on the bottom and curved on the top. The leading edge is longer than the trailing edge.

**Apex**: The peak or point of the airfoil.

**Lift**: Upward force that overcomes the effect of gravity.

Background Resources

Lesson 10: FROM NOSE TO TAIL

IDENTIFY THE FUNCTIONS OF THE BASIC PARTS OF AN AIRPLANE

**Project Skills:** Understanding parts of an airplane

**Life Skills:** Learning how to learn

WI Academic Standards: Science B.4. Nature of Science

**Time:**
25-30 minutes

**Supplies:**
- Label the Parts airplane poster
- Matching Game Poster
- 1 - 2" x 3" packet of sticky notes
- Masking tape
- Dry erase marker
- Eraser

**Getting Ready:**
- Write each airplane part listed on the Matching Game Poster onto individual sticky notes.
- Display the Label the Parts poster and the Matching Game Poster where youth can reach them.

---

**WHAT TO DO**

### Play the Matching Game

1. Pair up youth and ask pairs to look at the Matching Game Poster and find the functions that match each of the airplane parts.
2. Have each team pick one of the airplane parts and tell what description best fits its function.
3. If correct, have each team draw a line to connect that part with the function. If wrong, ask another group to match it to its description.
4. Continue until each part is matched to its function.

### Play the Label the Parts Game

1. Read one of the airplane parts listed on the Matching Game Poster to the group. Ask one of the teams to come up and point to the location of that part on the airplane poster.
2. If correct, ask the team to tell the group the purpose of that specific part. If they are not sure, refer them to the Matching Game Poster.
3. Ask the team to attach the sticky note next to the correct part on the airplane drawing.
4. Continue until all parts are identified.

---

**TALK IT OVER**

Try to get each youth to express his or her feelings and experiences.

**Reflect:**
- How did the Matching Game help you to learn?
- How did the Label Game help you to learn?

**Apply:**
- Which game helped you learn better? Why?
- What does this tell you about how you prefer to learn new things

---

Adapted from 4HCCS Aerospace project series Stage 2, Lift–Off (BU-6843), pages 32-33.
## Matching Game Poster

### Airplane Parts vs. Functions of Parts

<table>
<thead>
<tr>
<th>Airplane Parts</th>
<th>Functions of Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aileron</td>
<td>a. A small wing that produces lift and keeps the airplane from pitching up and down.</td>
</tr>
<tr>
<td>2. Cockpit</td>
<td>b. Part of the tail section that is connected to the horizontal stabilizer and allows the pilot to move the nose up or down (pitch).</td>
</tr>
<tr>
<td>3. Elevator</td>
<td>c. Part of a small wing that keeps the nose stable so it doesn’t yaw left or right.</td>
</tr>
<tr>
<td>4. Engine</td>
<td>d. Part of the tail section that is connected to the vertical stabilizer and allows the pilot to move the plane left or right (yaw).</td>
</tr>
<tr>
<td>5. Fuselage</td>
<td>e. Connected to the wing, this part allows the pilot to move the aircraft up or down by changing the lift produced by the wing.</td>
</tr>
<tr>
<td>6. Horizontal Stabilizer</td>
<td>f. Produces the power to make the airplane move.</td>
</tr>
<tr>
<td>7. Landing Gear</td>
<td>g. Spins very fast like an electric fan to produce thrust. This part is not on jet aircraft.</td>
</tr>
<tr>
<td>8. Propeller</td>
<td>h. The wheels on an airplane so it can land and taxi.</td>
</tr>
<tr>
<td>9. Rudder</td>
<td>i. The main structural part that connects all the other parts together. This is also where the passengers sit or cargo is stored.</td>
</tr>
<tr>
<td>10. Vertical Stabilizer</td>
<td>j. Where the pilot sits and flies the airplane.</td>
</tr>
</tbody>
</table>
Connected to the wing, this part allows the pilot to move the aircraft up or down by changing the lift produced by the wing.

Where the pilot sits and flies the airplane.

The main structural part that connects all the other parts together. This is also where the passengers sit or cargo is stored.

Part of the tail section that is connected to the horizontal stabilizer and allows the pilot to move the nose up or down (pitch).

A small wing that produces lift and keeps the airplane from pitching up and down.
Part of the tail section that is connected to the vertical stabilizer and allows the pilot to move the plane left or right (yaw).

Part of a small wing that keeps the nose stable so it doesn't yaw left or right.

The wheels on an airplane so it can land and taxi.

Spins very fast like an electric fan to produce thrust. This part is not on jet aircraft.

Produces the power to make the airplane move.
TAKE HOME ACTIVITY

BUILD AND TEST FLY PAPER AIRPLANES

WHAT TO DO

Experiment making paper airplanes
1. Pair youth up and ask each of them to make at least two different kinds of paper airplanes. Have youth print numbers on the airplanes so they can tell them apart.
2. Have youth test fly each of their planes and decide jointly which two planes fly the best.

Conduct a runway landing flight test
1. Have teams take turns trying to land their airplane on the runway.
2. Record 5 points on the Runway Record Sheet when an airplane lands on the runway.
Score 0 points if the plane does not land on the runway.
3. Record a plane’s result each time it is flown.
4. Make certain that everyone has the same number of flight tests.
5. Announce which plane(s) scored the most points. Congratulate your winning design team.

TALK IT OVER

Try to get each youth to express his or her feelings and experiences.

Reflect:
• How did your team change an airplane design to make it fly better?
• How did your team decide which two planes to use in the official Landing Flight Test?

Apply:
• When are other times that you have been a member of a team?
• Next time, what could you do to be a better team member?

Adapted from 4HCCS Aerospace project series Stage 2, Lift-Off (BU-6843), pages 12-13.
<table>
<thead>
<tr>
<th>TEAMS</th>
<th>ROUND #1</th>
<th>ROUND #2</th>
<th>ROUND #3</th>
<th>ROUND #4</th>
<th>ROUND #5</th>
<th>ROUND #6</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Names</td>
<td>Plane #</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Names</td>
<td>Plane #</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Names</td>
<td>Plane #</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Names</td>
<td>Plane #</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Simple Paper Airplane Template
(fold at dotted lines)

1. Crease paper in half
2. Fold corners down
3. Should look like this
4. Fold plane in half at center crease
5. Should look like this
6. Fold wings down
7. Should look like this
Dart Paper Airplane Template
(fold at dotted lines)

1. Crease paper in half
2. Fold corners down
3. Should looks like this
4. Fold sides into center crease
5. Should looks like this
6. Fold plane in half at center crease
7. Fold wings down
8. Should looks like this