AERONAUTICS & AEROSPACE
ACTIVITY BUNDLE

For Grades 6-8

Four hands-on STEM activities that introduce grade 6-8 learners to Aeronautics & Aerospace careers through investigation, experimentation, and play.

STEM NEXT
OPPORTUNITY FUND

STEM Next Aeronautics & Aerospace Activity Bundle (Grades 6-8)

Welcome to the STEM Next Aeronautics & Aerospace Activity Bundle! This bundle is one of three bundles now available from the Earth & Space Learning Center of Excellence, powered by the Institute for a STEM Ready America.

Use the four activities below to inspire youth grades 6-8 with hands-on science. Through these activities, youth will develop foundational STEM skills by engaging in hands-on investigations of aeronautics and aerospace concepts, while building career awareness by exploring how professionals use science, technology, engineering, and math.

Interested in more resources like this from STEM Next? Check out our Tools in our online Resource Library.

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Lesson 1: Twisters

In this lesson, youth will be able to:

- Use a model to understand tornadoes.
- Explain the conditions that promote tornado formation.
- Collect, analyze, and use data from repeated trials to identify patterns and form conclusions.

Time needed: 60 minutes

Preparation

Materials	• Tornado Video:
	  ○ What is a Tornado? SciShow Kids
	  ○ What Causes a Tornado? | COLOSSAL QUESTIONS
	  ○ What is a Tornado? LearnBrite
	• 8 oz. jar with lid (1 per group of youth is best, but you may also choose to do this as a demonstration if limited materials)
	• Water
	• 1 tsp clear dish soap (1 per group of youth)
	• Glitter (to sprinkle in jar)

Setup	• Gather all materials

Facilitation

Overview:

In this activity, youth will explore how tornadoes form by creating a swirling vortex inside a jar. Through hands-on experimentation, participants observe the characteristics of a tornado and investigate how changing variables, such as the amount of water or container size, affect the vortex.

Engage:

1. Show youth a video explaining tornado formation. You may choose one of the selected videos above or share your own.
2. Discuss what youth observed about the video and any experiences they may have with tornadoes.

Investigate:

1. Divide the group into pairs. Distribute materials to each group. Tell youth that they will be making their own tornado in a jar. Lead the group in the following directions.
    - Fill your container about ¾ full with clean water.
    - Add a squirt of dish soap, as well as glitter or food coloring, if desired
    - Seal the container tightly.
2. Ask youth: *What do you think we need to do to the jar in order to form a tornado vortex?* Allow for several suggestions. If no suggestion of swirling is given, tell youth: *Move the bottle rapidly in a circular motion. After a few seconds, you should see the water begin swirling. Stop, and watch your tornado!*
3. If time allows, try experimenting with more or less water to see how the shape and speed of the tornado changes. Try using different size bottles to see if the tornado changes.

Wrap-up:

Play Tornado Trivia to reinforce tornado formation basics and tornado safety.

Implementation

Extension:

- Build a Storm Chasing Vehicle- Have youth use the engineering design process to build a vehicle that can withstand the winds of a tornado. Use common materials (cardboard, tape, foam, bubble wrap, popsicle sticks, etc) to design and build a vehicle. The vehicle must remain upright while sitting in front of a fan.

Career Connection:

- Meteorologist
    - Share the Career Profile
    - Have youth predict the weather based on weather maps. Document with Answers
    - Invite a local meteorologist to come visit the program.

Lesson 2: Soft Landing

In this lesson, youth will be able to:

- Use the Engineering Design Process to complete a design challenge.
- Understand the difference and importance of constraints and criteria.
- Communicate and collaborate with peers to reach a goal.

Time needed: 60 minutes

Preparation

Materials	• Small plastic or paper cup (1 per group) • Paper plate (1 per group) • Jumbo Marshmallows (2 per group) • Miniature Marshmallows (2 per group) • A variety of materials to be used to build lander, suggestions include: Cotton balls,index cards, plastic straws, tape, scissors, construction paper, rubber bands, craft sticks, pipe cleaners, string, plastic Grocery bags
Setup	• Attach a plastic or paper cup to the plastic plate using tape (as shown below). Make one “lander” for each group of 2-3. Place 2 “astronauts” (marshmallows, big or small depending on cup size) into each lander. • Gather all materials and place in a Materials Hub. • Set-up a testing station with a measuring tape so teams can measure their drop height.
Presentation	Slides

Facilitation

Overview:

This engineering design challenge introduces youth to the problem-solving practices used by real aerospace engineers as they design and test a model Moon lander for the Artemis IV mission. Working in collaborative teams, students use the Engineering Design Process to plan, build, test, and improve a lander that protects marshmallow “astronauts” while meeting specific criteria and constraints. Through hands-on testing and

iteration, youth evaluate material properties, communicate ideas, and make evidence-based design decisions to improve their solutions.

Engage:

Show the video (Slide 2), Artemis II Launches Astronauts to the Moon. Ask youth: *What was exciting in that video? Do you know what the next steps are for Artemis? Would you go to the Moon?*

Investigate:

1. Share the story and challenge. Two astronauts are going to land on the far side of the Moon. You need to be part of the design team to create a lander that will not disturb the soft, powdery surface of the Moon and keep the astronauts in an upright and safe position.
2. Show the lander (cup attached to the plate) to the group. Place 2 marshmallows (large or small depending on the size of the cup) into the cup to represent the astronauts. Demonstrate dropping the lander from 3 feet (waist high). Ask the group: *What kinds of problems do you see with this basic lander? What kinds of things do you need to consider to make the lander safer for the astronauts?*
3. Review the steps of the Engineering Design Process. Explain that the criteria are things that must be included or that their tower must do. Reveal the criteria. Next, reveal the constraints. Explain that these are the limits or things that can not be included or done to the tower.
    - Criteria:
        - All building must take place under the landers platform.
        - Astronauts must remain inside the lander at all times, even after landing.
        - Want to land softly from at least 3 feet above the surface. A height above 3 feet is preferred.
    - Constraints:
        - No covering the cup or platform with any material.
        - Do not change the cup, platform or astronauts
        - Use only the materials provided.
4. Show the materials at the Materials Hub and answer any questions. Allow 5 minutes for youth to individually draw their idea for the lander.

5. Place youth into groups of 2-3. Have the groups share their individual ideas with each other and decide upon a design for their group lander. This should take 5-10 minutes. Have each group draw a diagram of their lander and list all the materials they will use for the lander.

6. Allow time to build the model. To limit congestion around the Materials Hub have only one person from each group gather their materials. During the build time, groups should also test and iterate their design.

Wrap-up:

Complete a final test of the lander in front of the entire group. Each team will explain their design, receive 2 new marshmallows and demonstrate how their lander works. Each team will have two trials to be successful. After going through all the teams ask: *What design options worked best? What would you change about your design?* If time allows, have teams make modifications to their designs. Have the teams retest to demonstrate the improvements.

Implementation

Extension

Have each group measure the distance that their rocket traveled. Compile the total distance that all the rockets in the group traveled. Calculate the average distance that the rockets in the group traveled.

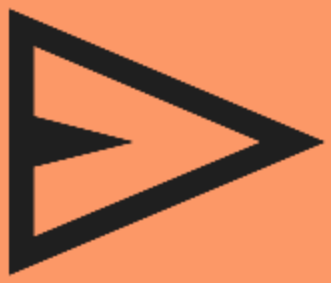
Career Connection:

- Aerospace Engineer
    - Share Career Profile
    - PBS Learning Media-Challenge of Flight: Helps youth discover the science and engineering principles behind flight by exploring how aerospace engineers tackle real-world challenges in designing and testing aircrafts
- Satellite Technologist
    - Share Career Profile

Lesson 3: Flight Plan

In this lesson, youth will be able to:

- Define the four forces that affect flight
- Explain how airplane design is related to the purpose
- Collect observations from tests and use evidence to make design improvements.



Time needed: 60 minutes

Preparation

Materials	• Paper (any type) • Tape • Scissors • Paper Plane Templates from Science Buddies • Box, Hula Hoop, Painters tape or similar objects to use as target
Setup	• Gather materials • Copy Paper Plane Template • Set-up target for Accuracy Challenge
Presentation	Slides

Facilitation

Overview:

In this challenge, youth explore how drones are used in real-world search and rescue missions by planning and carrying out systematic grid searches. Working in pairs, participants use maps, coordinates, and communication skills to navigate a drone through a search area while overcoming obstacles and conserving battery life.

Engage:

- Have each student make a paper airplane of their own design. Allow youth to fly their airplane for a few minutes. Ask the group, *What are the four*

principles of flight? Explain each principle below while demonstrating with a paper airplane that either you made or one that the youth made (Slide 2).

- *Thrust is the forward force that propels the airplane through the air. Thrust is created by your hand when you throw the paper airplane. In a real airplane, thrust is created with a propeller and an engine.*
- *Drag is the force that slows an airplane down. As an airplane moves through the air, it encounters resistance from the air, which creates drag. Drag acts opposite to thrust.*
- *Lift is the force that pushes the paper airplane up. When you throw a paper airplane, air flows over and under its wings. On a real airplane, the wings are usually designed with a slight curve or angle, which helps create lift. The air moves faster over the top of the wing and slower underneath, creating a difference in pressure that pushes the airplane upward.*
- *Weight (gravity) pulls the paper airplane down toward the Earth. Weight acts opposite to lift.*

Investigate:

1. Show that there are many different designs of airplanes (Slide 3). Ask youth: *Do you think all planes are the same? What do you think is the use of each plane?*
2. Share the challenge: *You will have to design a plane or planes to meet the different challenges* (Slide 4):
    - Distance Challenge – see who can fly the farthest
    - Accuracy Challenge – aim for a target and see who can land closest to the target
    - Longest Flight Challenge – time who can stay in the air the longest
    - Loop-The-Loop Challenge – which plane can do the most flips.
3. Divide the group into teams of 2-3. Provide each group with multiple pieces of paper, scissors, and tape. Allow 20-25 minutes for groups to build their planes and test. Provide a few templates for those groups that might be struggling.
4. As groups are working, encourage them to redesign as needed. Walk from group to group and ask some guiding questions to help youth problem solve: *What do you notice about how your airplane flies? Does it glide*

smoothly, dive, climb, or turn? What part of your airplane do you think has the biggest effect on how it flies? Why? How could you change your airplane to make it fly farther or stay in the air longer?How do you think the size or shape of the wings affects lift? If your airplane keeps turning to one side, what might be causing that? How could you fix it? What patterns do you notice between different airplane designs and how they perform?

Wrap-up:

Bring the group back together as a whole and have a final test for each of the challenges. After each challenge, examine the winning plane and discuss the characteristics that made it effective for the challenge. Intentionally refer back to the four basics of flight and how they are involved in the plane design.

Implementation

Extension:

- Add math
    - Have groups measure the distance that their plane traveled. Compile the total distance that all the planes in the group traveled. Calculate the average distance that the planes in the group traveled.
    - Count how many planes hit the target versus how many did not and calculate the percentage of target hits.
    - Have groups time the length of their plane's flight. Compile the total time in the air for the whole group. Calculate the average flight time for the whole group.

Career Connection:

- Airplane Pilot
    - Share Career Profile
- Drone Pilot
    - Share Career Profile
    - Surprisingly STEM: Wildfire Aeronautics Researcher
    - Play Rescue Mission: Have youth simulate a rescue mission using the practices of a drone pilot.

Lesson 4: Ready for Takeoff! Aviation Career Game

In this lesson, youth will be able to:

- Identify a variety of aviation careers and describe how they contribute to the design, operation, maintenance, and support of aircraft.
- Compare careers based on required skills, education, training, and working conditions.

Time needed: 20 minutes

Preparation

Materials	• Set of Aviation Career Cards (1 set per youth group)
Setup	• Copy and cut apart career cards. ○ It is suggested to print career cards on heavy cardstock to make the game easier to play.

Facilitation

Overview:

In this review activity, youth discover the wide variety of careers that support the aviation industry through brainstorming and a collaborative matching card game. As they play, participants identify the skills, education, and working conditions associated with different aviation careers while expanding their understanding of the many ways people contribute to air travel and aerospace.

Engage:

1. Have the group brainstorm all the reasons people use aircraft. Write these ideas on a whiteboard or piece of chart paper. Prompt students with some suggestions if they are having difficulty. Responses can include:
    - Moving people
    - Moving things

- Helping people (e.g., search and rescue)
- Fighting fires
- Getting people to the hospital

2. Have the group brainstorm careers/jobs of people that work with and on aircraft. Write these ideas on a whiteboard or piece of chart paper. If students find this task challenging, you could provide some category prompts such as people who:
    - Design aircraft
    - Build aircraft
    - Fly aircraft
    - Fix aircraft
    - Help passengers on aircraft
    - Help direct aircraft to their destinations

Investigate

1. Divide the group into teams of 3. Give each team a deck of Aviation Career Cards.
2. Explain that they will play a card game similar to Old Maid. The goal is to create as many pairs as possible and be the first one with no cards left.
    - Explain that they will play a card game similar to Old Maid. The goal is to create as many pairs as possible and be the first one with no cards left.
    - Choose one dealer. Have the dealer shuffle the cards. The dealer will distribute all the cards face down to all the players.
    - Players will look at their cards. The player to the left of the dealer will start. They will try to make a pair from the cards in their hand. Players make sets by matching the words in the Skills, Working Conditions, or Education and Training sections of the cards.
    - If the player does not have a pair in their hand, they ask any player for a specific type of card (e.g., “Do you have a person who works outside? Do you have a person who needs on-the-job training?”). If that specific player has a card matching the description, they must give the card to the player that asked. If the asked player does not have the card, they simply say no.

- Play then continues moving to the left. Players will continue to take turns until one player has gone out or there are no more pairs to be made.
- Have youth play several rounds.

Wrap-up:

After the group has played several rounds, bring all back together. Ask: *What new careers can we add to the list we started earlier?* Add any additions to the list on the chart paper or whiteboard. Ask: *Which career sounded the most interesting? Do you think you would like any of these careers? Why?*

Implementation

Alternative Facilitation

Career Guess Who: Give each pair of students a set of Aviation Career Cards. Lie all cards face up on the table. One student chooses a career card without revealing it to their partner. With all the cards still lying face up on the table, the other asks yes/no questions (e.g., "Do they work outdoors?" "Do they need a university degree?") until they guess the career. Switch roles. *To keep the game moving, it is recommended to limit the number of questions asked before the career is revealed. For example, limit it to 10 or 20 questions.*