STEM Careers Coalition

CLASSROOM ACTIVITY

Powering Our Skies

OBJECTIVES

Students will:

- Investigate and evaluate one innovative energy source for aviation.
- Compare and contrast their choice of energy source with other possibilities.
- Develop a recommendation that selects and justifies which energy source could best power future aircraft sustainably.
- Integrate learnings from their peers to optimize 0their own recommendation.

OVERARCHING QUESTION

How can we sustainably power our planes in the future?

ACTIVITY SUMMARY

Students will become energy engineers as they explore sustainable and innovative energy sources for the future of aviation. They will compare and contrast various energy sources as they consider the advantages and disadvantages each may present for aircraft. They will ultimately collaborate to develop a recommendation for a sustainable aviation power source.

MATERIALS

- Device with the ability to project, one for the instructor
- Devices with Internet access, at least enough for half the class
- *Designing Solutions Handout*, one per student

CHALLENGE

1. Display the Simplified Aircraft Motion image from NASA. Challenge the class to work with a partner and brainstorm conditions or systems that may generate each aircraft force. Kick off the brainstorm with the term *thrust*. Explain that thrust, (as indicated by the arrow), which moves the plane forward through the air, is generated by the airplane's engine.
2. After giving students a few minutes to discuss where drag, weight, and lift may come from, review:
    - Drag, which acts opposite thrust, is a result of air resistance or friction.
    - Weight is caused by gravity.
    - Lift is an aerodynamic force produced by an airplane's wings as it goes through the air.
3. Tell the class that in order for an airplane to balance weight with lift, drag with thrust, and fly at a constant speed, the airplane needs power (or energy). Explain that students are about to become

energy engineers as they investigate the best source of energy for today's airplanes. Elaborate by explaining that energy engineers focus on the production of energy from all different sources. While engineers' responsibilities vary, they often work to find new energy sources or to optimize existing ones.

4. Distribute one *Designing Solutions Handout* to each student, and elaborate on the challenge by reading aloud the bullets listed under *Step 1: Define the Challenge*.
5. Explain that students will work in teams of five energy engineers and that each team will perform research to better understand one type of energy. Then divide students into their energy teams and give groups a minute to decide who will be in charge of researching each type of energy listed in Step 1.
6. After answering any questions, prepare student groups to perform research to better understand the challenge:
    - Write the following website on the board: energy.gov/science-innovation/energy-sources. Ask all students to use this website to begin their research before they move on to other sources.
    - Explain that in order for each group to eventually provide a recommendation on the best sustainable power source for future aircraft, each student will first be responsible for gaining a general understanding of their energy source so they can decide whether it could be used to sustainably power an aircraft. They will then share what they have learned with their groups in order to develop a sustainable power recommendation for the future.
    - Explain that students will have about 20 minutes to complete their research and prepare to share what they learned with their group members.

DESIGN

1. Bring the class back together and explain that it's time to develop a solution to the challenge. Call on a student to read the handout's *Step 2: Create a Design* section aloud.
2. Explain that as group members share what they learned about their energy sources with each other, they will continue to look at the challenge through the eyes of an energy engineer. As such, they will compare and contrast the energy sources they researched in order to select one that their group believes could work best to sustainably power an aircraft.
3. Tell the class that they will have about 20 minutes to complete the *Design* portion of their handout. Quickly recap and encourage students to:
    - Approach the challenge from the perspective of an energy engineer with a special focus on sustainable energy.
    - Compare and contrast the advantages and disadvantages of each energy source in order to develop a recommendation on which source should be explored further.
    - Use a separate piece of paper to outline a recommendation that answers the questions provided on the handout.
    - Be ready to explain the reasoning behind their recommendation with another group.

SOLVE

1. When there are about 10 minutes left in the class period, pair student groups together. If possible, try to match groups who selected *different* power sources for their final recommendation.
2. Instruct each group to briefly share the potential advantages and disadvantages of their chosen energy source, as well as why they believe this would be the best option in terms of sustainability.
3. As groups share with each other, challenge them to compare and contrast their recommendations and consider how they could use what they learn from their peers' proposal to strengthen their own.
4. Go on to explain that once both groups have shared, groups should complete the *Step 3: Analyze Solutions* portion of the handout in order to strengthen their recommendation. If time permits, they may edit their recommendation to include these edits.

STANDARDS

Next Generation Science Standards

- Engineering Design:
    - ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- Earth and Human Activity:
    - HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
    - Disciplinary Core Idea: ETS1.B: Developing Possible Solutions
        - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

ITEEA Standards for Technological Literacy

- Standard 2: Students will gain an understanding of the core concepts of technology. In order to recognize the core concepts of technology, students in Grades 9–12 should learn that:
    - Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.
- Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies. In order to select, use, and understand energy and power technologies, students should learn that:
    - K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.
    - M. Energy sources can be renewable or nonrenewable.

DESIGNING SOLUTIONS

Step 1: Define the CHALLENGE

Your group's challenge is to:

1. Research traditional and innovative power sources, including:
    - **a.** Jet fuel
    - **b.** Biofuels
    - **c.** Solar power
    - **d.** Nuclear power
    - **e.** Battery power/Electric
2. Consider if or how each one could be used to sustainably power an aircraft, and compare and contrast their pros and cons.
3. Develop a recommendation for sustainable aviation in the future, as well as key considerations and/or next steps for the aviation industry.

As you research your power source and consider whether it could be used to sustainably power an aircraft, jot your notes below:

Step 2: Create a DESIGN

Overview: Share what you have learned about your power source with your group, and then develop a recommendation that explains which power source you believe could best sustainably power aviation in the future.

Requirements: Your recommendation must include:

1. **Advantages:** Why is this power source better than other possibilities? Be sure to consider its potential impact on the environment.
2. **Disadvantages:** What disadvantages or risks would aviation manufacturers need to keep in mind if they used this power source?
3. **Future considerations:** What additional research, changes, or next steps may aviation manufacturers or airline companies need to take in order to successfully transition to this power source?

Jot notes below and then complete your recommendation in a format of your choice on a separate piece of paper.

Step 3: Analyze SOLUTIONS

Once you have compared and contrasted your recommendations with another group, consider how the information they shared could be used to strengthen your own recommendation. Ideas include: Could any of their benefits also apply to your energy source? Or, could you use what you learned to develop a counterargument in favor of your energy selection?