

# Muse®

## Future Flight!

We are collectively at a point in time where we are studying history in our quest to achieve futuristic goals. This issue of *MUSE* explores the inspirations and applications for greener, more advanced aviation. Prepare for takeoff!

### CONVERSATION QUESTION

What is the future of flight?

### TEACHING OBJECTIVES

- Students will learn about the efforts being made to make flying more sustainable.
- Students will learn how aircraft of the future may get inspiration from dinosaurs.
- Students will learn about the science of quantum teleportation.
- Students will examine cause-and-effect relationships.
- Students will construct explanations.
- Students will collect evidence to support a claim.
- Students will write a pledge to reduce their carbon footprint.
- Students will research examples of biomimicry.
- Students will convert measurements using a mathematical process.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and cross-curricular activities.

### SELECTIONS

- **Taking Off Toward a Greener Future**  
Expository Nonfiction
- **Ptero-Soar**  
Expository Nonfiction
- **The Trouble with Transporters**  
Expository Nonfiction

## Taking Off Toward a Greener Future

pp. 10–13, Expository Nonfiction

Although air travel is the quickest way to cross long distances, it releases an enormous level of harmful emissions into the air. This article explores the solutions that scientists are currently researching to create a greener future for aviation.



### RESOURCES

- Cause and Effect: Travel Trouble

### OBJECTIVES

- Students will learn about the efforts being made to make flying more sustainable.
- Students will examine cause-and-effect relationships.
- Students will write a pledge to reduce their carbon footprint.

### KEY VOCABULARY

- **emissions** (p. 11) substances released into the air
- **biofuels** (p. 12) fuels made from plant or algae material or from animal waste
- **streamlined** (p. 13) having a smooth shape that makes motion through air or water easier

### ENGAGE

**Conversation Question:** What is the future of flight?

Discuss ways that students can reduce their carbon footprint. A few simple ideas are walking or biking (if safe) instead of being driven, unplugging chargers when not in use, using scrap paper for drawing and writing, and cutting down on shower time. Work with students to generate a master list that will be used to complete the EXTEND activity.

### INTRODUCE VOCABULARY

Post the key terms and discuss the definitions. Instruct students that they will be creating a word search puzzle using those three words in addition to another 17 theme-related words. Suggest that students highlight topical words as they read for use in the word search and distribute the grid paper. Share the puzzles with another class for use as a pre-reading exercise for this vocabulary-rich article.

### READ & DISCUSS

Read the article aloud with the class. Have students reread the article in small groups to answer the questions below. Share responses.

1. How does air travel worsen global warming?
2. Why was the hydrogen-powered plane's ten-mile loop important?
3. What are the obstacles to developing sustainable planes?
4. Why do some scientists question whether biofuels are truly better for the environment?
5. How are airports working to achieve a net zero footprint by 2030?

### SKILL FOCUS: Cause and Effect

**INSTRUCT:** Review cause-and-effect relationships: A cause makes something happen. An effect is what happens as a result of the cause. Lead students in a discussion that guides them to recognize the cause-and-effect relationships presented in this article. Introduce the *Cause and Effect: Travel Trouble* graphic organizer. Tell students they will record causes and effects related to different elements of air travel.

**ASSESS:** Review the worksheet. For additional practice with cause-and-effect relationships, challenge students to express cause-and-effect relationships that pertain to other forms of mass transit.

### EXTEND

**Language Arts:** Ask students what a pledge is. Define *pledge* as “a serious promise or agreement.” Have students choose one of the ideas from the list they generated in the ENGAGE activity and write a pledge to use it to reduce their carbon footprint. The pledge should identify the activity, state the promise, and have a signature. Suggest students have someone at home make the pledge with them. Ask student to keep the pledge for 30 days and then evaluate. Has the pledge become a habit they can continue? Why/why not?

## Travel Trouble

**Cause and Effect** Consult the article to explain the cause and effect of the events listed below.

Cause	Event	Effect
	Higher temperatures are creating changes around the world.	
	Today, there are more planes in the sky per day than ever before.	
	Currently, there are not enough biofuels to go around.	
	Hydrogen is expensive and takes up a lot of space.	

## Ptero-Soar

pp. 18–21, Expository Nonfiction

In this article, researchers travel back to the time of the dinosaurs in order to propel air travel into the future. Readers will learn how humanity learns from nature and from the past.



## RESOURCES

- Construct Explanations: Dino Details

## OBJECTIVES

- Students will learn how aircraft of the future may get inspiration from the dinosaurs.
- Students will construct explanations.
- Students will research examples of biomimicry.

## KEY VOCABULARY

- **rudder** (p. 21) a flat piece of wood or metal attached to a ship, boat, or airplane and used to steer
- **biomimicry** (p. 21) when people use ideas from nature to solve problems
- **aeronautical** (p. 21) relating to the design and construction of aircraft

## ENGAGE

**Conversation Question:** What is the future of flight?

Introduce “Ptero-Soar” and point out that aviation scientists are finding inspiration in dinosaur anatomy. Explain that imprints are one type of fossil evidence that scientists often find. Imprints can include bones, footprints, and leaf patterns preserved in mud that later hardened. Give each student a small lump of clay and have them flatten it out. Then have students work in groups. Give each group a tray of small objects that they can press into the clay to create imprints. Have groups switch tables and identify the imprints. Discuss factors that cause imperfect imprints.

## INTRODUCE VOCABULARY

Post and discuss the key vocabulary words. Provide groups of students with a letter/value sheet, which you can find online. Have students list the point value for each vocabulary word and total the sum. Then instruct them to put the three words in order from lowest value to highest value. During a quiet period, allow students to revisit the issue to locate and define the word that has the highest point value.

## READ & DISCUSS

Pose the following questions to prompt meaningful discussion. Students should use complete sentences and details to answer each question.

1. How are pterosaurs helping humans soar to new heights?
2. Explain the appearance of the pterosaurs.
3. Why are most recovered pterosaur fossils crushed flat?
4. What ideas do scientists have about how the large *Quetzalcoatlus* was able to get off the ground and fly?
5. Why have people previously ignored flyers from the dinosaur era when studying flight?

## SKILL FOCUS: Construct Explanations

**INSTRUCT:** Have students review the article and study the aviation future inspired by pterosaurs. Distribute the *Construct Explanations: Dino Details* graphic organizer. Tell students they will use information from the article to complete the chart. Also tell students to clearly explain how each body part is influencing the future of aviation.

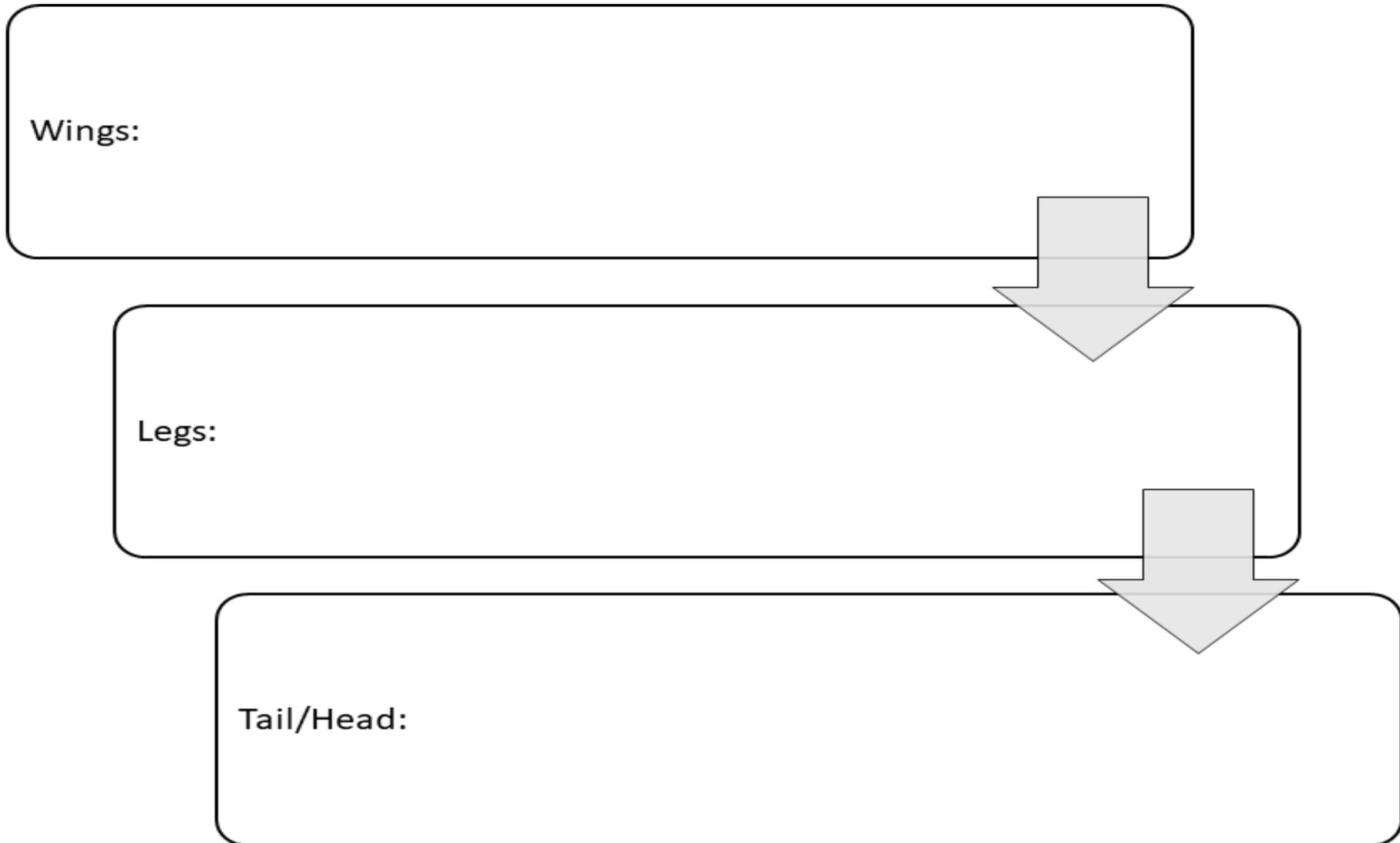
**ASSESS:** Collect the worksheet and assess for thorough explanations.

## EXTEND

**STEM:** Review the definition of *biomimicry* from the Key Vocabulary list. Discuss a few examples: the mosquito proboscis inspired a less painful hypodermic needle, sticky gecko feet inspired a non-toxic adhesive, plant seeds called burrs inspired the invention of Velcro. Have students research an example of a scientific invention inspired by nature and present it to the class. Presentations should explain the invention and its inspiration. They should include graphics and details about *where*, *when*, and by *whom* the invention was developed.

## Dino Details

**Construct Explanations** Use information from the article to explain how each pterosaur body part is inspiring the future of aviation.



## The Trouble with Transporters

pp. 36–39, Expository Nonfiction

From Captain Kirk to qubits, the many possibilities of teleportation are analyzed in this high-interest science article.



### RESOURCES

- Collect Evidence: Beam Me Up

### OBJECTIVES

- Students will learn about the science of quantum teleportation.
- Students will collect evidence to support a claim.
- Students will convert measurements using a mathematical process.

### KEY VOCABULARY

- **dematerialized (p. 37)** ceased to have material existence; disappeared, especially in a sudden or magical way
- **quantum entanglement (p. 39)** when two particles link together in a certain way, no matter how far apart they are in space

### ENGAGE

**Conversation Question:** What is the future of flight?

Play a short clip from the Star Trek TV series showing a scene with teleportation (“Beam me up!”). You might also show the “Wonka Vision” clip from the movie “Charlie and the Chocolate Factory.” Both are available on the internet. Discuss these futuristic science fiction scenes and invite students to share other movies or books that portray this transportation technology. Pose this question: *Will advancements in science be able to make these fantastical ideas a reality?*

### INTRODUCE VOCABULARY

Post and read aloud the vocabulary words. Tell students that many longer words are a combination of root words, prefixes, and suffixes. Have students identify the root words in the words **dematerialized** (*material*) and **entanglement** (*tangle*). Instruct them to provide a simple definition for the two root words. Then have them point out the prefixes and suffixes. Discuss how the prefixes and suffixes alter the meanings of the root words.

### READ & DISCUSS

Reinforce comprehension of the concepts presented in the article by using the following questions to direct discussion.

1. Why did the Star Trek TV series originally introduce the transporter?
2. What two things would you need to be able to do to create the same person after teleporting?
3. Explain the one type of transporting that has become real—quantum teleportation.
4. How does teleportation rely on entangled space?
5. Why is studying quantum teleportation incredibly useful to scientists?

### SKILL FOCUS: Collect Evidence

**INSTRUCT:** This article presents readers with information about quantum physics and teleportation. Present the *Collect Evidence: Beam Me Up* graphic organizer. Tell students to review the article and highlight sentences that provide evidence to support each of the claims stated. After they have collected evidence addressing all of the claims, they will record the information on the organizer. Remind students to cite information and details using page numbers.

**ASSESS:** Have students peer-review their work. Circulate and guide as needed.

### EXTEND

**Mathematics:** Reread this sentence from page 38: “In this experiment, scientists succeeded in teleporting the state of a photon 15 miles using crystals.” Remind the class that 1 mile = 5,280 feet. Instruct students to use the R-D-W (Read-Draw-Write) process to convert 15 miles into feet. (**Answer:** 79,200 feet) Ask: *Why does it make more sense to use the larger (miles) measurement in this case?*

## Beam Me Up

**Collect Evidence** Gather evidence from the article to support each claim listed below. Include text details and cite your evidence by using page numbers.

**Claim:** Quantum teleportation uses key concepts of quantum physics.

Supporting evidence (P. \_\_\_\_\_)

**Claim:** Quantum teleportation relies on entangled space.

Supporting evidence (P. \_\_\_\_\_)

**Claim:** Teleportation advances our understanding of quantum physics.

Supporting evidence (P. \_\_\_\_\_)