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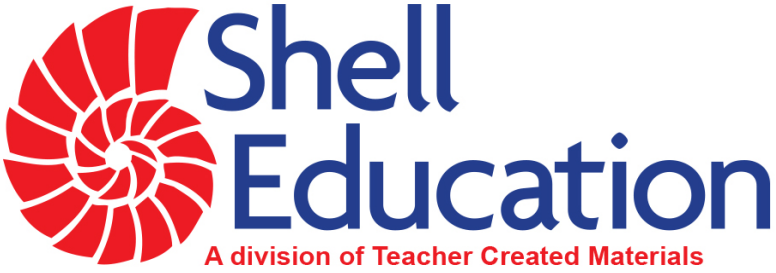

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180 Days of PRACTICE

GRADE 3

HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

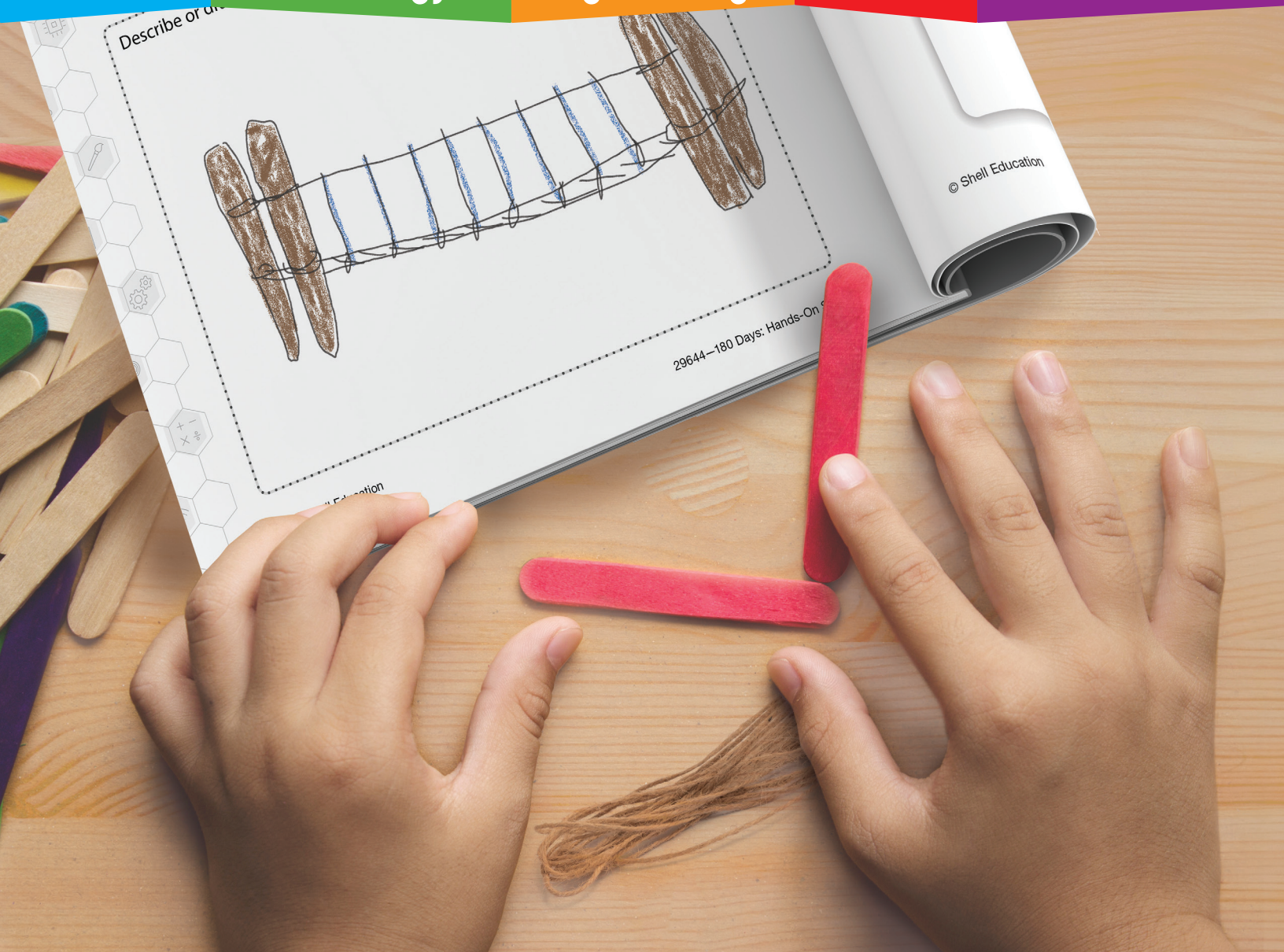


Table of Contents

Balanced and Unbalanced Forces Teaching Support

Overview of Unit Activities

Students will learn about and explore forces through the following activities:

- reading about balanced and unbalanced forces
- reading about and studying pictures showing different forces
- experimenting with air resistance
- drawing scenes showing forces that become unbalanced
- analyzing a diagram of forces acting on paper airplanes
- creating paper airplanes

Materials Per Group

Week 1

- basic school supplies
- chair or stepladder
- stopwatch

STEAM Challenge

- basic school supplies
- calculator
- construction paper (1–2 sheets)
- paper clips (2–3)
- tape measure
- tissue paper (1–2 sheets)

Setup and Instructional Tips

- **STEAM Challenge:** The challenge can be done individually or in groups. Smaller groups are recommended. If students are working with others, have students sketch their own designs first. Then, have them share designs in groups and choose one together.
- **Testing Days:** Model for students how to launch airplanes. Hold them from the bottom at shoulder height. Move your arm forward and release it.

Discussion Questions

- What is a force?
- What types of forces do we encounter every day?
- How could the words *balanced* and *unbalanced* be related to forces?
- How can heavy things fly in the sky?

Additional Notes

- **Possible Misconception:** Objects at rest are not affected by forces.
  Truth: Objects at rest have balanced forces.
- **Possible Design Solutions:** Students may design paper airplanes with pointy tips or wide wings. In Week 3, students may add small weights or paper clips to help increase flight distance.

Scaffolding and Extension Suggestions

- Support student with making paper airplanes by helping them find and follow directions for dart-style paper airplanes.
- Challenge students to learn about the centers of gravity for their paper airplanes and how they can adjust them to increase their planes' airtime.
- Encourage students to add designs to their paper airplanes to represent their own airlines or racing teams.

Answer Key

Week 1 Day 1

1. C
2. B
3. B

Week 1 Day 2

1. When the game begins, Teams A and B will each pull on the rope and try to pull the other team into the mud puddle.
2. Team A will win. It has more people, so the force they use to pull the rope their direction will have more strength.

Week 1 Day 5

1. The plane will crash to the ground.
2. The plane will glide.

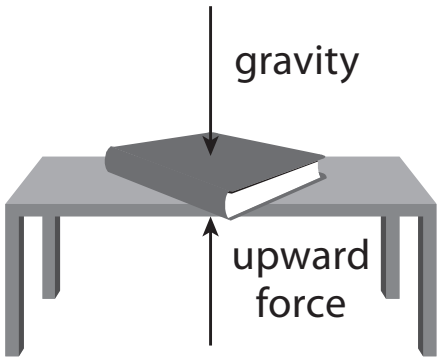
Weeks 2 & 3

See STEAM Challenge Rubric on page 221.

Name: _____ **Date:** _____

Directions: Read the text, and study the diagram. Then, answer the questions.

A force is a push or a pull. Forces act on objects and cause them to be in motion or stay at rest. Imagine a book sitting on a table. The table and gravity are both forces acting on the book. Gravity is pulling the book down; the table is pushing the book up. But the forces are balanced, so the book does not move. If a person pushes on the book, another force has been introduced. The forces are now unbalanced, and the book moves across the table.



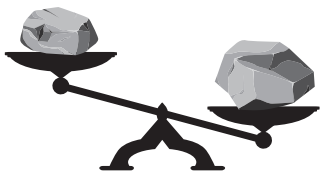
1. What is a force?

- (A) balance or unbalance
- (B) in motion or at rest
- (C) a push or a pull
- (D) action or inaction

2. What happens to an object with balanced forces?

- (A) Gravity pulls it down.
- (B) The object will stay at rest.
- (C) The force will change direction.
- (D) The object will move.

3. Are these forces balanced or unbalanced?

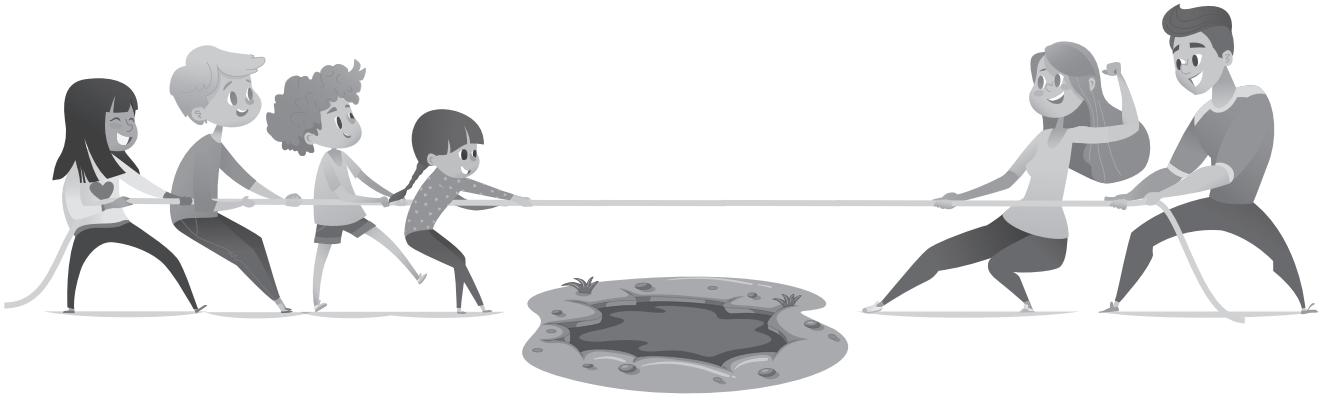


- (A) balanced
- (B) unbalanced

Name: _____ Date: _____

Directions: Read the text, and study the picture. Then, answer the questions.

Forces have both strength and direction. Imagine a soccer ball in the grass. The forces of the ground and gravity are balanced, and the ball is motionless. If someone kicks the ball, a new force is introduced, and the forces become unbalanced. Now the ball rolls across the grass. How far will it go? Where will it go? That depends on the strength and direction of the kick.



Team A **Team B**

1. What will happen when the tug-of-war game begins?

_____

_____

2. Who do you think will win the competition? Explain your answer using the words *force*, *strength*, and *direction*.

_____

_____

_____

Name: _____ Date: _____

Directions: Follow the steps to experiment with air resistance. Then, answer the questions.

Steps

1. Get two sheets of paper, a stopwatch, and a chair or stepladder.
2. Crumple up one sheet of paper into a ball. Leave the other paper flat.
3. Stand on the chair or stepladder, raise your arm, and drop the paper ball. Use the stopwatch to time how long it takes to reach the ground.
4. Repeat step 3 with the flat sheet of paper.

1. How long did it take the paper ball to reach the ground? _____
Describe how it dropped.

_____

2. How long did it take the flat paper to reach the ground? _____
Describe how it dropped.

_____

3. Air resistance is also called *drag*. It is a force that slows down an object in the air. Which paper do you think had more drag? Why?

_____

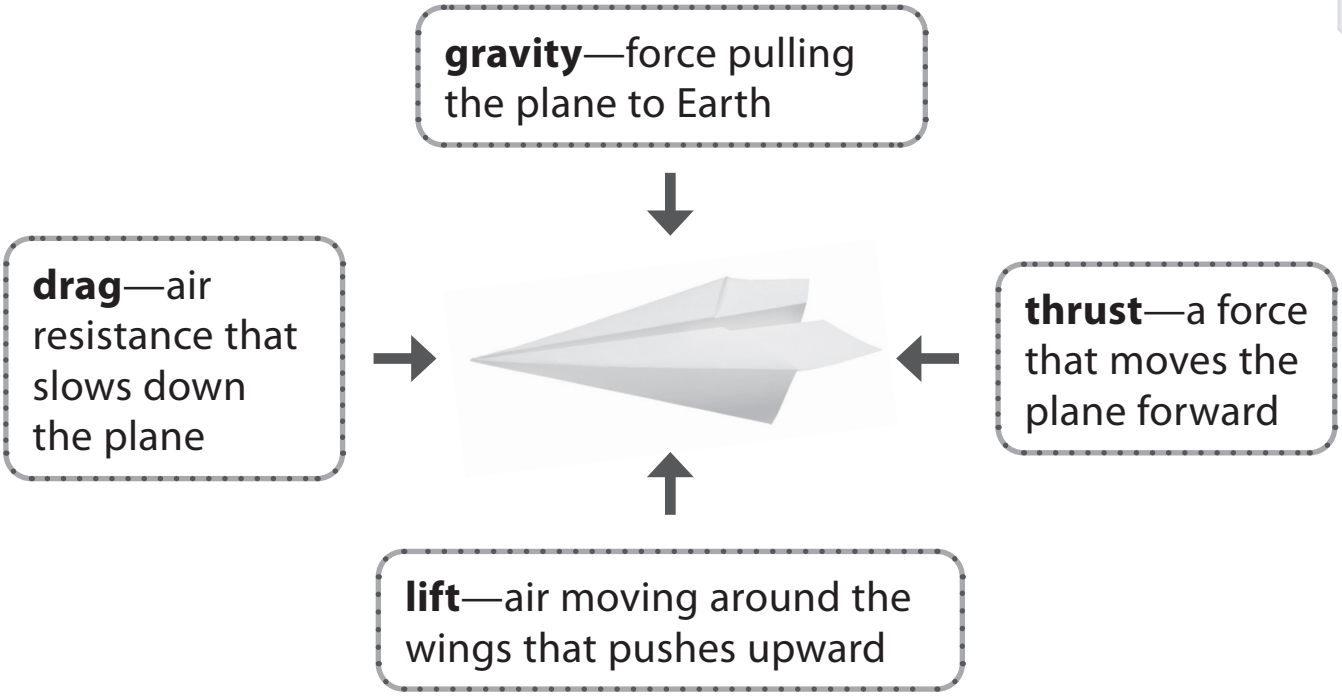
_____

Name: _____ Date: _____

Directions: Think of all the balanced forces around you. Imagine what would happen if some became unbalanced. Think about pictures on the wall, playing a sport, or eating a meal. Draw a fun, creative picture showing at least three "force mix-ups."

Name: _____ Date: _____

Directions: Study the diagram. It shows the forces that affect paper airplanes. Read the text, and answer the questions.



1. What do you think happens if gravity is stronger than lift?

_____

_____

_____

2. What do you think happens if the four forces are balanced?

_____

_____

_____

Name: _____ **Date:** _____

Directions: Read the challenge. Then, answer the question.

The Challenge

Your class is having a paper airplane competition. You want to enter. Design and build a paper airplane that will fly the farthest distance.

Criteria

To be successful, your airplane design must…

- be made of a folded piece of letter-size paper.
- fly the farthest distance.

Constraints

- Paper is the only supply allowed.
- When each airplane is launched, it must be held in the same student's hand at shoulder-height.

1. What are you excited about?

_____

_____

Quick Tip!

You will want to maximize thrust and lift. You will want to minimize drag and gravity.

Name: _____ Date: _____

Directions: Research three different types of paper airplanes. Record your findings in the table. Then, answer the questions.

Type of Plane	Sketch It	Describe It

1. Which type of plane do you think will travel the farthest? Why?

_____

_____

2. How do you think the wings will affect lift?

_____

_____

Name: _____ **Date:** _____

Directions: Sketch one or more designs for your paper airplane. Then, answer the question.

1. What concerns do you have about your design?

_____

_____

Name: _____ **Date:** _____

Directions: Read the questions to guide your planning. Build your paper airplane. Record notes as you build.

Things to Consider

- How can you make sure your paper airplane is symmetrical, or the same, on both sides?
- What order should you follow to fold the paper?
- How will you maximize the distance the plane travels?
- How can you practice for the competition?

Building Notes
(steps, challenges, discoveries, changes, etc.)

Quick Tip!

Make a few copies of your paper airplane design.
If you test one and it crashes, you will have backups.

Name: _____ **Date:** _____

Directions: Hold the airplane at shoulder height. Hold it from the bottom to launch it. Test your paper airplane three times. Record the results. Then, answer the question.

Flight	Distance Traveled	Other Flight Notes
1		
2		
3		

Average distance: _____

Hint: To find the average distance, add up the times of all three flights. Then, divide that number by three. You may use a calculator.

1. Did your paper airplane travel the farthest distance?

yes no

2. If no, sketch what the airplane that did go the farthest looked like.

Name: _____ Date: _____

Directions: Think about your paper airplane design. Answer the questions. Then, plan how you want to improve it.

1. What went well with your paper airplane?

_____

_____

2. What could make your paper airplane even better?

_____

_____

_____

The following constraints have been adjusted.

- The airplane can be made of any type of paper.
- The paper can be any size.
- The airplane can include supplies other than paper.

3. How could the constraint changes help your design?

_____

_____

_____

Name: _____ **Date:** _____

Directions: Plan your new paper airplane design. Then, sketch your new design. Label the materials. Then, complete the sentence.

In my redesign, I will…

add _____

change _____

1. This paper airplane design will work better because

_____

_____

Name: _____ Date: _____

Directions: Gather your materials. Read the questions to guide your planning. Rebuild your paper airplane. Record notes as you build.

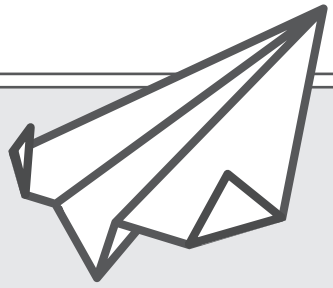
Things to Consider

- What new materials do you need?
- How do you need to change your steps?
- How many copies of this design will you make?
- What adjustments will make it fly better?

Building Notes
(steps, challenges, discoveries, etc.)

Quick Tip!

If your plane goes down fast, bend both sides of the tail up a little. Think of what other small changes might help.



Name: _____ Date: _____

Directions: Have one team member hold the airplane at shoulder height. They should hold the airplane at the bottom to launch it. Retest your paper airplane three times. Record the results.

Flight	Distance Traveled	Other Flight Notes
1		
2		
3		

Average distance: _____

Hint: To find the average distance, add up the times of all three flights. Then, divide that number by three. You may use a calculator.

1. Did your paper airplane travel the farthest distance?

yes no

2. Did your new design work better? Explain your evidence.

yes no

_____

_____

_____

Name: _____ Date: _____

Directions: Think about how you worked on this challenge. Answer the questions.

1. What did you enjoy most about this challenge?

_____

_____

2. What did you learn from this challenge?

_____

_____

3. Which paper airplane design worked better? What made the difference?

_____

_____

4. What advice would you give to someone interested in making paper airplanes?

_____

_____

Talk About It!

What do you think engineers must consider when designing real planes?