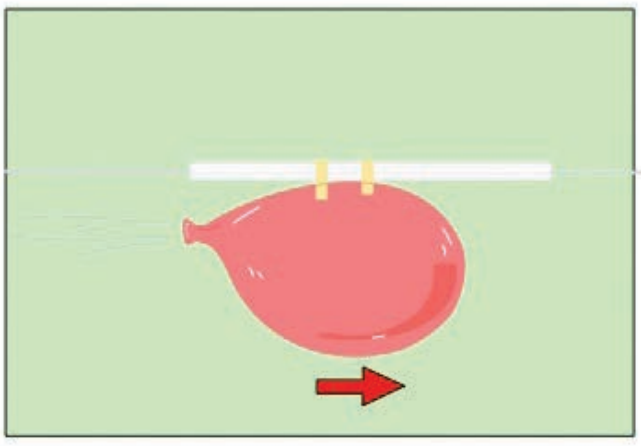
LESSON 17: Balloon Rockets

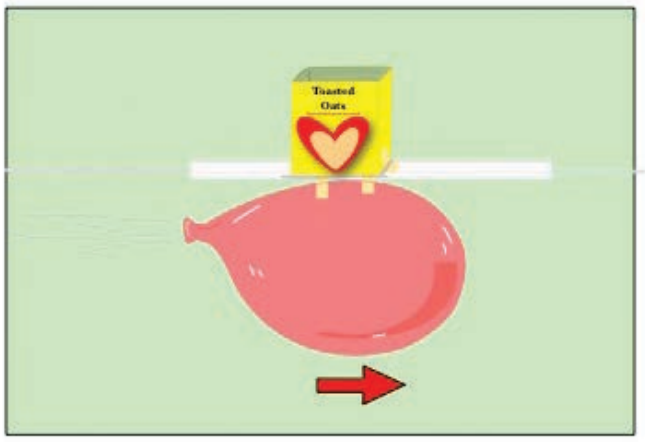
EXPERIMENTATION

As the students perform the experiment, challenge them to identify the independent, dependent, and controlled variables, as well as whether there is a control setup for the experiment. (Hint: As the amount of gas in the balloon changes, does the distance the rocket travels change?) Review the information in the ***Scientific Inquiry*** section on pages 14–16 to discuss variables.

EXPERIMENTAL PROCEDURE

1. Tie one end of a string to a chair, doorknob, or other support.
2. Put the other end of the string through a straw. Then pull the string tight, and tie it to another support in the room.
3. Blow up the balloon, and pinch the end of the balloon to keep the air inside. Do not tie the balloon.
4. Tape the balloon to the straw so that the opening of the balloon is horizontal with the ground. You may need two students for this: one to keep the air pinched inside the balloon and the other to tape the balloon to the straw.
5. Have one student pull the balloon all the way back to the end of the string (the starting line), so the balloon opening is against one support. That student should hold the balloon opening closed. Have another student use the marker to draw a finish line near the other end of the string.
6. Let go of the balloon and watch it move along the string!
7. Then, have students test different methods to transport "cargo" across the string to the finish line.





DATA COLLECTION

Have students record data in their science notebooks or on the following activity sheet. What happened when the opening of the balloon was released and the gas was allowed to escape? If they timed the process, how long did it take for a rocket to cross the finish line? Have students answer the questions on the activity sheet (or similar ones of your own) to guide the process.

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ANALYSIS & CONCLUSION

Use the questions from the activity sheet or your own questions to discuss the experimental data. Ask students to determine whether they should accept or reject their hypotheses. Review the information in the ***Scientific Inquiry*** section on pages 14–16 to discuss valid and invalid hypotheses.

ASSESSMENT/GOALS

Upon completion of this lesson, students should be able to …

- Apply a scientific inquiry process and perform an experiment.
- Describe force, pressure, and thrust.
- Define and provide examples of Newton's Second and Third Laws of Motion.
- Explain the general science behind rocketry.
- Describe drag and power (see ***Differentiation in the Classroom***).
- Differentiate between thrust and drag (see ***Differentiation in the Classroom***).

MODIFICATIONS/EXTENSIONS

Modifications and extensions provide alternative methods for performing the lesson or similar lessons. They also introduce ways to expand on the content topics presented and think beyond those topics. Use the following examples, or have a discussion to generate other ideas as a class.

- Tell your students that they need to devise a way to transport cargo across a string using only the materials you provide them. Have the students work in groups or individually to test methods. Discuss how they may accomplish this task and offer hints as needed.
- Use the lesson to practice measurement and apply calculations. Measure the distance from the start to the finish line on the string. Measure the mass of the inflated balloon. (They can use a clip to keep the balloon opening closed and then subtract the mass of the clip.) Then, time how long it takes for the balloon to move across the finish line. Students can then use these measures to calculate the rocket's force.

REAL-WORLD APPLICATIONS

- Jet engines work by igniting fuel, combined with compressed oxygen, inside the engine. As a result of the reaction, large amounts of gas are released quickly out of the rear of the aircraft. The extremely high acceleration of the mass of gas creates a large force. Then, as indicated by Newton's Third Law of Motion, an equal and opposite force (thrust) is created in the opposite direction of the released gas, propelling the jet forward.

COMMUNICATION

Discuss the results as a class and review the activity sheet. Review the information in the ***Scientific Inquiry*** section on pages 14–16 to discuss the importance of communication to scientific progress.

Fun Fact

Fireworks, developed by the Chinese, are considered the earliest form of rockets.

LESSON 17 ACTIVITY SHEET: Balloon Rockets

OBSERVE & RESEARCH

1. Write down the materials you observe. _____

_____

_____

2. Predict how these materials may be used. _____

_____

_____

3. Define the following key terms. Then, provide an example of each by writing the example or drawing/pasting an image of the example.

Term	Definition	Example (write or add image)
Force		
Thrust		
Newton's Second Law of Motion		
Newton's Third Law of Motion		
Pressure		

4. Consider how a balloon can be propelled down a string and how/why that would work.

▶**Write your hypothesis.** _____

_____

_____

LESSON 17 ACTIVITY SHEET: Balloon Rockets

PERFORM YOUR EXPERIMENT

1. Tie one end of a string to a chair, doorknob, or other support.
2. Put the other end of the string through a straw. Then pull the string tight, and tie it to another support in the room.
3. Blow up the balloon, and pinch the end of the balloon to keep the air inside. Do not tie the balloon.
4. Have a partner tape the balloon to the straw so that the opening of the balloon is horizontal with the ground, while you keep the air pinched inside the balloon.
5. Have your partner use the marker to draw a finish line near the end of the string. Then, let go of the balloon and observe!
6. Test different methods to transport "cargo" across the string to the finish line. See your teacher for materials.

ANALYZE & CONCLUDE

1. Once you have the balloon set, what happens when you let go of it? What causes this to happen? _____

_____

_____

_____

2. What do you think will make the balloon move faster? _____

_____

_____

3. What happens when you add cargo to the balloon rocket? _____

_____

_____

4. Is your hypothesis valid? Why or why not? If not, what would be your next steps? _____

_____

_____

LESSON 17 ACTIVITY SHEET: Balloon Rockets

EXPAND YOUR KNOWLEDGE—ADVANCED

1. Define the following key terms. Then, provide an example of each by writing the example or drawing/pasting an image of the example.

Term	Definition	Example (write or add image)
Fluid		
Drag		
Power		

2. How are modern rockets propelled? _____

_____

_____

3. If a pilot wants to fly at a constant speed, what must occur? What if the pilot wants the aircraft to accelerate?

_____

_____

_____

4. What is Newton's First Law of Motion? _____

_____

_____