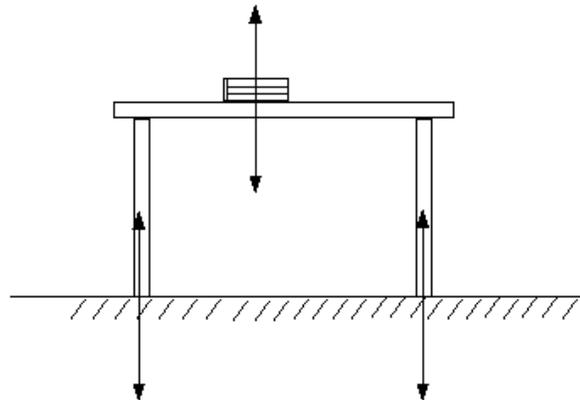


# NASA Spotlite Interactive Lesson

## Objects at Rest Grades 5-8



## Teacher Packet

# NASA Spotlite Interactive Lesson Guide



This NASA eClips™ Spotlite Interactive Lesson supports existing curriculum and should be used as one of many strategies to build students' understandings of science content. The goal of this 5E lesson is to address a science misconception. Through watching a student-produced video (Engage), completing activities (Explore), explaining relevant concepts while applying new vocabulary collectively using a Frayer Model (Explain), and applying new information (Extend/Elaborate), students will develop an understanding of the science content and how to correct the science misconception.

This PDF document should be downloaded to use the interactive features. The hyperlinks included in this document open PDFs or webpages and may perform differently based on the device being used. Links may have to be cut and pasted into a web browser to open.

Try using Adobe Acrobat Reader and Flash Player for optimal performance of all interactive features included in this guide.

An accompanying student packet is located on the NASA eClips Website.

## What are NASA Spotlites?

NASA Spotlites are 90-120 second student-produced video segments that address common science misconceptions as determined by reputable assessment sources such as the National Assessment of Educational Progress (NAEP),

National Science Foundation (NSF) Factual Knowledge Questions, and the Misconceptions-Oriented Standards-based Assessment Resources for Teachers (MOSART).

NASA Spotlites are designed to increase scientific literacy in a standards-based classroom. By producing Spotlite videos, students gain production experience, as well as deepen their understanding of science content. Approved NASA Spotlites can be found at the NASA eClips website.  
<https://nasaclips.arc.nasa.gov/>

## Animated 5E Instructional Model



NASA eClips™ Guides use the 5E constructivist model developed by Biological Sciences Curriculum Study. Constructivism is an educational philosophy that promotes student-centered learning where, students build their own understanding of new ideas. The 5E instructional model consists of five stages for teaching and learning: Engage, Explore, Explain, Extend (or Elaborate), and Evaluate.



This icon identifies the suggested directions and information to read to students.

**Save**



Remind students to save responses. Suggested steps: Under "file" choose "save as." Type your name in front of the document name. Choose "save."

# Lesson Information

## Science Misconception

An object at rest has no force acting on it.

## Standards

### Next Generation Science Standards

**PS2.A: Forces and Motion** - Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction. The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

**PS2.B: Types of Interactions** - Objects in contact exert forces on each other. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

## Objective

In this lesson, students will address the common misconception that objects at rest have forces acting on them. As the students develop their understanding of Newton's First Law of Motion through explore activities, they will learn new vocabulary that applies to new concepts. Students will apply the vocabulary as they explain how forces act on objects at rest.

## Time Frame

Between two and three 45-minute class periods:

Day 1 - Engage and Explore

Day 2 - Explain and Elaborate/Extend

Day 3 - Evaluate

## Safety

Explain proper use of materials used in the inertia experiment.  
Review digital citizenship before students use online resources.

## Materials

### Assessment

Per student: copy of pretest and posttest

### Frayer Model Activity

- Per small group: copy of a digital Frayer Model (alternatively, this can be printed)
- Per classroom: chart paper for posting final vocabulary definitions

### Explore Activity

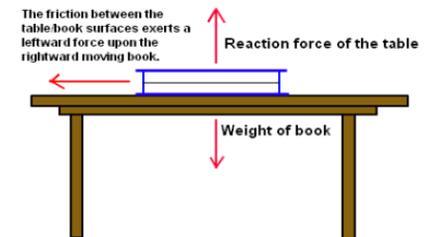
Per small group:

- one book cover or large piece of smooth paper
- one book with a hard, glossy cover
- one book with a rough or non-glossy cover
- other objects to place on the book cover

## Background Information

- The motion of an object can be described by its speed, direction of motion, and position.
- Objects change their motion only when a net force is applied.
- Newton's First Law of Motion - Objects at rest will often have several forces acting on them, but these forces are balanced.
- Force is not a property of an object; it is an interaction.

• Forces come in pairs. For example, an apple sitting on a desk has the force of gravity pulling down on it while the desk exerts an upward force equal to the force of gravity.



**Target Vocabulary:** inertia, balanced, gravity, force, speed, direction

# Engage

## Pre-assessment

Probe for students' prior knowledge using the pre-assessments.

1. Pretest items are located on page 12. Student packets contain a pretest.
2. Essential question
3. Discussion questions

### Essential Question

How do forces act on an object at rest?



## Today's Lesson

In today's lesson you will learn about forces. Using interactive Frayer Models, you will learn key vocabulary that will help you form a clearer understanding of how forces act on objects at rest.

What do you already know about the forces acting on objects at rest?

**True or False:** An object at rest has no force acting on it.

## Spotlite Video



Next, you will watch a short video on objects at rest. As you watch the video, pay close attention to any new vocabulary.

(Example vocabulary: inertia, balanced, gravity, force, speed, direction)



[Video Link- NASA Spotlite: Objects at Rest](#)

NASA eClips™ Website -<https://nasaclips.arc.nasa.gov/spotlite>

NASA eClips™ YouTube -<https://youtu.be/1hCcbESXpGs>

Use the questions to lead the class in a discussion.

1. What did you learn about the forces acting on an object at rest from watching the video?
2. What are the different forces that can act on an object?
3. How do forces act on an object at rest?
4. What causes an object to change direction or speed?

# Explore

## Explore Activity



In this experiment you will learn about inertia. In the investigation, you will try to remove a book cover from under an object without moving the object on top. Magicians do this all the time. Have you ever seen a magician pull a tablecloth out from under a pile of dishes? Was it magic or science?

You will need the following items for this experiment:

- one book cover or large piece of smooth paper
- one book with a hard, glossy cover
- one book with a rough or non-glossy cover
- other objects to place on the book cover

Procedures:

1. Place the book cover (or piece of paper) on a flat, smooth surface.
2. Put the book with the glossy cover on top of the book cover.
3. Quickly (and in one smooth motion) yank the book cover out from under the book.
4. Write down what happens.
5. Do the experiment again, this time putting other objects on top of the book cover. Observe what happens and write your answers to the following questions:

- Does mass have any effect on the experiment?
- Does the type of object you add have any effect? If so, in what way and why?

6. Try the experiment again using a book with a rough or non-glossy cover. What do you notice? Can you explain how this experiment relates to Newton's First Law of Motion?

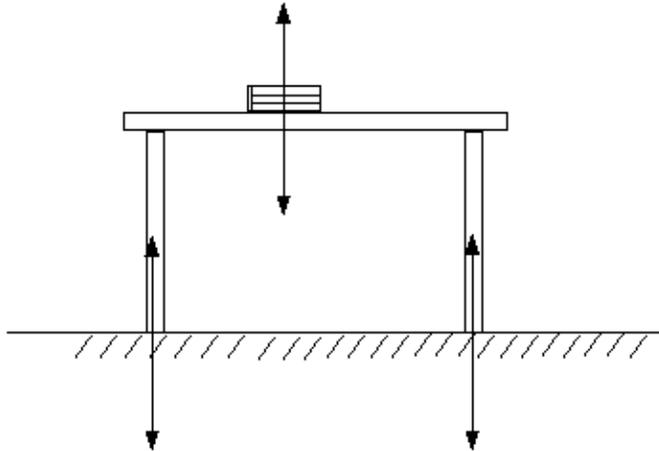
Activity Source - Swift Mission Education and Public Outreach  
[http://swift.sonoma.edu/education/newton/newton\\_1/html/newton1.html](http://swift.sonoma.edu/education/newton/newton_1/html/newton1.html)

# Explore

## Explore Activity



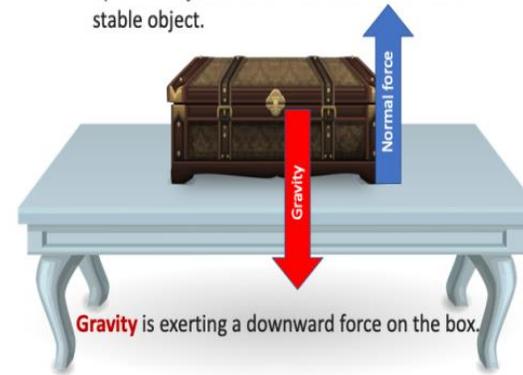
In the picture identify two forces acting on each object that is at rest.



### Think-Pair-Share

What forces act on objects at rest?

The **normal force** is the support **force** exerted upon an object that is in contact with another stable object.



**Gravity** is exerting a downward force on the box.

A trunk is resting upon the table. The surface is exerting an upward **force** upon the trunk in order to support the weight of the box.



### Let's Compare Your Answers

In the example, the force of Earth's gravity is acting to pull the object down to Earth. At the same time, an equal and opposing force is acting to push the object upward, whether from the table or from the floor.

# Explain

## Vocabulary Development

It's almost impossible to learn science concepts without also learning vocabulary words. Those vocabulary words help people discuss science concepts, so they're important. However, knowing vocabulary words is not the same as understanding science concepts. This section is designed to help your students do more than memorize definitions as they connect the vocabulary to the science concepts that they have explored.

1. Place the word "forces" in the center of the graphic organizer. (See page 11 for a fillable Frayer Model.) Facilitate a discussion with students exploring why this word is key vocabulary to this study.
2. Ask students to brainstorm characteristics of "forces" and add responses to the area with the corresponding heading on the graphic organizer.
3. Ask students to continue their exploration as they research the topic using a variety of resources including their textbook and notes.
4. Next, ask students to add examples and non-examples in the Frayer Model. Emphasize the higher-level thinking skill of comparing and contrasting.



How are the examples alike/different than the non-examples?

5. Using the information provided, ask students to develop their own definition of the word "forces" that is clear and concise. An example is in the Answer Key section of this document (page 14).
6. After completing the example together, assign a new vocabulary word to each group of students to work on collaboratively.



Now complete a new Frayer Model with a partner. Select one word from the key vocabulary list and fill in the graphic organizer. We will share some as a class.

### Frayer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.

7. Groups will share their Frayer Models and lead discussions to check for understanding of each vocabulary word. Refer to definitions in the Answer Key (page 8).
8. Compile and post final definitions so all students have access for later reference.



You will review key vocabulary. Pay attention to how your definitions compare to standard definitions.

# Explain

## Vocabulary Words

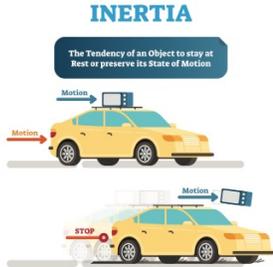
Word	Definition
<p><b>INERTIA</b></p>  <p>The Tendency of an Object to stay at Rest or preserve its State of Motion</p>	<p>Inertia is the tendency of an object to continue doing what it is doing, either moving or resting, unless acted on by an outside force. The inertia of an object is related to its mass (the greater the mass, the greater the inertia).</p>

Image credit: By VectorMine, Shutterstock.com

Word	Definition
<p><b>DIRECTION</b></p> 	<p>Direction is the line or course on which something is moving.</p>

Image credit: By Jirawat Phuengkriphan, Shutterstock.com

Word	Definition
<p><b>SPEED</b></p> 	<p>Speed equals distance divided by time or <math>s = d / t</math>.</p>

Image credit: By Flipser, Shutterstock.com

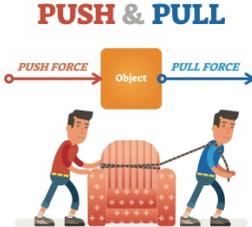
Word	Definition
<p><b>FORCE</b></p>  <p><b>PUSH &amp; PULL</b></p>	<p>A force is whatever can cause an object with mass to accelerate (change its direction or speed). Force may be expressed with both magnitude (speed or velocity) and direction.</p>

Image credit: By VectorMine, Shutterstock.com

Word	Definition
<p><b>GRAVITY</b></p> 	<p>Gravity is a force between objects based on their masses and the distance between the objects.</p>

Image credit: By Mypokcik, Shutterstock.com

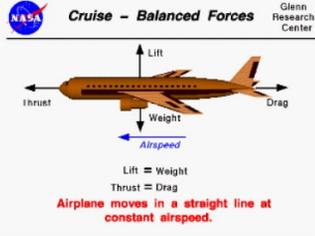
Word	Definition
<p><b>BALANCED</b></p>  <p><b>Cruise - Balanced Forces</b></p> <p>Lift = Weight Thrust = Drag</p> <p>Airplane moves in a straight line at constant airspeed.</p>	<p>Balanced means having different parts or elements properly or effectively arranged, proportioned.</p>

Image credit: NASA Glenn Research Center

# Elaborate/Extend

## Elaborate/Extend Activity

It is important for the students to explain what's going on by applying what they have learned. It is not unusual for students to have a bit of difficulty with elaborate activities. Student are not used to doing "novel" activities and being asked to apply what they know.

List 3 examples of objects from this room that are at rest and identify the forces acting on them.



Image credit: by Happy May, Shutterstock.com

Select one object from the list and describe what would happen to that object if the forces acting upon it were unbalanced or not equal.

## NASA Connection

The Antares launch vehicle stands 40.5 meters tall, has a main diameter of 3.9 meters and a liftoff mass of approximately 282,000 Kilograms. It needed two powerful engines to launch it into space.



This Antares rocket stands ready for liftoff at NASA Wallops' Island.

What forces are needed to keep the Antares rocket at rest?

Learn more about Antares at this link. <https://science.nasa.gov/>

# Evaluate

## Post-assessment

Check students' understanding with these activities.

### Identify Misconception



What is a common misconception about objects at rest and how can you correct this misconception?

### Discussion Questions

1. What did you learn about the forces acting on an object at rest from watching the video?
2. What are the different forces that can act on an object?
3. How do forces act on an object at rest?
4. What causes an object to change direction or speed?



Carefully rewatch the NASA Spotlite video about forces on objects at rest to assess your understanding of Newton's First Law.



[Video Link- NASA Spotlite: Objects at Rest](https://nasaclips.arc.nasa.gov/spotlite)

NASA eClips™ Website -<https://nasaclips.arc.nasa.gov/spotlite>

NASA eClips™ YouTube -<https://youtu.be/1hCcbESXpGs>

## Vocabulary Review



Now complete this fill-in-the-blanks activity using vocabulary about objects at rest.

There are many forces that act on an object at rest. A force is what causes an object with mass to (1) accelerate, change direction or speed. The force between objects that is based on their masses and the distance between the objects is called (2) gravity. (3) Inertia is the tendency of an object to continue doing what it is doing, either moving or resting, unless acted on by an outside force. When an object is at rest or at a constant speed, we say the forces acting on the object are (4) balanced.

### Word Bank

gravity  
inertia  
accelerate  
balanced

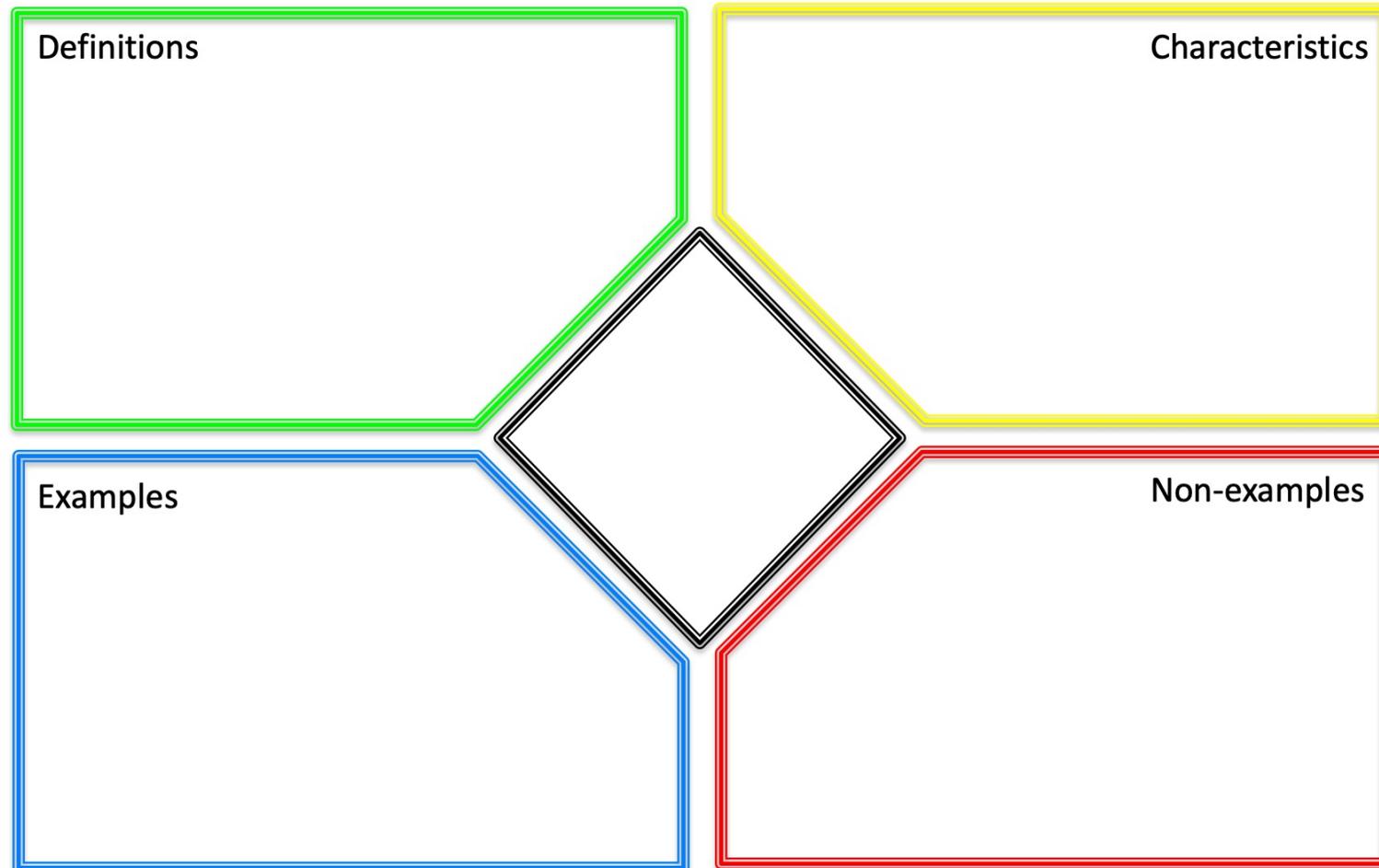


Using your new vocabulary words, explain how forces act on objects at rest.

# Resources

## Frayer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.



The graphic organizer consists of four colored boxes arranged around a central diamond shape. The top-left box is green and labeled 'Definitions'. The top-right box is yellow and labeled 'Characteristics'. The bottom-left box is blue and labeled 'Examples'. The bottom-right box is red and labeled 'Non-examples'. The central diamond is outlined in black and is empty.

# Resources

## Objects at Rest Grades 5-8 Pretest/ Posttest NASASpotliteInteractiveLesson

Read each question and select the best choice.

1. Identify the statement that correctly describes forces acting on an object at rest.

4. No change in force is necessary to:

2. An apple is resting on a desk. The apple:

5. Sharon went bowling with her friends. The pins standing at rest at the end of the lane:



3. Which statement about forces is TRUE?

# Answer Key

## Objects at Rest Grades 5-8 Pretest / Posttest NASASpotliteInteractiveLesson

Read each question and select the best choice.

1. Identify the statement that correctly describes forces acting on an object at rest.

Select the best answer.

- A. Objects at rest have no force acting on them.
- B. All objects have properties, one of which is force.
- C. There cannot be a force without motion.
- D. **Force is an interaction between objects and is not a property of an object. \*\*\***

2. An apple is resting on a desk. The apple:

Select the best answer.

- A. has no force acting on it.
- B. **has an upward force equal to the force of gravity pulling it downward. \*\*\***
- C. has only gravity acting on it.
- D. has kinetic energy.

3. Which statement about forces is TRUE?

Select the best answer.

- A. Objects change their motion only with applied balanced forces.
- B. Inertia is a force that pulls objects toward each other.
- C. Gravity is an object's tendency to remain the same.
- D. **An object with a greater mass requires more energy to move. \*\*\***

4. No change in force is necessary to:

Select the best answer

- A. start an object moving.
- B. stop an object from moving.
- C. cause a change in the motion of an object.
- D. keep an object doing what it is already doing. \*\*\*

5. Sharon went bowling with her friends. The pins standing at rest at the end of the lane:



Image credit: by Oligo22, Shutterstock.com

Select the best answer.

- A. have no force acting on them.
- B. won't change their motion when hit by the bowling ball.
- C. **have several forces acting on them. \*\*\***
- D. have unbalanced forces acting on them.

# Answer Key

## Fruyer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.

The graphic organizer is a diamond-shaped frame divided into four quadrants. The top-left quadrant is labeled 'Definitions' and has a green border. The top-right quadrant is labeled 'Characteristics' and has a yellow border. The bottom-left quadrant is labeled 'Examples' and has a blue border. The bottom-right quadrant is labeled 'Non-examples' and has a red border. The center of the diamond is a white diamond shape.

## Vocabulary Word

-Force

## Characteristics

-number of atoms that are packed into an object  
-does not change due to location

## Non-examples

-matter  
-distance

## Examples

-launch  
-throw  
-hit  
-friction

## Definition

A force is whatever can cause an object with mass to accelerate (change its direction or speed). Force may be expressed with both magnitude (speed or velocity) and direction.

# Product Information

This product has been developed by the National Institute of Aerospace's Center for Integrative STEM Education.

This document is based upon work supported by NASA under award No. NNX16AB91A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration (NASA).

Published January 2019