

## Inertia Tower

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### Lesson Overview

In this lesson, students will collaborate on an investigation to test the relationship between the mass of an object and the concept of inertia.

### Alignment

#### Science Standard/Indicator Addressed

8.P.2A.3 Construct explanations for the relationship between the mass of an object and the concept of inertia (Newton's First Law of Motion)

#### Science and Engineering Practices (as appropriate)

S.1A.1 Ask questions and define problems  
S.1A.2 Develop and use models  
S.1A.3 Plan and carry out investigations  
S.1A.4 Analyze and interpret data.  
S.1A.8 Obtain, evaluate, and communicate information.

#### Standards for Mathematical Practice

Standard 1 Make sense of problems and persevere in solving them.  
Standard 7 Identify and utilize structure and patterns.

#### ELA Inquiry Standards

Standard 3 Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.  
Standard 6 Read, write, and communicate using knowledge of a particular discipline.  
Standard 7 Integrate the Reading, Writing, and Communication Standards and the Inquiry-Based Literacy Standards to communicate and create understanding within content areas.  
Standard 8 Extend and deepen understanding of content through purposeful, authentic, real-world tasks to show understanding and integration of content within and across disciplines.

### Connections

#### Disciplinary Literacy Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

- [Graphic organizers](#)
- [Exit ticket](#)

- [Making Thinking Visible \(MTV\)](#)
- [Popsicle stick grouping](#)

### Computational Thinking

- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems

### Content Area (2 or more) Connections

Math  
Science  
ELA

### Lesson Plan

**Time Required** – Two 60-minute class periods

#### **Disciplinary Vocabulary** –

- Inertia
- Mass
- Newton’s First Law
- Equilibrium
- Balanced and unbalanced forces

#### **Materials Needed:**

- 1 Dozen Eggs (optional)
- Pie Pan (optional)
- Toilet Paper Roll
- Glass of Water
- Unhemmed Tablecloth
- Set of dishes and silverware (the unbreakable kind)
- Scissors
- Wooden Blocks (10/group)
- Plastic Cups (10/group all same size)  
Note: The cups will not stack like the wooden blocks because the cups have less mass than the wooden blocks.
- 3 x 5 Index Cards (9/group)
- String (cut into 8-inch lengths for each notecard)

- Hole Punch (1/group)
- Chromebook, laptop, etc.
- <https://youtu.be/0F4QJU-qvYY>

**Formative Assessment Strategies:**

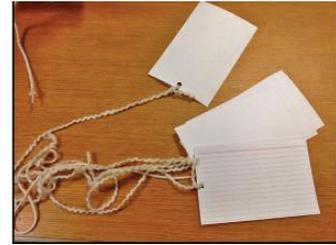
- Student dialogue
- [Graphic Organizers](#)
- [Exit Ticket](#)
- [Here's What, So What, Now What](#)
- Discussion Questions
- Paper Slides

**Lesson 2, Part A**

**Engage**

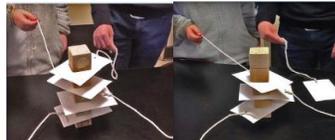
- Place a sheet of chart paper on the wall and make a T-table with “Yes” on the left side and “No” on the right. Tell the students they will see a video of a teacher trying to pull a tablecloth from under a place setting of china (you can do this experiment in class instead of using the video). Have the students place their initials on a sticky note and place the sticky on the chart based on if the student thinks the tablecloth can be successfully pulled out from under the china.
- Show the students the short video of a tablecloth being pulled out from a place setting on a table or conduct the experiment yourself. <https://youtu.be/0F4QJU-qvYY> .
- Direct students attention back to the T-chart with the sticky notes. Ask the students why they did think the experiment would work and why they didn't think the experiment would work. If you conduct the experiment in class, have several students try to pull the tablecloth from under the china.
- Tell the students they will be exploring a new term called inertia and they will be investigating Newton's First Law of Gravity. “Today we will observe Newton's First Law by attempting to remove index cards from a tower of wooden blocks without causing the blocks to fall.”
- Groups students using popsicle sticks
  - Before class, write the name of each student on a popsicle stick and place them in a cup.
  - Pull sticks out of the cup randomly three at a time.
  - Each set of three will be a group of students who will work together during the investigation.
- Ask one person from each pair to come up and collect the materials for the investigation
  - Wooden Blocks
  - Index Card
  - String (cut to length)
  - Hole Punch

- The students work together to prepare the notecards for the activity
  - Use the hole punch to punch a hole about 3 cm from the short end of the index card.
  - Tie a piece of string to the index card. Do this for each index card
  - Be sure not to bend the index card as you work.



### Explore

- After the students assemble the string onto the index cards they will stack the wooden blocks placing an index card between each block. Make sure the blocks are stacked directly on top of each other.
- Place the index cards so the strings are facing in different directions.
- Start at the top, removing the first index card with a swift pull directly backwards. Do not pull at an angle.



- Continue having each person in the group remove an index card from top to bottom. If the blocks fall over, restack and start again. Discuss with your partners how this investigation is similar to the tablecloth trick.
- Restack the blocks and have all group members pull the index cards at exactly the same time. Again, discuss with your partners how this investigation is similar to the tablecloth trick.
- Next get a stack of plastic cups from your teacher. Make a tower with the cup the way you built the tower of blocks with an index card between each cup. Make sure to put the open end of the cup on top of the index card.



- Pull the index cards from between the cups like you did with the wooden blocks. What happens?

### Explain

- The teacher will circulate the classroom and ask questions as students build their towers and pull the index cards out from between the blocks and cups.
- When all groups have had a chance to investigate with both the wooden blocks and the paper cups, they will return the materials and assemble back as a whole class.
- Pass out the discussion questions for the day and have the students answer them independently.
- Collect questions before students leave for the day.

## Exit Ticket

- Discussion questions for day one.

## End Lesson 2, Part A

### Begin Lesson 2, Part B

- Pass out the discussion questions from the last class period. Take the time to have several students share out their answers.
- Today we will continue to experiment with Newton's First Law and this idea of inertia and balanced and unbalanced forces.

### Explore

- Have students get back in their groups from the previous class period.
- On the demonstration table assemble a pie tin, toilet paper roll/cardboard cylinder, egg, and glass of water in this fashion:
  - <https://youtu.be/STQRUzalH2M?list=WL&t=5>
- Like the previous class period, post a T-chart on the wall and have students place their initials on sticky notes and post under "yes" or "no" as to whether or not they think you can get the egg to drop into a glass of water.
- Teacher demonstration of the "Egg Drop" experiment.
- Have students come up and try to get the egg in the glass of water.
- After several students have tried the experiment, have the groups discuss and write down how this demonstration is similar to the ones they saw and conducted in the last class period.
- Assign the following video link <https://youtu.be/pi24rnvzyKQ?list=WL> , to the groups and have them watch and take notes paying close attention to the following vocabulary words:
  - Inertia
  - Balanced/unbalanced forces
- The students may watch the video several times so they are well versed on what happens with the water balloon.
- The students will then create "Paper Slides" of teacher selected experiments that were performed over the last two class period. They will include detailed pictures and explanations of what is happening during the experiments using the vocabulary they have learned during the course of the two class periods.
- Paper Slides Technique:
  - Students illustrate 3 or more slides.
  - As students illustrate, they work on a narrative to go with the slides. They will not write the narrative on the slides but may make notes for their own reference.
  - Once students design their illustrations and narrative, they will video the paper slide and narrate along, "behind the scenes", changing the pictures as the narrative changes.

- This can be used as a unit review, review of reading/video, process to bring concepts to reality.
- Example: <https://www.youtube.com/watch?v=Qf6L1PTG3p4>
- Paper slide videos will be presented during the next class period.

### Explain

- Have the groups take out their answers to how the “Egg Drop” demonstration is similar to the ones they saw and conducted in the last class period.
- The students will present the “Paper Slide” videos
- Ask the students if they can get more than one egg to drop in a glass of water and how they may make that happen.

### Exit Ticket

- [Here’s What, So What, Now What](#)

### End Lesson 2, Part B

**HANDOUTS FOR LESSON BEGIN  
ON THE FOLLOWING PAGE.**

## Inertia Towers

### Materials:

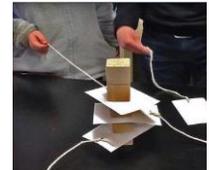
- Scissors
- Wooden Blocks (10/group)
- Plastic Cups (10/group all same size)
- 3 x 5 Index Cards (9/group)
- String (cut into 8-inch lengths for each notecard)
- Hole Punch (1/group)

### Directions:

1. Use the hole punch to punch a hole about 3 cm from the short end of the index card.
2. Tie a piece of string to the index card. Do this for each index card
3. Be sure not to bend the index card as you work.



4. After the students assemble the string onto the index cards they will stack the wooden blocks placing an index card between each block. Make sure the blocks are stacked directly on top of each other.
5. Place the index cards so the strings are facing in different directions.
6. Start at the top, removing the first index card with a swift pull directly backwards. Do not pull at an angle.



7. Continue having each person in the group remove an index card from top to bottom. If the blocks fall over, restack and start again. Discuss with your partners how this investigation is similar to the tablecloth trick.
8. Restack the blocks and have all group members pull the index cards at exactly the same time. Again, discuss with your partners how this investigation is similar to the tablecloth trick.
9. Next get a stack of plastic cups from your teacher. Make a tower with the cup the way you built the tower of blocks with an index card between each cup. Make sure to put the open end of the cup on top of the index card.



10. Pull the index cards from between the cups like you did with the wooden blocks. What happens?

Discussion Questions: Day One

1. Did you get the blocks and cups to stack on top of each other without falling the first time you set them up? If not, what did you adjust to make them stack without falling?
2. How are the block and cup stacking experiments similar to the tablecloth experiment?
3. What is important about the tablecloth and the index cards to make these experiments successful?

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