



Balance



The Nuts and Bolts

Students will learn about forces and balancing points as they interact with objects and create a hanging mobile.

The Quick Start

Share the video with students and stop at the PAUSE BREAKS for class discussions or assessments. Don't be afraid to stop often and review sections of the video.



Discussion points (PAUSE BREAKS):

How could I carry the large stack of boxes? (1:28 video timestamp)

Allow students to brainstorm ways to carry the boxes. In brainstorming, all responses/ideas are accepted. Make a class list of ideas. After brainstorming is done, evaluate each response/idea. What challenges or difficulties do some present or eliminate?

How is holding tree pose in Yoga similar to the tower of boxes? (2:29 video timestamp)

Students can discuss how holding a pose in Yoga and creating a stack of boxes are similar? Through discussion, the idea of **BALANCE** may be shared.

Where do you see evidence of balance in your world? (3:09 video timestamp)

Formative Assessment

Discussion allows students to share ideas, connect with their experiences, and see beyond boxes and Yoga.

In-class model: Give two minutes of Alone Zone thinking, encourage students to write down/draw what they are thinking. Then share ideas in small groups. Finally, share ideas with whole class. Teacher accepts all ideas, does not give comment on them. If students add clarification or ask questions, allow students to defend their thinking.

Virtual model: Give two minutes of Alone Zone thinking, encourage students to write down/draw what they are thinking on paper or on a shared document (i.e. google doc, Jamboard). Then share with the whole class. Teacher encourages questioning and clarification.

As Formative Assessment, the teacher should keep Balance lists from groups.

Student Interactive Challenge

Students will try to balance a pencil on their finger. (3:49 video timestamp)

To do this, students will need a pencil or other long, thin object and their finger. Give them time to try different ways to balance the pencil. Allow for frustration and opportunities where students observe and learn from each other.

Allow students time to balance the pencil horizontally across their finger. What do they notice? Some student may want to try other objects (rulers, spoon, stick)- give time to explore. The idea of a balancing point, may enter the discussion at this point. Students may or may not notice differences in the balancing points, based on the objects they are balancing.

Student Investigation

Students will balance a ruler on their finger. (5:13 video timestamp)

Once students have their rulers balanced, ask them to notice where their finger is on the ruler. Introduce the idea of the middle or center of the ruler. Also, talk about the number (6) and how this is half of the full 12 inches. **May be different if using a different length ruler.

Scientific Modeling

Students will create a model to help explain why the ruler balances at the center point. (6:11 video timestamp)

In-class model: Allow students Alone-Zone time to create their models. Then share models in small groups or through gallery walk. Students should be encouraged to notice similarities in design and to focus on what makes a model understandable to others.

Virtual model: Similar to in-class model, students will first create their models and then share in breakout rooms. Use developed talking/listening protocol.

****Modeling used to help in explaining and sensemaking is an important skill and tool to be developed and used. Use students models to look for similarities, differences, talking points, and points of clarity and confusion. Using the model is a process of representing what you think is happening in a two-dimensional way.**

What force is pulling ruler onto the finger? (6:45 video timestamp)

Students may have already brought up gravity in their discussions or models. If not, give time for students to consider how gravity is a force that objects toward each other.

****Before sharing the gravity and forces definitions, give a quick formative assessment break: Ask students to describe (either in writing, drawing, speaking, or combination) what are forces and gravity. Record students' ideas. These will be revisited later as students make sense of forces and gravity.**

Exploration and Extensions

Explore balanced and unbalanced forces with the ruler (7:26 video timestamp).

Allow students to explore using the ruler, either balanced on their finger or another **fulcrum** or pivot point (block, pencil, cardboard triangle) to balance objects such as coins, unit cubes, or gram counters. The time spent exploring will uncover many wonderings and questions about how to balance objects, placement of fulcrum, placement of objects.

****Allow free exploration and discussion. Record questions, observations, and claims as students try different arrangements of objects and placements.**

Hanging Mobile Sculpture (7:49 video timestamp)

This hands-on creative activity will employ understandings gained through balanced and unbalanced forces. It will also require persistence.

Materials needed:

- Long stick or hanger (thin metal is better)
- String, fishing line, yarn
- Small objects to hang (shells, coins, erasers)
- Scissors and tape
- Additionally, paperclips can be used to slide objects

Follow up activity with a sharing session. Have students share their designs, challenges, and how they persevered or persisted.

Background for teachers

The Wonder of Science

PS2.A Forces and Motion

<https://thewonderofscience.com/videos/2017/12/10/ps2a-forces-and-motion>

The Physics Classroom

<https://www.physicsclassroom.com/class/newtlaws/Lesson-1/Balanced-and-Unbalanced-Forces>

Books for Read Aloud

- Newton and Me By Lynne Mayer
https://www.youtube.com/watch?v=_Wib_MOsM6Q&t=68s
- Motion by Darlene Stille
<https://www.youtube.com/watch?v=qTEvLIPzW28&t=4s>
- Oscar and Cricket: A Book About Moving and Rolling by Geoff Waring
<https://www.youtube.com/watch?v=py7QoZO0b30>

Video Resources

- Crash Course Kids: Defining Gravity
<https://www.youtube.com/watch?v=ljRIB6TuMOU>
- Sci Show Kids: Swings, Slides, and Science
<https://www.youtube.com/watch?v=JvSCIZ3vHOI>
- The Dr. Binocs Show: What is Newton's First Law of Motion
<https://www.youtube.com/watch?v=adLj6kygws>

NGSS Connections

There are multiple entry points for connecting with NGSS. Connections are listed for DCI, SEP, and CCC.

NGSS	Classroom Connections
Disciplinary Core Ideas	
PS2.A Forces and Motion (Kindergarten) <ul style="list-style-type: none"> • Pushes and pulls can have different strengths and directions. (K-PS2-1), (K-PS2-2) 	As students explore how to balance objects. They will begin to notice forces (pushes and pulls).
PS2.A Forces and Motion (Third grade) <ul style="list-style-type: none"> • 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 of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1) 	Students can begin to explore balanced and unbalanced forces, including that objects at rest have multiple forces acting upon them (including gravity) netting the force to zero.
PS2.B Types of Interactions (Kindergarten) <ul style="list-style-type: none"> • When objects touch or collide, they push on one another and can change motion. (K-PS2-1) 	Students will begin to notice what happens when objects touch and/or pull on each other. They will observe changes in motion due to these pushes and pulls.
PS2.B Types of Interactions (Third grade) <ul style="list-style-type: none"> • Objects in contact exert forces on each other. (3-PS2-1) 	Students will use information about balanced and unbalanced forces to create hanging mobiles. They will begin to understand that placement and weight affects balance.
Science and Engineering Practices	

<p>Developing and Using Models</p> <p><u>Kindergarten:</u> Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagrams, drawings, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <p><u>Third grade:</u> Develop and/or use models to describe and/or predict phenomena.</p>	<p>Students will begin to represent their thinking (initial understandings) in drawings. These models will be used as communication supports.</p> <p>Students will quantify and qualify their models to help explain their thinking as they use models to predict balance and unbalanced objects.</p>
<p>Crosscutting Concepts</p>	
<p>Cause and Effect</p> <p><u>Kindergarten:</u> Events have causes that generate observable patterns.</p> <p><u>Third grade:</u> Cause and effect relationships are routinely identified, tested, and used to explain change.</p>	<p>Students will begin to notice caused events (i.e., objects fall when no longer balanced, objects can balance when center point is changed).</p> <p>Students will be able to make predictions of outcomes based on relationships (i.e. weight of objects, placement of objects, placement of fulcrum or pivot point).</p>

***Final Thoughts
For Planning***

Give time and space for students to share what they already know about forces, gravity, and balance. Allow for students to share their ideas and experiences (prior knowledge)

Create shared experience through read alouds, shared digital resources, as student-generated investigations, observations, and research.

Use the time, to develop students' sensemaking by engaging in brainstorming and scientific modeling. Allow modeling to serve as an entry point to where students are in their thinking during their experiences thinking about balance and forces.

Be explicit about directing student attention to how claims are supported with evidence. Have students engage in scientific arguments by listening to each other, as they share their observations and evidence.

Additionally, use the explorations to focus on how students deal with frustration, "failure", and can use persistence and perseverance in productive ways. How do we persevere when frustrated? How can difficult tasks be broken down into manageable parts? How can we ask for assistance?

EXTENSION IDEA: Add the "A" to the STEM activity of building a hanging mobile sculpture. Look at artwork that employs movement and/or balance. See: <https://www.artsy.net/article/artsy-editorial-7-artists-created-innovative-mobiles-alexander-calder>

Investigate kinetic sculptures such as STRANDBEEST
<https://www.strandbeest.com/>

