

NGSS Unit Planning with UbD

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Unit: Force and Motion

NGSS Covered:

3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Cross Cutting Concepts (CCC): Cause and Effect

Disciplinary Core Ideas (DCI): Forces and Motion

Science and Engineering Practices (SEP): Planning and Carrying out Investigations

CCSS ELA Covered:

3. W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

3. W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

CCSS Mathematics Covered:

3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Note: This learning sequence can take anywhere from 5 to 7 days depending on your time blocks.

Understanding by Design NGSS Unit Plan

Stage 1: Desired Results

Understand

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 of motion.

Essential Question(s)

1. How do balanced and unbalanced forces affect the motion of an object?
2. Is wind a force?

Stage 2: Evidence/Assess

Know

Students will know that balanced and unbalanced forces affect an object.

Students will understand that:

Zero net force means even if an object is at rest there are multiple forces acting on it.

What are balanced and unbalanced forces:

Balanced Forces: equal forces acting on an object do not cause a change in motion

Unbalanced forces: Two forces acting on an object are not equal in size and cause a change in motion.

Vocabulary terms: force, motion, balanced, unbalanced

Do

SEP- Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Trials: Students will work in cooperative groups and conduct three trials using a smaller rope. They may conduct the three trials however they decide. Out of the three trials, one has to show balanced force. They will fill out a multi flow map, which shows cause and effect to document the process and record their outcome as either balanced or unbalanced depending on their trials. Examples students have used are tying the rope to their shoelaces or doing finger tug of wars.

Stage 3: Learning Plan	
Materials: chart paper, 25 ft. rope, yarn, duct tape, rubber gloves, small pieces of rope about 5 ft. one for each group (6 groups?), science journals, poster paper or construction paper (one for each group), markers, crayons Engage: Step 1: CCC: Cause and Effect: Give each student a pinwheel. Outside is best to let them play with the pinwheel. Tell students to observe what the pinwheel does depending on what they do with the pinwheel. After about 10 minutes have students pair share what their observations were. What did they notice? Was it a windy day or did they have to provide wind to make the pinwheel move? Have a whole class share out and start an anchor chart titled Force and Motion with their observation and questions. As the learning sequence continues add to the chart and refer to it often. Step 2: Phenomena DCI: Forces and Motion: You can start with the quick phenomena video showing the truck about to hit the wall (link below). Play it a couple of times. Let students discuss what they think will happen and why. Put a box on a table and talk about the forces that are acting on the box (box is at rest but are there still forces acting on the box?). This is an example of balanced forces. The box is still. There is equal strength pushing on the box from the top and bottom and side to side. Then ask a student to move the box without lifting it. How does motion affect the box? This is an example of unbalanced forces: The force to move the box is stronger than the force keeping it on the table. Gravity may come up as well as weight and speed. Tie this into the pinwheel activity. Where do students see evidence in nature (weather) of force and motion? Discuss wind as a force. If students have had background on weather this is a great time to bring that back in and see if students can make connections between weather and force and motion, especially severe weather. Discuss the vocabulary terms using questioning techniques. Remember you want the students to make their own discoveries from the materials and activities you have created. Add to anchor chart.	

Step 3:

DCI: Forces and Motion:

Tug of War: Traditional with the whole class inside or outside. Use a rope that is not too rough on the hands. You can have students wear rubber gloves. Tie one piece of colorful yarn to the rope in the middle. Put a mark of some kind on the ground to show the middle of the rope. (Tip: Using duct tape and making an X works well.) Then mark two spots on either side of the middle mark about two feet, one on one side of the yarn and the other on the other side of the yarn. The game stops when one side pulls their yarn over their mark. Preface safety. Scientists always take precautions to be safe. Do the game again one other way- here are some suggestions: taller and smaller, boys and girls (don't think the boys will automatically win). Let students watching predict who they think will win and why. The "why" is important to gauge understanding of the concept balanced and unbalanced forces. There is a great video of students against the teachers for a Tug of War to show during this time (link below).

Class Discussion about the tug of war- Why did the teams win? How does the tug of war connect to wind and weather? Add to anchor chart.

Explore:

SEP: Planning and Carrying out an Investigation

CCC: Cause and Effect

Put kids in groups of 5 or 6. Give each group a piece of rope and have them conduct the three trials (see description above in stage 2: Do). They should be recording in their science notebooks their observations with each trial. Pass out one multiflow chart to each group. Students will fill out the multiflow chart (cause and effect) and state whether the force was balanced or unbalanced. They can draw a picture or use words. Suggestion: Make one person at each group the writer or the person to fill out the multiflow chart. To integrate math, students can measure the distance traveled when someone is pulled to help document the motion (how far was someone pulled). This can then be documented as part of the evidence that addresses their claim.

Explain:

DCI: Forces and Motion

You can show video about force and motion and/or read books (some suggestions listed below). In their groups, students will then state their claim (tries to answer the essential question(s)) and provide evidence that supports their claim (uses examples from their trials). There is a Claims, Evidence, Reasoning (CER) form attached for groups to fill out.

Elaborate:

SEP: Developing and Using Models

Have a group discussion about the results of each group. What did they discover? What was their evidence to support their claim that balanced and unbalanced forces affect the motion of an object? Groups can then create a model (poster) of their learning using pictures, labels, words, a title, and a chart of some kind to demonstrate understanding. Students should include the words balanced, unbalanced, force and motion on their model.

Evaluate:

SEP: Planning and Carrying out an Investigation

CCC: Cause and Effect

Formative Assessments: Students will then plan an investigation to further demonstrate the effects of balanced and unbalanced forces on an object. They will come up with a plan within small groups, conduct an investigation, state their claim, and provide evidence for their claim. You can put out various materials and students can create a trial using the materials They will then explain their reasoning to the rest of the class. Explanations can be done many ways. Here are some suggestions: FlipGrid videos, iMovie, PowerPoint, Educreations (app), Discovery Ed board, InfoGraphics (piktochart).

Resources:

Truck almost hitting wall: <https://www.ngssphenomena.com/phenomena/#/changing-forces/>

Cause and Effect Template: Tug of War: see attached document

Video on a tug of war- Kids vs. Teachers- <https://www.youtube.com/watch?v=rP2MviNn52g>

Anansi and the Tug of War- book

The Tortoise and the Elephant- book

Knowledge Transfer

Students will demonstrate the cross cutting concept cause and effect by documenting their test results on a multi flow map. They will then conduct their own investigation on balanced and unbalanced forces and the effect it has on objects. Measurement can be used to predict future patterns.