3-D Statements

Key

Practices Disciplinary Core Ideas Crosscutting Concepts

Unit Level

Students are challenged to explain how a floating train works in order to reassure nervous citizens. To solve the mystery, students plan and conduct investigations, analyze patterns in data (patterns), and obtain information about magnetic force, gravity, and balanced and unbalanced forces. Students write explanations and create physical models and diagram models to show why the train's vertical motion is stable at times and changes at times (stability and change).

Chapter 1: Why does the train rise?

Students ask questions about the floating train and discover, by analyzing patterns in data(patterns), that a force can cause an object's motion to change as it starts or stops moving (stability and change).

Chapter 2: Why does the train rise without anything touching it?

Students plan and conduct investigations and obtain information from books and from patterns in data to gather evidence (patterns) that magnetic force can cause some objects to move without the magnet touching the object (cause and effect).

Chapter 3: Why does the train fall?

Students ask questions about what causes objects to fall, and they write explanations and make models to show how the force of gravity causes the train to fall back to the track (cause and effect).

Chapter 4: Why does the train float, even though gravity is acting on it?

Students gather evidence to support the claim that two forces can act on an object at once. They discover how balanced forces can make an object's motion stable (stability and change) by planning and conducting investigations and obtaining information by reading.

Chapter 5: Why does the train change from floating to falling?

Students use mathematical thinking as they measure the distance at which magnetic force on a paper clip no longer balances the force of gravity (stability and change). They also engage in oral argumentation about balanced and unbalanced forces and create final written explanations, physical models, and diagram models about the floating train.

Lesson Level

Lesson 1.1: Pre-Unit Assessment

Students write initial explanations about what causes a train to start and stop moving (stability and change) as it rises, floats, and falls back to the tracks.

Lesson 1.2: Making an Object Move

Students ask questions about the floating train. They plan and conduct investigations to figure out many ways to cause a wooden block to start to move (cause and effect) and learn that these pushes and pulls are called forces.

Lesson 1.3: Forces All Around

Students obtain and evaluate information by reading *Forces All Around*, a book about forces that make objects start or stop moving (stability and change). The class finds patterns in data (patterns) from observations in the book and from their own investigations in the previous lesson.

Lesson 1.4: Explaining Forces and the Train

Students write explanations detailing their understanding that a force must have caused the train to change from not moving to rising up off the track (stability and change; cause and effect).

Lesson 2.1: Discovering Non-Touching Forces

Students plan and conduct investigations to gather evidence about the claim that forces can act between objects that are not touching. Observations of objects changing motion, from not moving to moving (stability and change), serve as their evidence.

Lesson 2.2: What Objects Do Magnetic Forces Act On?

Students identify patterns in data (patterns) based on their investigations of which objects magnetic force can act upon.

Lesson 2.3: Investigating Ways Magnetic Force Moves Objects

Students plan and conduct investigations with two magnets and a paper clip, and they obtain information from a reference book about the ways magnetic force can change the motion of objects (stability and change, cause and effect) by attracting or repelling.

Lesson 2.4: What My Sister Taught Me About Magnets

Students obtain information by reading *What My Sister Taught Me About Magnets* about a young girl's magnet investigations. They then use mathematical and computational thinking to analyze the data tables the girl makes (patterns).

Lesson 2.5: Explaining Magnetic Force and the Train

Students apply what they have learned about non-touching forces, magnetic forces, and change (stability and change) by making models and writing explanations showing what causes the train to rise without anything touching it (cause and effect).

Lesson 3.1: Observing Evidence of Gravity

Students begin to investigate what causes things to fall (cause and effect). They pose questions about gravity, based on patterns they notice in what they have discovered so far about gravity and other forces (patterns).

Lesson 3.2: Reading About Gravity

Students obtain information about the objects involved in the force of gravity by reading a reference book. Students construct oral explanations about what causes an object to fall (cause and effect).

Lesson 3.3: Observing Forces in Chain Reactions

Students observe changing motion as evidence of touching forces, magnetic forces, and gravity (stability and change) in chain reactions they design. They compare and contrast magnetic force and gravity based on patterns in data (patterns).

Lesson 3.4: Modeling and Explaining the Falling Train

Students use mathematical thinking as they create diagram models of forces that change the motion of several objects. They create physical models and write explanations about what causes the train to fall (cause and effect).

Lesson 4.1: One Object, Two Forces

Students discuss changes and stability in the train's motion (stability and change). They then gather evidence to support the claim that two forces can act on an object at once.

Lesson 4.2: Investigating Balanced Forces

Students discover how balanced forces can make an object's motion stable (stability and change) by planning and conducting investigations in order to balance gravity and magnetic force on a floating paper clip and by obtaining information from a reference book.

Lesson 4.3: Explaining a Bridge

Students obtain information by reading about how an engineer uses an understanding of balanced forces to explain why a bridge is stable and safe (stability and change).

Lesson 4.4: Modeling and Explaining Balanced Forces

Students ask questions about balanced forces and the floating paper clip. They then make models and write explanations about why the train floats (cause and effect).

Lesson 5.1: Investigating Unbalanced Forces

Students find patterns in data (patterns) about balanced and unbalanced forces. They use mathematical thinking as they measure the distance at which magnetic force on a paper clip no longer balances the force of gravity (stability and change).

Lesson 5.2: Hoverboard

Students engage in oral argumentation about balanced and unbalanced forces based on evidence they obtain by reading about what causes a hoverboard to rise, float, and fall (cause and effect).

Lesson 5.3: Electromagnets and Predicting Patterns

Students learn about electromagnets by obtaining information from observations and from reading a reference book. They make predictions based on patterns of repeated motion (patterns).

Lesson 5.4: Modeling the Train

Students make two kinds of models—physical models and diagrams—to show why the train rises, floats, and falls. These models demonstrate students' understanding of balanced and unbalanced forces and stability and change (stability and change).

Lesson 5.5: End-of-Unit Assessment: Students' Explanations

Students write explanations about why the train changes from floating to falling (stability and change). They define problems that could be solved by new inventions that use magnetic force.