Action, Reaction

Forces and Motion

Alonna Smith
Published by *K20 Center*

Grade Level	6th – 8th Grade	**Time Frame**	4-5 class period(s)
Subject	Science	**Duration**	250 minutes

Essential Question

How does our knowledge of energy transfer influence our daily lives?

Summary

This lesson focuses on applying Newton's third law of motion and on finding solutions to problems associated with collision. By the end of the lesson, students will be able to examine and explain evidence to support Newton's third law of motion, identify a real-world problem involving a transfer of energy and collision, then apply their understanding through scientific principles to design, modify, test, and compare their own solutions.

Snapshot

Engage

Students begin by watching a video about collisions in football. While watching, students record what they notice and what they wonder.

Explore

Students work through three activity stations that allow them to observe Newton's third law of motion.

Explain

Students use a T-chart to guide a class discussion about what they discovered in their activity stations.

Extend

Students research, design, and build a "helmet" for an egg, melon, or apple.

Evaluate

Students create a PSA on how to stay safe in a collision.

Standards

Next Generation Science Standards (Grades 6, 7, 8)

MS-PS2-1: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

Oklahoma Academic Standards (7th Grade)

7.ESS3.1.2: Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes.

Attachments

- Bell Ringer Handout—Action, Reaction - Spanish.docx
- Bell Ringer Handout—Action, Reaction - Spanish.pdf
- Bell Ringer Handout—Action, Reaction.docx
- Bell Ringer Handout—Action, Reaction.pdf
- Design a Helmet—Action, Reaction - Spanish.docx
- Design a Helmet—Action, Reaction - Spanish.pdf
- Design a Helmet—Action, Reaction.docx
- Design a Helmet—Action, Reaction.pdf
- Interacting Forces T-Chart Handout—Action, Reaction - Spanish.docx
- Interacting Forces T-Chart Handout—Action, Reaction - Spanish.pdf
- Interacting Forces T-Chart Handout—Action, Reaction.docx
- Interacting Forces T-Chart Handout—Action, Reaction.pdf
- Lesson Slides—Action, Reaction.pptx
- PSA Handout—Action, Reaction - Spanish.docx
- PSA Handout—Action, Reaction - Spanish.pdf
- PSA Handout—Action, Reaction.docx
- PSA Handout—Action, Reaction.pdf
- Stations Journal—Action, Reaction - Spanish.docx
- Stations Journal—Action, Reaction - Spanish.pdf
- Stations Journal—Action, Reaction.docx
- Stations Journal—Action, Reaction.pdf

Materials

- Lesson Slides (attached)
- Bell Ringer Handout (attached, one per student)
- Design a Helmet Handout (attached, one per group of 2-4 students)
- PSA Handout (attached, one per student)
- Stations Handout (attached, one per student)
- T-Chart Handout (attached, one per student)
- Student devices with Internet connectivity
- Eggs, apples, or melons
- Building materials such as paper, cardboard, bubble wrap, egg cartons, or whatever is available
- Newton's cradle (several, if available)
- Dice within Dice (several sets, if available)
- Balloons
- Fishing line
- Straws
- Tape
- Sticky notes

Engage

Use the attached Lesson Slides to guide the lesson. Introduce the lesson title, essential question, and lesson objectives on **slides 2-4**. Then, move to **slide 5** and distribute a copy of the attached **Bell Ringer handout** to each student. Use the Bell Ringer strategy to elicit prior knowledge; ask students to describe a collision they have experienced or witnessed. This doesn't have to be a car collision; it could be two people running into each other or someone running into an object. Have a few volunteers share what they wrote.

Teacher's Note: Vocabulary Use

Focus on equal and opposite reactions during the Bell Ringer discussion, but do not use academic language (action, reaction, force, energy) unless a student brings these terms up first.

Go to **slide 6** and have students watch this video. (The video is linked in the Lesson Slides, and the full URL is available in the Resources section below.) As they watch the video, direct students back to the Bell Ringer handout to apply the I Notice, I Wonder strategy. Have them jot down what they observe and what questions they have about the information in the video.

After the video, have students pair up to discuss their observations and questions with a partner using the Think-Pair-Share strategy and the space provided on the Bell Ringer handout. Students should write down what they had in common with, and what was different from, their partners' observations and questions.

Embedded video

https://www.youtube.com/watch?v=Aa53zQlnpe4

Explore

Teacher's Note: Station Set-Up

Prior to this activity, set up three types of stations in the classroom. For average-sized classes, set up two of each station to limit the number of students at one station at a time. The three stations are described in detail below.

Go to **slide 7**. Invite students to conduct their own experiments with the station activities to observe patterns and collect data on interacting forces. The stations enable students to interact with the principles of Newton's third law of motion. Give each student a copy of the attached **Stations Journal** and instruct them to use it as a guide, documenting their answers to the questions posed on the handout as they work through the stations. Allow students to spend 5-7 minutes at each station before rotating.

Balloon Rocket Stations: To ensure that students are using their time efficiently, set up the fishing line before class, but allow students to attach the straw and balloon to the string. Watch the YouTube video about a balloon science experiment that provides an example of what the balloon rocket should look like.

Newton's Cradle Station: Allow students to interact with Newton's Cradle and answer questions based on their interactions.

Double Dice Station: Have students interact with the double die to help them understand what happens to the human brain during a collision.

Explain

Lead a whole-class discussion about the patterns students noticed in the station activities. Review the questions that students were asked on their Stations Handout to guide the discussion.

Go to **slide 8**. Distribute one of the attached **Interacting Forces T-Chart handouts** to each student. Ask them to summarize what they learned about interacting forces during the station activities by listing what they found out on the left side of the T-Chart, and then diagramming evidence (or providing evidence some other way) to support the claims on the right side.

Ask for volunteers to share something they found out during the station activities. Write this information on the left side of the whole-class T-Chart. On the right side of the T-chart, lead students in diagramming evidence (or providing evidence some other way) to support the claims made on the left. Use the T-chart provided on **slide 9** or create your own on the board.

Sample Student Responses

On the left side, students might share that when they released the balloon, air came out in one direction and the balloon moved in the opposite direction, or that when one marble of the Newton's Cradle is pulled up and then released, another marble on the opposite side will bounce up.

Go to **slide 10**, which notes about Newton and Newton's third law. Spend a few moments introducing Newton to the class. You may wish to note Newton's first and second laws of motion as well.

Relate Newton’s third law of motion to the students' experiences at the stations in the Explore phase. Define the phenomena students experienced in the Engage and Explore of "every action having an equal and opposite reaction." Use the picture of two people on ice skates pushing on each other's hands as an additional example to help students conceptualize Newton’s third law.

Extend

Continue to **slide 11**. Divide the class into groups of 2-4 students each. Distribute the attached **Design a Helmet** handout to each group. Ask groups to use their Internet-connected devices to research helmet designs and examine cross-sections of different types of helmets—such as football, baseball, and bicycle helmets—from the past and present. They should make notes on the structure and materials that were used to build the helmets. After they've completed their research, ask groups to select a prototype to use as inspiration for an upcoming "test drop," in which they will design a "helmet" to protect an egg, apple, or melon as it is dropped from a specified height.

Teacher's Note: The Drop

Instruct students to bring common, recyclable materials from home to use in the construction of their helmet. You can choose whether to provide the students with an egg, apple, or melon to serve as the "head" the helmet will protect. You may also choose the location and height of the drop. It will need to be high enough to cause an impact, as in this example video. Set timelines for students as you see fit for the helmet design and drop stages of the lesson.

Go to **slide 12**. Have students follow the instruction for drawing and labeling their design on the Design a Helmet handout. Be sure to approve each initial design and offer any support needed. Once the initial design is approved, have students continue working in teams to build their helmet using the common materials brought from home. After building their design, invite groups to test their helmets by dropping the selected item from a specified height. After each drop, allow students to give their peers feedback on the design (e.g., "Here is what I like about the design" and "Here are my suggestions"). This feedback can be written on sticky notes or similar. Students will then use the feedback to rebuild and retest their helmets.

Teacher Note: Science And Engineering Practices

The redesign process in this phase is important to fulfill the science and engineering practices outlined by the Oklahoma Academic Science standards.

Evaluate

Continue to **slide 13**. Distribute a copy of the **PSA Handout** to each student. Instruct students to create a Public Service Announcement (PSA) about how to stay safe in the event of a collision. Students may choose to create a poster, a video, or a radio announcement. Students can choose any type of collision that involves the use of helmets as protection, but they should record their ideas on their handouts to indicate the subject of their PSA to you. Ask the students to use the rubric on the second page of the PSA handout as a guide for this portion of the lesson. Prior to starting the activity, go over each element from the rubric that needs to be included in the PSA.

Optional: Tech Integration

Posters: Canva, Piktochart, LucidChart, etc.; or does this assume the poster will be digital? What would a video or radio announcement look like?

Resources

- Cool Science Experiments Headquarters. (August 4, 2015). Balloon rocket science experiment [Video file]. YouTube. https://www.youtube.com/watch?v=DVlf-HwdyTU
- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (n.d.). Canva. Tech Tools. https://learn.k20center.ou.edu/tech-tool/612
- K20 Center. (n.d.). Piktochart. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2394
- Spangler Science TV. (January 12, 2011). Helmet safety - Cool science fair project [Video file]. YouTube. https://www.youtube.com/watch?v=h7g723Rhuyk
- TODAY. (September 29, 2017). The new football helmet that could save kids from concussions [Video file]. YouTube. https://www.youtube.com/watch?v=Aa53zQlnpe4&feature=youtu.be