

Need for Speed

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Grade Level

3rd grade

Lesson Overview

Students will learn about vehicle and passenger safety while solving a challenge using limited time and materials.

Learning Objectives

Students will understand the meaning of balanced and unbalanced forces in physics. Students will collaborate in small groups. Students will design a model, test its success, and identify areas for improvement. Students will iterate their prototype and retest in multiple trials.

Standards

NGSS 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.

NGSS 3-5-ETS1-1: Design a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.

NGSS 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Preparation

- Students should be well acquainted and know each other's names.
- Students should have experience working in small groups on a design project.
- A 5-to-8-foot ramp must be built with a Point A and Point B clearly labeled, this can be made from cardboard.

Materials and Resources

- Pinewood Derby Car Kit
- Prototyping supplies: Cotton balls, balloons, rubber bands, popsicle sticks, tape
- Hardboiled eggs: 2 eggs for each group of three for multiple trials

- 5 feet of cardboard
- Balanced and unbalanced forces diagram
- Vehicle and Passenger Safety Survey Data: attached
- Pinewood Derby Rules:
<https://www.northernstarbsa.org/Forms/Activities/PinewoodDerbyRules.pdf>
- Airbag Locations: <http://www.firerescue1.com/data/bagsairdan.jpg>

Activity 1: The Challenge (10 minutes)

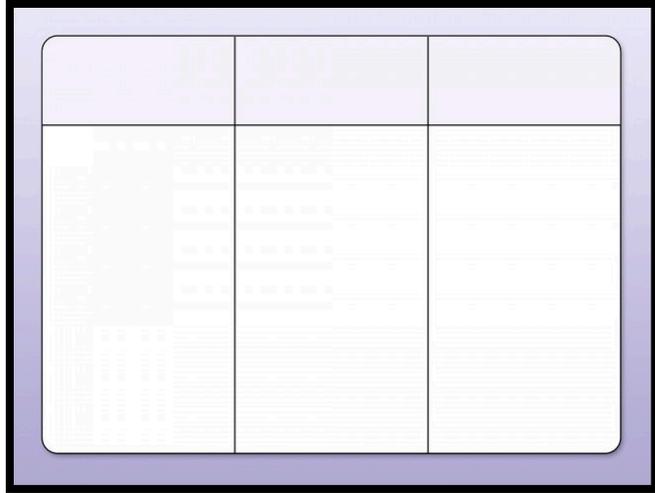
1. Gather the students in a circle.
2. Review balanced and unbalanced forces using a diagram.
3. “Today we will be working on cars. First I’m going to share some information with you.”
4. Share the passenger safety survey data, the Pinewood Derby Rules, and the Airbags location documents to share context for building empathy for the user.
5. Introduce the challenge to the whole group.
6. “Here is your challenge: You must transport a boiled egg (“Eggbert”) from Point A to Point B without it cracking. You will have cardboard, balloons, rubber bands, popsicle sticks, cotton balls, a boiled egg and a pinewood derby car kit. You will have 30 minutes to design and test your car. We will be working in groups of three.”
7. “Although the data shows that brakes and drivers are important parts of vehicle safety, Eggbert does not have legs to use breaks nor arms to steer. You must design a vehicle that protects him based on the information you have and his needs as a passenger.”
8. Assign groups.
9. “Remember, we learn the most when things don’t go as planned, and some of the best ideas come from our biggest failures!”
10. “We will let you know when there are five minutes left. Good luck!”

Activity 2: Jam Time (30 minutes)

1. Students will be invited to use prototyping materials and the pinewood derby car kit to begin solving the challenge.
2. Instructors will stand by to help with cutting of materials or to be thought partners when groups get stuck or frustrated.
3. Instructors will observe groups to witness learning moments to debrief about later.

Activity 3: Unpacking the Challenge (10 minutes)

1. “How did it go, did anyone’s egg crack? Did the car make it from Point A to Point B?” Students will answer (almost, no, yes).
2. “We will go around the circle and each team will share how they designed their car, the biggest challenge they faced, and a piece of advice for someone just starting the challenge.” One group member from each group will share their experience.
3. Record successes, challenges, and advice using a 3-column T-chart.



4. When all the groups have shared ask the students to notice similarities as a group. Ask the students, “Were any of the challenges or successes the same group to group? At what points in the challenge did we learn the most or were we most frustrated?”
5. “When we see similarities in our challenges we can empathize with other students and other groups, as well as other designers. As we empathize we see others’ perspectives as well as gain an opportunity to reflect on our own strengths and challenges.”
6. “What did you learn about vehicle and or passenger safety? What advice would you have for people driving in real vehicles?” Students will answer (seatbelts are important).
7. Discuss the importance of safety in vehicles and why we have laws about passenger safety.

Activity 4: Iterate it! (10 minutes)

1. “Now you will have five minutes to iterate on (change/fix) your prototype based on the information you learned in the debrief.”
2. Gather the students back in a circle and conclude the lesson. “Please share one thing you changed and if it worked or not.” Students will respond.

Troubleshooting

Students may have trouble working in groups and sharing responsibilities.

Groupings should allow for students to be successful while working with a diverse range of students. Each team should have students with varying skills sets, strengths, and challenges. If you are aware of a difficult dynamic between two students, it may not be a good idea to put them in the same group (until they are ready to work on their relationship by designing together).

Students may also find collaborating is a challenge, especially when there is a wide range of ideas.

It may be a good idea to save this lesson for later in the school year when students have had other opportunities to collaborate without time and material constraints.

The students may become frustrated if they can't create a design that allows them to reach the goal.

It is important that the classroom culture is a safe place for learning and failure. Prototypes should be celebrated, and lessons should be learned from designs that fall short of the goal. In the debrief make sure to reflect on all of the learning that happens when the design doesn't go as planned.

Students might feel pressure from the time constraint and become frustrated.

This approach may not work for all students, especially those with learning disabilities or students who freeze when under the clock. Differentiate for those who need it! You can tell students about the challenge ahead of time and invite them to ask questions so they have time to process the information.

Make sure conversation and content is age-appropriate. A student may have been in an accident and want to share details. Students who have been in accidents may feel some kind of trauma.

Be aware of the maturity of the group when discussing this topic. Cars are a tool we use every day, and there are often tragedies related to car crashes. Cars can be dangerous machines when not operated correctly, and it is important for students to understand the significance of passenger safety while not being overwhelmed by it.

Assessment

The instructor will know the activity is successful if all students participate, the students create cars that protects the eggs, the cars makes it from Point A to Point B, and students share out about their experience.

If students are able to reflect on the experience, sharing their designs, challenges, and advice for future designers, this will reflect their understanding.