



# LESSON PLAN

## GRAVITATIONAL FORCE GRADES 6-8

### SUMMARY

Students engage in an activity to figure out what size parachute works best to get an object to the ground without damage.



**MS-PS2-4.** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Science & Engineering Practices	Connections to Classroom Activity
<b>Using Mathematics and Computational Thinking</b>	<ul style="list-style-type: none"><li>• Students design a parachute to land an egg. Students must use computational thinking when designing their parachute to make decisions about the size of the parachute and compare it with the size of the object being dropped.</li><li>• Students will also use math when scaling their parachute to land a heavier object.</li></ul>
Disciplinary Core Ideas	Connections to Classroom Activity
<b>PS2.B: Types of Interactions</b>  Newton's Law of Universal Gravitation and Coulomb's Law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.  Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space and can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	<ul style="list-style-type: none"><li>• Students figure out relationships between gravity and resistance during the parachute activity.</li><li>• Students learn about gravitational force between objects by watching the Generation Genius video.</li></ul>

## Cross Cutting Concepts

## Connections to Classroom Activity

### Patterns

- Students analyze pattern of gravitational forces and resistance.

## DURATION

90 min.



## ENGAGE

Tell students you came across an interesting video the other day and would like to share it with them to see what they think. Have students create a t-chart. Ask them to write *Notice* on one heading and *Wonder* on the second. Tell them to record observations in the notice column and questions in the wonder column. Play the video "[Humvee Airdrop](#)" from 1:00 min. to the end.

Have students discuss what they notice and wonder in small groups for 5 minutes. Each group will need to share what they noticed and wondered when time is up.

Ask groups to share their collective observations and record them on the board to reference later in the lesson. Common observations include trucks were being dropped from the plane, parachutes were used so the trucks wouldn't smash on the ground, and the trucks looked like they were on pieces of wood. Next, have groups share what they wonder and document these questions as well. Questions could include *Trucks are heavy, why didn't they smash to the ground? How can parachutes slow down something so big? Why would we need to drop trucks out of a plane?*

Tell students that parachutes have been used for many years and for many reasons. Have students discuss ideas for why people use this method to get items from one place to another. Ideas will vary, but many students will reference things they have seen in person or on a screen.

Next, ask students what they think parachutes do. Many students will know that parachutes are used to slow things down that fall from the sky. Then tell them to work in their groups to develop a model (on scratch paper or a whiteboard) to explain how parachutes work.

As students create their models, look for misconceptions and incomplete ideas, such as the following:

- Size of the parachute compared to the weight of the object
- Missing key ideas like gravity and resistance
- Durability of container to withstand the landing and keep objects safe

It is not important to correct these misconceptions or incomplete ideas at this time. As students' progress through the rest of the lesson, they will be prompted to consider these ideas during their design task.

When groups are finished with their parachute models, have students participate in a gallery walk to provide feedback on other group models. Remind students that feedback needs to be based on evidence and not opinion and questions need to be for the purpose of clarification. Groups may revise their parachute models based on feedback from their peers.

## MATERIALS

- Garbage bags
- String
- Plastic eggs (for trials)
- Real eggs (for challenge)
- Tape of different kinds, glue, and poster putty
- Scissors
- Hole punch
- Straws (optional)
- Different size washers, marbles, or things that can be added for weight inside the plastic egg (to approximate the weight of an egg)
- Digital scale (can weigh in ounces or grams)
- Stopwatch or timer
- Video camera or cell phone for recording egg drops (optional)



## EXPLORE

Say to the class, “As you have seen and discussed, parachutes are used to get many different things to the ground.” Tell students that today they are going to engage in a design challenge. In their small groups, they will need to design a parachute that will get an egg safely to the ground without cracking. Explain that when engineers design parachutes for heavy loads, they often test them using smaller items to see which designs work best. (*Optional:* Inform students that groups that successfully land their egg may have an opportunity to scale up their design to land a heavier load.)

Tell students they will be using plastic eggs for their trials. Plastic eggs weigh less than real eggs, so they will need to open their eggs and add materials inside (e.g., washers and marbles) to get them to weigh between 2.0 and 2.5 ounces (56–71 grams).

Show students the materials they will use to build their parachute and explain any safety protocols and if there are limits on any of the materials. (If materials are limited, giving out bundled materials is an option.) Explain that they will also need to use these materials to attach the parachute to the egg. Show students the testing area. If the area is outside the classroom, tell students the expectations for using the testing area.

Break students into groups of three or four students and tell them the first step is to draw a design of their parachute. Tell students that when the design is complete, they will need to show it to the teacher to have it approved. Give them no more than 10 minutes to design.

Next, give students time to build their parachute, attach their egg, and test it in the testing area. Time allowed for building and testing can vary but should be at least 30 minutes and can be divided into different days.

As students revise their parachutes based on testing, have them update their design. Designs should include the length of their parachute lines, the length and width of their chute (or circumference if making a round chute), a materials list, and any other information that they would need to scale up their model.

When development time is up, have students detach the plastic egg and attach the real eggs.

As students drop their eggs, have them time how long it takes them to get from the launch to the land. (*Optional:* Record the drops on a video camera or cell phone.) If dropping eggs inside, make sure the landing site is covered in plastic in case of failures.



## EXPLAIN

After the investigation, have students analyze their results. Allow groups time to assess their designs to look for strengths and areas of improvement. Circle back to the video from the beginning of the lesson by asking students how their parachutes compared with the ones they saw in the video.

Engage students in a discussion about what they felt was successful and why. Have students explain their thinking around parachutes and how they work. At this point, many students will bring up the idea of gravity but might not know the word *resistance*. It is not important at this point to give them that word; however, many students will understand the concept that the parachute slows things down because the air hits the inside of the chute.

After students have shared their ideas and explanations, confirm that gravity plays a role in how parachutes work because gravity pulls things down. Ask them if they think the force of gravity does anything else? Allow students to share their thoughts about gravity.





## ELABORATE

Many students will know that gravity is the force that pulls objects down to Earth, but tell students the force of gravity is responsible for many other things.



### WATCH THE GENERATION GENIUS GRAVITATIONAL FORCES VIDEO AS A GROUP

After the video say, “You all said that gravity pulled things down to Earth, but what new things about gravity did you learn from the video?” Have students share what they learned.

Lastly, have students develop an explanation for how parachutes work to land objects successfully to the ground from a plane or other tall peak.



## EVALUATE

There are multiple ways to assess your students’ understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.



## EXTENSION

Have students scale up parachutes that successfully landed an egg. Parachutes could be scaled up to land an object that weighs a pound or more. However, this option will depend on the availability of drop sites. The extension activity will give students the opportunity to engage in problem solving and math skills because students will need to use ratios to build to scale.

