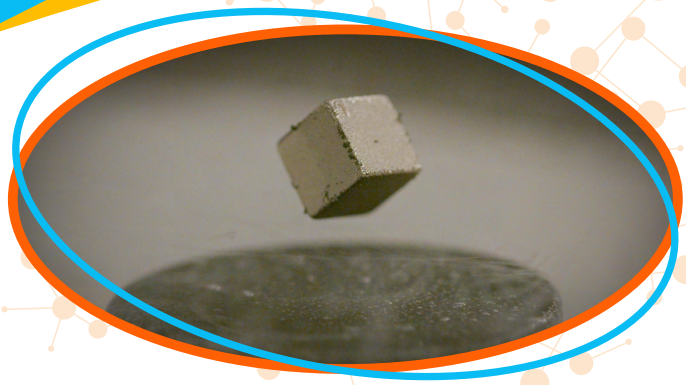
GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.



TEACHER GUIDE

NEWTON'S LAWS OF MOTION
GRADES 6-8

COMMON MISCONCEPTIONS

- **Objects at rest have no forces acting upon them.**
  The idea that forces are acting upon all objects, whether at rest or moving, is difficult for some students. An object sitting still on a table has forces acting on it equally that cause it to be still. The force of the table is pushing up with the same amount of force as gravity pushing down.

- **Objects in motion need a continual force acting upon them to keep them in motion.**
  Students might think an object in motion needs a continual force to keep it moving because they can't see some of the forces that are slowing it down. When a bike is pedaled, the force of the feet pushing the pedals gets the bike moving. The reason the movement does not continue forever once pedaling stops is due to forces we can't see such as friction with the road, gravity and air resistance.

NEWTON'S 1ST LAW OF MOTION

Newton's 1st law of motion, sometimes called the law of inertia, typically states that a body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force. For middle schoolers, simplifying the definition may help them understand it better. Stating that an object's motion won't change unless acted upon by a force works well for middle schoolers. In the case of Newton's 1st law, an object could be completely still, or moving. More simply stated, objects tend to continue doing what they have been doing. This law can be demonstrated in so many relevant scenarios such as kicking a ball or stopping a rolling ball with your foot.

NEWTON'S 2ND LAW OF MOTION

Newton's 2nd law of motion is a little more complicated than the first. This law is typically represented by the equation Force = Mass x Acceleration. With this equation in mind, middle schoolers need to understand that more force would be required to make something heavier move as much as a lighter object. This particular law is developed more fully in high school.

NEWTON'S 3RD LAW OF MOTION

Newton's 3rd law of motion states that for every action there is an equal and opposite reaction. There are many excellent

examples of this in everyday life, such as bouncing a ball, or playing ping pong. If students were to drop a ball from a certain height, it would bounce back, but not quite equally. This is due to other forces acting on the ball such as friction and air resistance.

TEACHER TIPS

Newton's Laws of Motion can be abstract and difficult for students to understand. Many students typically memorize the laws, but don't fully understand their concepts. Giving students opportunities to engage in hands on experimentation can help them to conceptualize the laws.

ABOUT THIS LESSON

This lesson was created by the National Science Teaching Association (NSTA) to pair with the Generation Genius video and support *NGSS*.

They have requested we provide the following background with this lesson:

The Next Generation Science Standards (NGSS) are the national standards on how students learn science, and they are based on contemporary research presented in *A Framework for K–12 Science Education (the Framework).* The shift in science teaching and learning required by the Framework is summarized in this infographic: A New Vision for Science Education.

At the start of each Generation Genius lesson, students are presented with a phenomenon, then they try to explain it. Students will notice they have gaps in their knowledge and ask questions, which motivates them to build ownership of science ideas they need in order to explain how or why the phenomenon occurred. The way students build ownership of science and engineering ideas is through active engagement in the science and engineering practices (SEPs). This process of sensemaking, or doing science to figure out how the world works, is one of the major shifts the *Framework* encourages.

To engage in the SEPs, students should be part of a learning community that allows them to share their ideas, evaluate competing ideas, give and receive critiques, and reach consensus. Students can start by sharing ideas with a partner, then with a small group, and finally, with the whole class. This strategy creates opportunities for all students to be heard, build confidence, and have something to contribute to whole-class discussions. Each Generation Genius lesson provides conversational supports to facilitate such productive student discussions to contribute to sensemaking.

Excited to continue your shift toward the new vision for science education? Check out the Generation Genius Teacher Guide page on the NSTA website for resources and strategies to engage every student in your classroom in **doing** science.