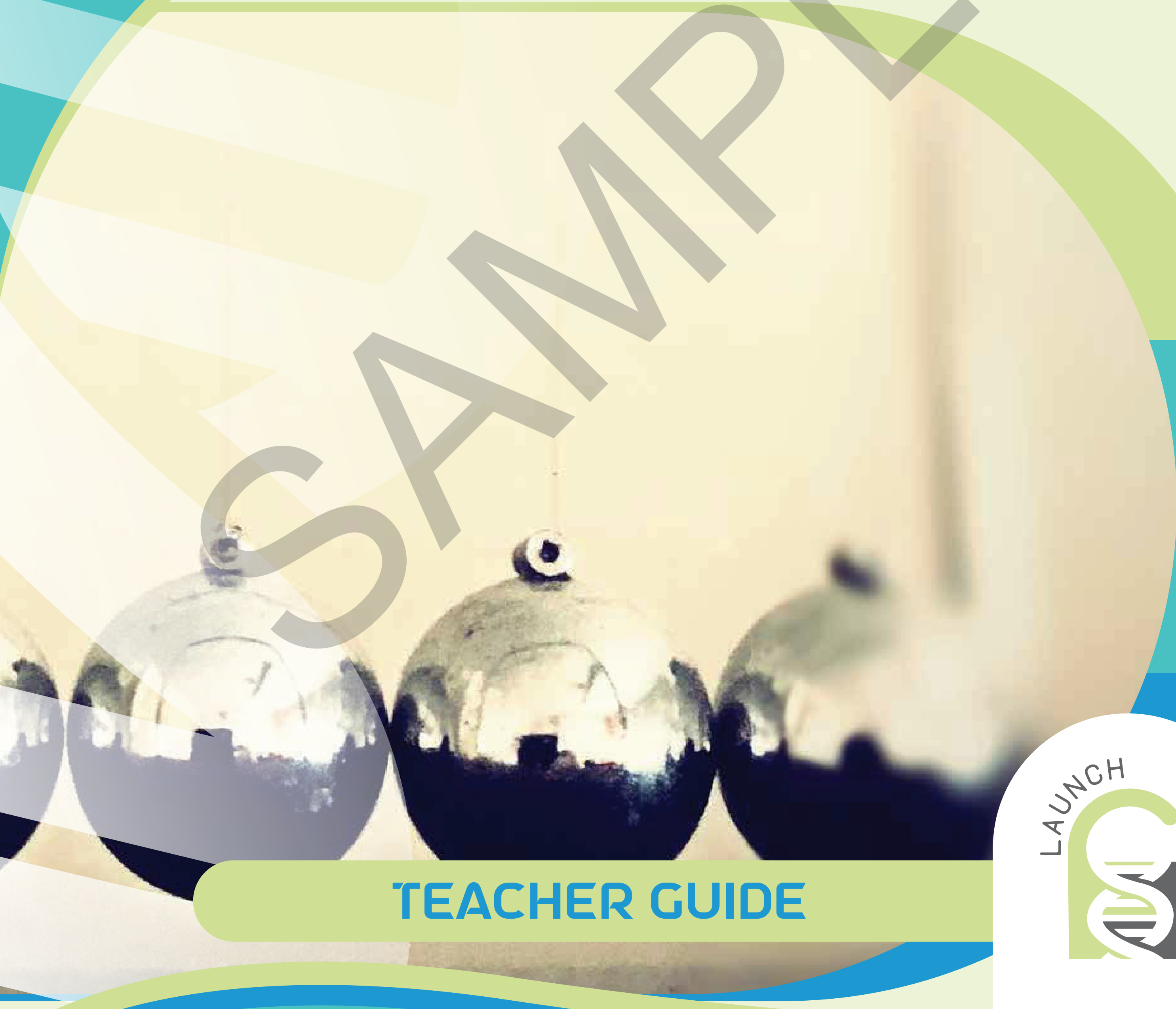
NEWTON'S NOTIONS



TEACHER GUIDE

LAUNCH

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: SURPRISING SPIN Watch what happens to objects in a spinning water-filled tube, and begin a KWLQA chart. **Time required: 1 hour**	☐ SPIN IT AROUND! ☐ PUT YOUR OWN SPIN ON IT	30 minutes	Day 1
	☐ IS YOUR HEAD SPINNING?	30 minutes	Day 2
ACTIVITY 2: INERTIA DROP Use the magic, nay, science of inertia to explain why some objects just stay put, practicing Newton's First Law. **Time required: 2 hours**	☐ GET TO KNOW NEWTON	45 minutes	Day 3
	☐ PUT INERTIA TO THE TEST	30 minutes	Day 4
	☐ SHOW WHAT YOU KNOW	45 minutes	Day 5
ACTIVITY 3: NEWTON'S...TUBE? It's not Newton's cradle, but it works the same way and is a great introduction to Newton's Second Law. **Time required: 2 ¾ hours**	☐ CONNECTING ENERGY AND FORCE	60 minutes	Day 6
	☐ MOMENTUM IN A TUBE ☐ MANIPULATING MOMENTUM	60 minutes	Day 7
	☐ SHOW WHAT YOU KNOW	45 minutes	Day 8
ACTIVITY 4: RAMP RUNS Race different balls down ramps to learn about gravity and how it fits into Newton's Second Law. **Time required: 2 ¼ hours**	☐ RAMP IT UP	30 minutes	Day 9
	☐ HOW ATTRACTIVE!	60 minutes	Day 10
	☐ SHOW WHAT YOU KNOW	45 minutes	Day 11
ACTIVITY 5: WHAT A DRAG Explore a new type of force – friction – as measure the drag on a weighted			

activity 2

INERTIA DROP

Your student will get insight into "magical" tablecloth pulls by finding out they have a lot to with Isaac Newton and the work he did in discovering the basic laws of physics.

LEARNING GOALS:
I can use mathematical models to show that the total momentum of a system of two objects moving in one dimension stays the same unless there is a net force.

GET TO KNOW NEWTON

CONTENT

- To understand the spinning water tube, your student will study the work of Isaac Newton.
- A short biography of Isaac Newton is included (in the context of the laws of motion).

6

PREDICT

Question: Who was Isaac Newton – when and where did he live? What did he do?
Answer: Answers will vary. Most students have heard of Isaac Newton and know he has something to do with gravity or motion, but they're likely not sure of the details about his life and work.

7

CONTENT

- This section includes a reading selection about Newton's major work, the *Principia*, which introduced the three laws of motion.
- The vocabulary term **physics** is defined.
- Your student will learn the First Law of Motion (the Law of Inertia) in this activity, and the other two later.
- Here's some additional background for you (you can share with your student if you think they'd be interested).
  - Newton was 43 years old when he published the *Principia*, which is relatively young by today's standards but not by those of the 17th century.
  - While Newton was an accomplished scholar, having given optics lectures for Cambridge and invented Calculus, he had not yet published most of the ideas he's known for today.
  - In 1684, Newton's friend Edmond Halley (yes, as in Halley's comet!) had a discussion with the famous English scientists Christopher Wren and Robert Hooke. They were having trouble determining the equations that predict planetary motion, and Halley decided to go and ask the best mathematician he knew: Isaac Newton.
  - Newton claimed he had already done the calculations long ago but lost his notes about them. He spent the next few months redoing the equations.
  - When Halley brought the work to the Royal Society (the main scientific organization in England at the time), they were impressed and wanted more. Astronomy was not Newton's favorite topic (he really preferred light), but Halley convinced Newton that if he didn't publish a larger work about planetary motion, Hooke would.

3 activity NEWTON'S...TUBE?!

Here, your student will make a simple version of a Newton's cradle to demonstrate how energy is conserved in moving objects. This will help them learn more about why the objects in the spinning water tube moved the way they did.

LEARNING GOALS:

- ✓ I can use mathematical models to show that the total momentum of two objects moving in one dimension stays the same unless there is a net force.
- ✓ I can use data to show that Newton's Second Law of Motion describes the relationship between net force, mass, and acceleration of an object.

CONNECTING ENERGY AND FORCE

13

CONTENT

- Follow along with your student, or allow them to work independently, as they read about the connections between energy, momentum, and force.
- The terms energy and momentum are defined.
- The following equations are introduced: momentum **($p=m \times v$)** and the force-momentum relationship **($F=\Delta p/\Delta t$).**
- They will also see an example of a word problem that uses the equations for momentum and force to solve a problem. Make sure they pay close attention to the worked example because the questions that follow are similar.

14

CONTENT

- Your student will use the relationship (equation) of momentum, mass, and velocity to solve three word problems.

MULTIPLE AGES AND ABILITIES:

The ability to do these word problems using equations is valuable, especially for older students, but it is not necessary to move on to the next section. You can do them and have your student listen, or you can skip them altogether. It is more important that your student understands the conceptual relationships between the variables in the equations; for example, increasing mass or velocity will increase the momentum, and changing a momentum over a short period of time requires more force than doing so over a long period of time.

There are several instances of using equations to solve problems throughout this kit; however, you can treat them all this way and still get a complete conceptual experience if the math is out of reach. On the other hand, please don't avoid the problems just because they involve math. The required math understanding is Algebra I level, which is commonly used in secondary school physics courses. With your guidance, these types of problems can be excellent confidence builders.

EQUAL AND OPPOSITE

35

CONTENT

- Follow along as your student learns the definition and applications of thrust.

THINK ABOUT IT!

Question: If you wanted to move forward on the skateboard and you had a large rock, what could you do? Explain using the terms thrust, action force, and reaction force.

Answer: If you throw the rock backward, the thrusting backward action force will result in the reaction force of moving forward.

How to Help: *Feel free to add other examples as needed, like kickback from a gun, a hammer hammering a nail, or a ball bouncing on the ground.*

36

CONTENT

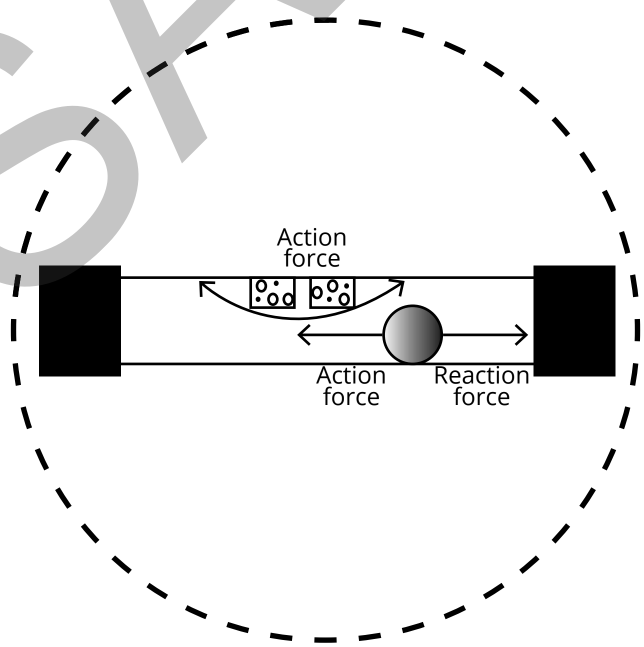
- Follow along as your student reads this short selection that introduces Newton's Third Law, which at this point is more like a summary of what they just learned in the previous sections, just with some additional vocabulary.

REFLECT

Question: In the spinning water tube, how can Newton's Third Law explain the behavior of the corks and steel balls? Draw a picture to show the action and reaction forces.

Answer: Your student might benefit from drawing the imaginary circle the tube is moving around. If they do, here's a sample of possible student work.

Notice how this student has labeled the action and reaction forces on the steel ball with the same size arrow, but, because they don't yet know why the behavior of the corks is different, they neglected to include a reaction force arrow on the cork.



LAUNCH
SCIENCE UNLOCKED

Contact us at: www.homesciencetools.com/customer-service/

A Product of Homesciencetools.com

Kit	SU-NEWTON
Instructions	IN-NEWTONT
Revision Date	3/2021