Eggs and inertia

BY TODD HOOVER

A basic photo of an egg recently broke the world record for most likes on Instagram. The egg has more than 53 million likes. Since a simple image of an egg has become so popular, it is a great time to create a lesson focusing on science concepts associated with eggs. Consequently, this month's column describes how eggs can be used to review the concept of inertia. (See Online Supplemental Materials for videos showing how to carry out certain phases of this activity.)

Materials

Note: Select the number of materials based on whether you want to perform a demonstration or have groups or individual students carry out the activity.

- raw egg
- table salt
- hard-boiled egg
- investigation tools, if desired, such as scales, flashlights, etc.
- empty water/soda bottle
- bowl or plate

Engage

To engage your students in thinking about the physical properties of eggs, challenge them to stand an egg on end on the smooth surface of a table. Students will find it difficult, if not impossible, to make the egg stand upright. Next, have the students create a small pile of salt on the table, and ask them to attempt to stand the egg on end atop the pile of salt. With a little bit of trial and error, students should be able to make the egg stand (Figure 1).

Explore

For the Explore phase, provide each group one raw egg and one hard-boiled egg. Then, have students spend five minutes developing a way to tell which egg is hard-boiled and which egg is raw—without breaking the egg! If you provide students with tools such as flashlights and balances, some students may be able to distinguish the raw egg from the hard-boiled egg because the raw egg is more translucent. Students may come up with other ideas and the teacher should analyze them on a case-by-case basis to determine if the method is an effective way to tell the difference between a raw and hard-boiled egg.

FIGURE 1: Egg on salt

Next, have students conduct a spinning test by spinning the eggs on their side. While the eggs are spinning, have students extend an index finger and quickly tap the top of the egg. If the egg does not begin spinning again in a circular motion, it is a hard-boiled egg. If the egg does

start slowly spinning after being quickly tapped, then it is the raw egg. Newton's first law of inertia explains this phenomenon: An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

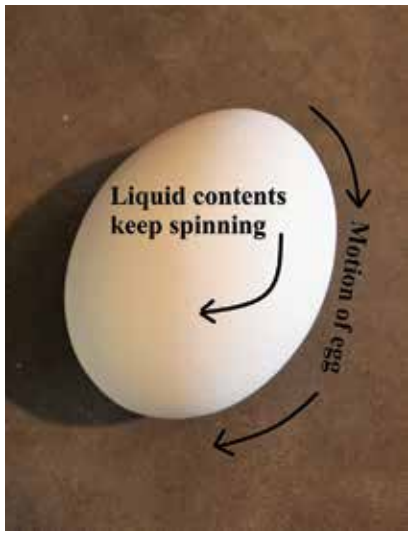
When the hard-boiled egg is tapped, the entire egg comes to rest because it is solid inside. When a raw egg is tapped, its liquid egg white and yolk continue to move even though the shell comes to rest. When the student removes his or her finger, this moving force inside the egg causes the entire egg to start spinning again (Figure 2).

Note: Students may notice that the hard-boiled egg tends to spin faster than the raw egg when they are both spun with the same amount of force. The liquid inside the raw egg slides about and causes the center of gravity to shift and prevents the egg from spinning quickly. The solid egg, if spun with enough force, will conserve energy by spinning on its end in a smaller circle (see Resources for more information).

Explain

Next, ask students to share their results with the class. Students should demonstrate and construct a scientific explanation describing what is happening to the eggs based on their investigation. However, if you find students need additional information, have them read about this experiment via an article titled "Newton's Laws of Motion Explain Spinning Eggs" (see Resources).

FIGURE 2: Diagram of spinning egg



Elaborate

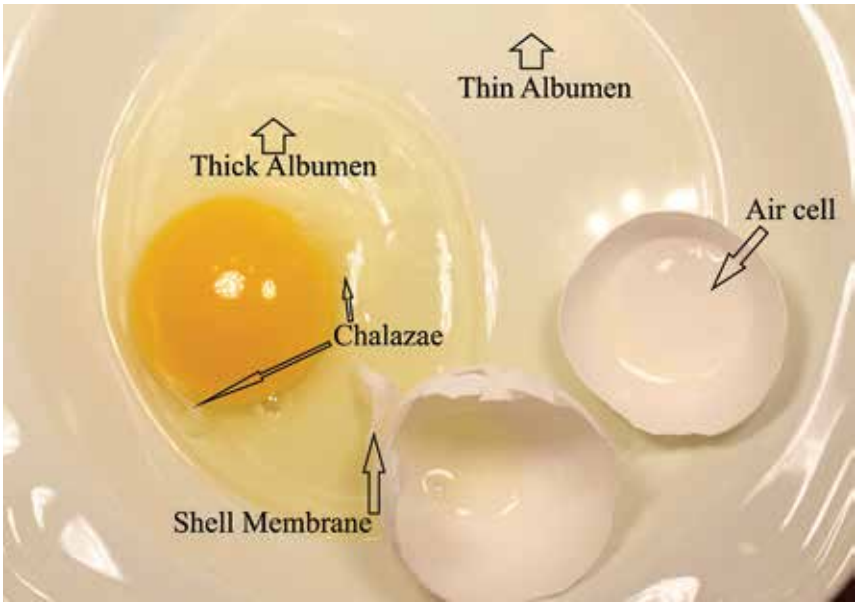
To elaborate, have students examine the structure of a raw egg (Figure 3). Have them carefully crack the raw egg and place the inside contents onto a small bowl or plate. They should notice that the inside of the shell has a skin-like lining, known as the shell membrane. It is actually two membranes; one is inside the other. An air cell rests between the membranes at the large end of the egg.

When students examine the contents of the egg that are in the bowl, they may see the thin albumen, the clear runny liquid that is mostly spread out around the yolk. They may also see the thick albumen that surrounds the edges of the yolk. The yolk itself should sit atop the albumen. That is because when you crack an egg onto a bowl or plate, it does not retain its sphere shape. While not completely flat, the yolk sits slightly higher than the albumen. Connected to either side of the yolk are what appear to be small white cords called chalazae, which are made of the same material as the clear albumen. When the hen drops the yolk from her ovaries, it rolls down through the oviduct, and as it spins, it collects albumen on each end, which is spun into cords. These cords help hold the yolk in the center of the egg, which is beneficial to the chick embryo as it develops. The embryo develops first on the side of the yolk at the germination

Safety notes

Participants should wear indirectly vented chemical safety goggles and gloves during all phases of the activity. Wash hands with soap and water upon completing this lab activity. Eggs can contain salmonella, so proper handwashing procedures must be followed. The teacher should make preparations so that students are working in a clear, unobstructed area to minimize spills. Water on tile floors can be slippery. Egg allergies must be considered. Do not permit students with egg allergies to interact with the eggs. No part of the activity should be ingested. Be certain all surfaces are thoroughly disinfected at the end of the experiment.

FIGURE 3: Structures of an egg



spot. By being suspended in the middle of the egg, the embryo is less likely to develop structural abnormalities that would result if it were pressed against the side of the egg shell.

The yolk itself contains highly concentrated nutrients that become the primary source of food for the developing embryo. The yolk is encased in its own membrane, known as the vitelline membrane or yolk sac. For a quick and easy way to separate the yolk from the egg white, have students take an empty plastic soda or water bottle, gently squeeze the bottle, and then hold the mouth of the bottle against the edge of the yolk sac. When students release the pressure on the side of the bottle, the yolk is suctioned inside the mouth of the bottle, leaving the egg white behind. If they are careful, students should be able to gently squeeze the bottle and deposit the yolk, with the yolk sac still intact, at a separate location. For additional information on the various egg parts, check out an article titled "The Different Parts of an Egg" (see Resources).

Evaluate

Ask students to describe to a family member how to tell the difference between a raw and hard-boiled egg using the spin method. Have them record this explanation and submit it to the private class website, Flipgrid, or to the teacher, using whatever learning management system is appropriate to your setting. The teacher can evaluate the submission to determine if students adequately explained Newton's First Law of Motion. ●

RESOURCES

Newton's Laws of Motion Explain Spinning Eggs—*https://scienceprojectideasforkids.com/newton-motion-inertia-eggs/*

The Different Parts of an Egg—*https://www.saudereggs.com/blog/the-different-parts-of-an-egg/amp/*

Spinning egg—*https://phys.org/news/2018-03-egg.html*

Online Supplemental Materials

Videos showing various parts of this activity—*www.nsta.org/scope1907*

NGSS Connection

The demonstration or content in this article can be useful when creating instructional sequences designed to achieve the following *NGSS* dimensions:

MS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

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