Lazy Days: An Active Way to Put Newton's First Law into Motion (or Rest)

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Students are better able to understand Newton's first law when they build from their own personal experiences of bicycling, skateboarding, or riding in a car. Most have experienced a tumble when their skateboard or bicycle comes to an abrupt stop. Alternately in a car, your body continues moving when the brakes are applied and you feel the force of the seatbelt holding you in place. Start moving again and you feel your body pushed forward by the seat against your back. These common experiences provide good opportunities to learn about the concept of inertia (and to obey the law and wear seatbelts!). The state of motion of the rider does not change until an outside force is applied. We like to tell students to look at inertia as nature's way of "being lazy." This is how the name of this lab exercise, Lazy Days, is derived.

The Lazy Days stations provide students with multiple opportunities to witness and apply Newton's first law firsthand and the nature of the forces responsible for the changes they observe. It includes some familiar demonstrations for inertia, which may be found in teacher's editions of textbooks or in online resources (see Table I). What sets Lazy Days apart from more traditional introductory demonstrations of Newton's laws is that it becomes a highly kinesthetic and active learning environment that makes learning accessible to all types of learners,[1-3] and allows them a chance to observe and explain inertia by applying it in different contexts.

One of the strengths of Lazy Days is that it allows teachers to choose which stations they would like to have the students perform and which best fits their curriculum. We typically utilize two or three 45-minute class periods to allow the students ample time for discussion at each station. Since Lazy Days utilizes common everyday household items, it is also well suited for teachers with a limited budget and enables students to see that physics experiments do not have to be done in a high-tech lab with expensive equipment.[4]

Table I. Lazy Days stations.

Station	Materials Needed
Catch That Quarter!	Many quarters (one or two bank rolls = 40 per roll)
Penny for Your Thoughts	Pennies, firm index cards
Eggsellent	Raw and hard-boiled eggs (three of each is sufficient), plastic dishes, duct tape. Safety consideration: do not lift eggs off of the plates.
Domino Effect	Dominoes, ruler, shoebox, duct tape
Red Light, Green Light!	Open hallway (10-20 meters long)
Cup Tower Power	Plastic drinking cups, firm index cards
My Cup Runneth Over	Plastic drinking cup, water, plastic traffic cones, duct tape, timer. Safety consideration: have towels available to wipe up spilled water.
Tennis Anyone?	Tennis ball, string, duct tape. Safety consideration: have student observers stand out of line of the released tennis ball.
A Piece of the Pie	Plastic plates, large marble
Water Whirled	Plastic drinking cup, water, wooden board with strings attached at the corners. Safety consideration: have student handler wear safety glasses.

Lazy Days stations

• *Catch That Quarter!*

In this first station, students place a quarter (or several quarters) on their raised forearm (see Fig. 1). Quickly they drop their forearm, and before the quarters have moved appreciably downward in response to gravity, they catch the quarter(s) with the same hand of the forearm on which the quarters rested. More quarters add a bit more mass to the stack, noticeably changing the tendency of the quarter to move.

Fig. 1. A student prepares to Catch That Quarter!

• A Penny for Your Thoughts: This is a variation of the magician and tablecloth-place setting trick. Here, students place a penny or stack of pennies at the center of a firm index card supported on a cup and quickly pull the card out, leaving the pennies in place, only to be affected by gravity. This can be done on a flat table, or it can be done with the index card resting over an open plastic container or cup. The pennies will move vertically directly downward into this cup, but essentially students should see that they have remained motionless in the horizontal dimension.

Fig. 2. Determining raw and cooked eggs is the goal of Eggsellent.

• *Eggsellent:* For Eggsellent, students figure out a way to take advantage of inertia to determine whether or not an egg is raw or cooked. A mix of the two types of eggs is placed each on its own small plate. Students cannot lift the eggs off the plates or intentionally break the eggs to see what is inside (see Fig. 2). Spinning the eggs provides a clear difference in motion: cooked eggs spin continuously, while raw eggs wobble around, showing that the liquid inside the egg has its own type of motion compared to an egg that is solid all the way through. Be vigilant about not letting students pick up and accidentally break eggs—they may only rotate them.[5]

• *Domino Effect:* For this station, students create a pile of dominoes and use a ruler to rapidly flick at the bottom domino to knock it out and into an empty shoebox. The other dominoes remain in a stack and drop to the table (see Fig. 3). Each bottom domino is then flicked out of the pile until they are in the shoebox.[6]

Fig. 3. Trying to see the role of inertia in the Domino Effect.

• *Red Light, Green Light!:* Red Light, Green Light! used to be a popular children's game, but it is also a tool to experience inertia and momentum. Students stand at a start line in a long corridor, with the person who is "It" being 10-15 meters away. "It" is turned away and students at the start line start to move forward. "It" says "1, 2, 3..." and quickly turns around saying "red light," commanding students to stop. Students caught still moving when "red light" is called must go back to the start (see Fig. 4). "It" may also call out "green light," allowing students to continue to move, but may suddenly call "red light" or "yellow light" (meaning students can proceed with some caution in case "red light" or "green light" is called). Instructors doing Red Light, Green Light! in a school hallway may want to inform teachers in nearby classrooms about the activity and potential for noise.

Fig. 4. Students try to deal with momentum and inertia in Red Light, Green Light!

• *Cup Tower Power:* This station was developed by a former student who participated in Lazy Days early in my teaching career. Using plastic drinking cups and firm index cards, students create a tower of alternating cups and cards (Fig. 5). Students have the liberty to put several cups together for greater mass, and have the cups either facing up or down. The task is to quickly remove the cards while having the cups remain in place as a tower by simply falling into each other as the cards are flicked out.

Fig. 5. Students can demonstrate Newton's first law with Cup Tower Power.

• *My Cup Runneth Over:* Students now have to maneuver through an "obstacle course" holding a full cup of water with one hand at eye level. Traffic cones are used to guide students through a path in a corridor, where they are constantly changing direction (see Fig. 6). The goal is to get through the course without spilling water in the quickest time possible. However, that means learning how to hold the cup while walking and changing direction so the water does not spill from side to side out of the cup.

Fig. 6. Students challenge the inertia of water in the cup in My Cup Runneth Over.

Fig. 7. No one gets wet in Water Whirled with the help of Newton's first law.

• Tennis Anyone? This demonstration allows students to imagine what would happen if the Sun suddenly vanished from the center of the solar system (although presumably Earthlings would not know that the sun had disappeared for almost 8 minutes due to the finite speed of light and gravity). A string or cord is attached (with duct tape) to a tennis ball. The student holds the end of the string and twirls the ball around in a vertical circle, and releases the string at the top or bottom of the arc. Fellow students can see what happens to the ball immediately after release. Keen observers will note that, immediately after release, the ball appears to continue in a straight line in the direction it was going at the moment of release (much like the theoretical Earth without a Sun). Quickly though, gravity begins to influence the direction of motion of the tennis ball and it arcs down to the floor. Releasing of the tennis balls should also be done in a location and direction that avoids the possibility of interference from other students, a wall, cabinet, or glassware in the classroom.

• A Piece of the Pie: This station applies principles similar to the Tennis Anyone? station. A marble is put on a large paper or plastic plate and the marble is made to spin around the rim of the plate. A second plate is given to the students, except that a pie-shaped section is cut out of the plate. The task is repeated; however, the marble does not "jump" across the missing pie piece onto the plate and continue. It just moves in a straight line, linearly along the table.

•Water Whirled: Finally, students perform Water Whirled and attempt to not get wet. A cup of water is placed on a square wooden board. The board is held by string attached to each corner. Taking the end of the strings, the student whirls the board with its passenger cup around in a vertical circle overhead (see Fig. 7). Done quickly, the cup and water do not tumble off and no water is spilled.

Lazy Days is a student-centered, fun, engaging, invigorating, and even competitive activity with purposeful learning that can improve understanding of an abstract concept. It allows flexibility and differentiation from the teacher's perspective. It also shows students a variety of ways to see and experience inertia, and the relationship of mass, frictional, and gravitational forces, that is a bit different from riding in a car or watching a magician perform the tablecloth trick. Students are even inspired to develop their own new station that demonstrates Newton's first law. You may be compelled to make it a regular part of your next Lazy Days opportunity!

References

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