Ball-Launcher Design

3rd Grade
Michael Schuette

References:

- The central idea for this lesson is from the lesson *The Technology Challenge* in the 2005/2006 Columbus Public Schools Science Curriculum Guide.

Benchmarks:

ST-4: Use a simple design process to solve a problem.
ST-5: Describe possible solutions to a design problem.

Objectives:

Students will brainstorm solutions the problem of launching a ping pong ball the farthest distance. They will then design, build, and test a launching device while adhering to design constraints. This lesson should span two or three science class sessions.

Materials (per group of 3-5 students)**:**

- 1 plastic spoon
- 2 rubber bands
- 8 craft sticks
- 2 square Lego® or wooden blocks, 1~2" tall
- roll of Scotch® tape (the sticky kind)
- ping pong ball
- scissors
- 7" × 14" heavy cardboard (box weight)

Initial Demonstration:

Engage students in a discussion about things they have used (not body parts) that have make their lives easier or that have facilitated some task. Tell them that these things are technologies, and have them define *technology* in their journals as anything that makes tasks easier for people. With them taking notes in science journals, and offering ideas, start filling out a table on the board of tasks and technologies that make those tasks easier, for example:

Task	Technology
Talking to someone far away	Telephone
Measuring length	Ruler
Digging a hole in the ground	Shovel
Launching a ball	

Leave the last spot in the table blank for now; it will be filled in soon. Tell students that each of the tasks mentioned were more difficult, or were *problems*, before *inventors*

solved the problems by creating *solutions*, or inventions, to address them. They should now define *inventor* in their journals as someone who makes something that did not exist before. Now it's time to address the blank spot in the table.

Target Observations:

- Some objects make it easier to do things.
- People made these objects.

Target Model:

- Technology enables us to perform tasks more easily than would otherwise be possible.
- The people who made these technologies can be referred to as inventors.

Procedure:

Day 1

Place students into groups of 3 to 5 and assign group names or numbers. Tell them that they are teams of inventors and it is each team's job to create an invention that will launch a ping pong ball as far as possible. After each team builds a ball launcher, there will be a contest to see which one can launch a ball the farthest. They must use a *design process*. When using a design process, the inventor usually follows the following steps:

Design Process

1. Find a problem.
2. Learn about the problem.
3. Think of a solution to the problem.
4. Build and test the solution.
5. Make the solution better and retest. Repeat this step several times until the best solution emerges.

Provide them with the design rules:

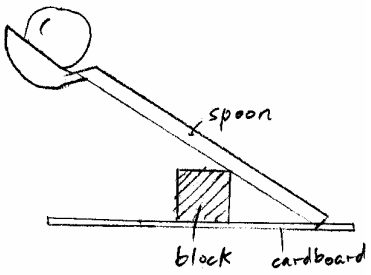
1. Complete launcher construction by the end of class.
2. Use only materials provided.
3. Launcher must be portable.
4. Ball may not be pushed, pulled, or thrown by the student.
5. Launcher will be judged by the distance the ball flies before hitting the ground.

Discuss the safety procedures students should follow when building and using their launchers, such as never launching anything toward someone and appropriate use of all supplies (SI-4). Distribute a bag containing the construction materials to each group.

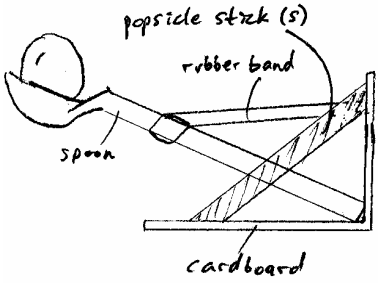
Option A – Heavy Guidance

If you believe your class could use significant help in this design process, or if time is short, you may want to explain some basic designs to them in advance, and let

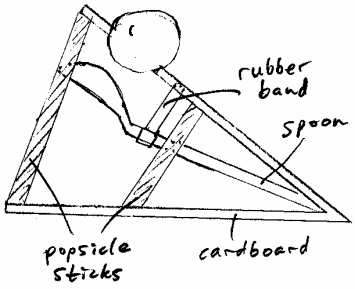
them choose which one they'd like to use. Three possibilities are given below, where the end of the spoon is attached to the cardboard in each case. Some other possible designs include a 1-2 hybrid, 3 but using a fulcrum (block) instead of a rubber band, or a 1-3 hybrid. Another possibility is similar to Design 3 but without a spoon, where a rubber band with a piece of wood or spoon taped to its center is stretched across the ball opening in the cardboard, and is simply pulled back and released, causing the wood or spoon piece to strike the ball. Assist the groups in their design and construction.



Design 1 – Throwing (spoon-bending)



Design 2 – Throwing (rubber band force)



Design 3 – Hitting (rubber band force)

Option B – Light Guidance

If time and/or the creative abilities of your class permit, let the groups begin their own design explorations with minimal assistance. Multiple trials may be necessary before a working ball launcher is built.

Encourage groups to test their designs several times before the final launch.

<u>Target Observations</u>:

- Building a ball-launcher is challenging.

<u>Target Revised Model</u>:

- To invent a solution to a problem, such as launching a ball the farthest distance, requires the use of a design process. The best solution may not always be the first solution.

<u>Procedure</u>:

Day 2

Review the design process the students undertook during the previous meeting. Relocate them to a place where the launching competition can be carried out (Clear enough room in the classroom, use the hallway, or go to the playground.) and re-group them into their design teams. Allowing one student from each group to be the ball releaser, begin the competition. As a ball is launched, let another student from the participating group mark where the ball landed, while another student measures the flight distance. Allow 3 launches and count a group's best distance as its final result.

After each group has participated, tabulate the results on the chalk board, instructing the students to record the results in their journals. Compare each of the designs and have them think about why some worked better than others (SI-2, 3). Discuss the challenges and successes students experienced throughout the designing/building and launching process, while emphasizing problem-solving skills and the *different* kind of thinking they had to do. Ask them what changes they could have made to their launchers to increase the ball's distance (SI-5). Let each group name their ball-launcher, entering this new name into the blank cell of the table they started during the previous science class.

Tell them that to improve technology, the build-test-modify part of the design process is often repeated many times. Finally, have students write in their journals a short summary of what they did during the last two science days, explaining the process they used to design the launcher and the challenges they faced.

Possible extension: Allow students more time (another day) to modify their designs, implementing the improvements they came up with, followed by a second launch opportunity.

Target Observations:

- The ball-launcher did/didn't work as well as the group expected.

Target Revised Model:

- Just like when inventors create solutions to problems, solutions aren't perfect the first time. However, if the design is modified after initial testing, and the modify-test sequence is reiterated many times, a better solution is likely to emerge.

Summary:

Students have experienced the design process, and now have a better understanding of the challenges (and rewards) that are inherent to such a process.