Justin Time Challenge
Teacher Notes

Connections to *NGSS*:

Dimension	Name or *NGSS* code/citation
Disciplinary core idea	MS-PS2-5
Science and engineering practice	MS-PS2-4
Crosscutting concept	MS-PS2-5

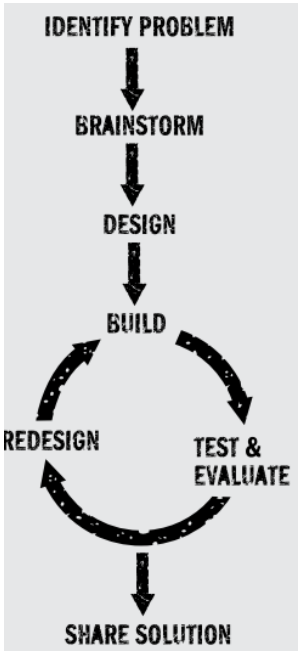
Resources:

Engineering Design Process Templates:

Design Squad *http://pbskids.org/designsquad/parentseducators/workshop/process.html*

Other engineering design process templates can be found at NASA: *www.nasa.gov/audience/foreducators/plantgrowth/reference/Eng_Design_5-12.html#.U_jfovldU00*

TeachEngineering.org: *www.teachengineering.org/engrdesignprocess.php*



Engineering Design Process from *http://pbs.org/designsquad*

Materials: For a class of 25 students

200 Pennies

50 paper cups (3oz)

200 paper clips

300 metal washers (these were purchased from local hardware store in bags of 50; they can vary in size)

Ball of string, 400 feet, 10-ply (students can cut to size)

Scissors (one pair per group)

Masking tape

Box of craft/popsicle sticks (100 count)

Protractors (one per group)

Meter sticks (one per group)

Ziploc bags (quart size—*do not* put out with other materials; they are to be used for storage of devices if needed)

Supplies should be sufficient so that no one material runs out for a group. Materials can be placed in stock containers at the front of the room for groups to select from.

Room setup

Materials can be placed in a central location as stock supplies. Allowing students to move chairs and tables is often beneficial for students to have space to create their device and maintain safety considerations. Many groups will use attach their devices between tables and chairs.

Safety

Please make sure no one is standing in the way of the device during testing and that all testing occurs perpendicular to the floor.

Pacing and tips

Recommended time needed: 2 class periods of 45 minutes

2 min: Move students into groups

10 min: Introducing design challenge and review of EDP (more time may be needed if this is the first experience with engineering design challenges)

5 min: Brainstorming of ideas individually

5 min of group discussion of brainstormed ideas

10 min: Group decides on initial device design

15 min: Build and test initial design. ***Safety note: Please make sure no one is standing in the way of the device during testing and that all testing occurs perpendicular to the floor.***

20 min: Single variable testing. **Note:** Teachers can manage time in several ways. You can tell and show students what lengths to cut string to such as 10 cm, 20 cm, 30 cm, or you can have these precut. For weight investigations, remind students to remain consistent in how they vary the weight. For example, have groups use 5, 10, or 15 washers or 10, 20, or 30 pennies in a cup that will be attached to the string. For each of these single variable tests, the teacher must check that other variables are controlled. If desired, the teacher may have students graph the data from the single variable testing. The graphs are intentionally left blank for now to allow for differentiation by the teacher. Scaffolding may include providing labeled *x* and *y* axes with units and titles for students who need additional support.

20 min: Redesign, build, and test. Teachers may want to check redesigns on paper before allowing students to build.

10 min: Group sharing. Teachers should highlight the multiple solutions created by the groups and also use this discussion to reinforce the science concepts. Teachers may ask specific questions relating back to the engineering design process with prompts such as “How did you evaluate the results from the testing (the data on the charts) to help you in the redesign?” and “If you had more time or supplies could your design/device be improved? How?” This group sharing is also a great

opportunity to contrast science investigations that answer a question and engineering-design challenges that solve a problem. While a science investigation leads to knowledge as the outcome, engineering leads to technology in the form of a product or process. The multiple solutions that can be generated are an effective way to celebrate the different abilities of each group.

Reflection prompts: Assign for homework. Discuss as a class afterwards. The prompts create the opportunity to reinforce the science content with an emphasis on identifying and controlling variables as well as recognizing cause and effect. The relationship students should be able to express is that as the length of string increases, the number of swings decreases in a given time period. There is no relationship between the mass of the bob and the number of swings. The questions focusing on teamwork and collaboration highlight the importance of these skills in group work and deemphasize the "product" aspect of the challenge since there are multiple ways to achieve success and meet the requirements of the challenge.

Group devices can be stored in labeled plastic Ziploc bags if needed.