



The Slingshot Project

A Freshman Engineering Design Project
Developed by Dr. Ron Roedel, Arizona State University

Overview:

Student teams work together to design and build a slingshot device that will launch a squash ball through a given horizontal and vertical location in space. The students are provided with a plastic water balloon slingshot that has a basket that is the perfect size for holding a squash ball. Each team is to design a device made of lumber that will hold the plastic slingshot and that can be mounted on a given cart to conduct the specified launch. The slingshot device must be able to reproducibly launch the squash ball.

Learning Objectives or Student Outcomes:

By the end of this lesson or activity, students will be able to

1. design and build a slingshot device that will reproducibly launch a squash ball through a given horizontal and vertical location in space.
2. maintain a “design notebook” that documents the design process used by the team.

Length of Lesson:

This is generally one of two or three projects in a semester. The length of the lesson will vary depending on the amount of time devoted to the project in class AND the amount of time given to students for reaching certain checkpoints in the project.

Team Size:

Teams of 4 work best; if necessary, a few teams of 3 or 5 students may be formed.

How is *positive interdependence* ensured?

Positive interdependence is ensured through the completion of one final product and one design notebook.

How is *individual accountability* ensured?

Individual accountability is ensured through peer assessments, such as evaluation forms or a salary allocation activity, where each team member divides a given “salary” amongst the different team members and provides a brief explanation of each decision.

Assessment:

Students will be informed of project design and design notebook deliverables prior to beginning work on the project. Team progress may be assessed at different points throughout the project; two such checkpoints are 1) when the teams must turn in their design ideas to the wood shop and 2) at the data-gathering point in the project, when students test designs in order to obtain data on the trajectory of the ball being launched.

Team Skills Needed for Success:

Students must have the ability to communicate and collaborate as each team must complete one design and design notebook together. Each teammate must feel free to contribute ideas and constructive feedback.

Materials Needed by Students:

- plastic water balloon slingshot (provided)
- standard dimensional lumber (provided)
- standard measuring ruler
- any team-selected additional parts at a cost not to exceed \$5.35 (receipts must be provided)

Instructions to Students:

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| 1 | Project Description Each team will be given a plastic water balloon slingshot that has a “basket” that is the perfect size to hold a rubber squash ball. You are to design a device that will securely hold, accurately aim, and reproducibly release the squash ball. You will be shown a cart and given this cart’s dimensions so that you can design your device so that it can be mounted on top of the cart. Each team is to decide and angle with respect to the horizontal that the device would hold the slingshot at. |
| 2 | Design Constraints <ul style="list-style-type: none">• The device is to allow the length of the “pull” of the elastic cord of the slingshot to be accurately measured.• The release procedure of the device is to allow for reproducible releases.• The device is to be made out of standard dimensional lumber.• The “pull” length measuring device is to be made from a standard measuring ruler.• The total cost of any additional parts, except the dimensional lumber, is not to exceed \$5.35 (receipts had to be provided). |
| 3 | Designing the Device First, you will brainstorm ideas in your team for a possible design. Once a preliminary design is agreed upon, your team is to turn in a drawing that includes dimensions of all the wood that is needed to construct the launch device. The dimensional drawings will then be handed over to the wood shop and the wood each team needs will be cut and given back to the team. When your team receives its wood, your team will construct the device. The teams will be provided any tools and hardware that is needed to assemble the devices. If your team has any special equipment that is needed but not provided, your team will have to purchase that equipment, so long as it does not exceed the cost of \$5.35. |

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| <p>4</p> | <p>Ball Trajectory Data Gathering</p> <p>After the launch device is constructed, the teams will have to obtain data on the trajectory of the ball being launched as a function of the length of the pull of the elastic cord. To do this, the teams will gather in a gym to record videotapes of their squash balls being launched. The teams are to decide on three pull lengths to use so that they can obtain the ball trajectory as a function of the pull length. Each of the three launches is videotaped so that the teams can digitize the video and then determine a function from this data. Once the teams have a function determined, they are ready for the launch date.</p> |
| <p>5</p> | <p>Launch Day Information</p> <p>On the launch day, each team is given the horizontal and vertical distance at which the .35m by .35m target will be placed. The teams then have to determine how far they will pull their cord back so that the slingshot will launch the squash ball through the target. If the team successfully shoots the ball through the target, the team has demonstrated that their device and function have worked properly. If the team fails to shoot their ball through the target, they have to explain why their device did not successfully launch the ball through the target. Also, they have to explain how they would improve the device so that it could successfully launch the ball through the target.</p> |
| <p>6</p> | <p>Design Notebooks</p> <p>Each team is to keep a “design notebook” that documents the design process that the team used. The notebook is also to contain a succinct report that includes the final outcome of the project as well as the final artifact and a description of the project.</p> |