Drone Drop Challenge

STEM Global Teacher Workshop

- path.org
- https://www.wghalliance.org/initiative/stem-global/resources/

Time: 90-120 minutes or 2-50 minute class periods

Subject & Grade Level(s): MS-HS science or engineering

Brief Overview: An authentic global health challenge is the delivery of critical medical supplies (e.g., vaccines, blood products, etc.) to remote communities. In this engineering design challenge that is a variation on the classic egg drop challenge, students work in teams to design, prototype, and test a vaccine container that will be delivered via drone technology. This activity represents a partial design cycle, but could be extended to include re-design, re-test, and optimize phases.

STUDENT UNDERSTANDINGS

Design Challenge Scenario: PATH, a global health organization, is working to streamline the "last mile" of cold chain supply systems. The vaccine cold chain is the equipment and systems that maintain vaccines at a safe temperature (usually 2°C to 8°C) from the moment the vaccines are made to the moment they are administered. Vaccine outreach visits to remote villages often require transportation by bike or by foot. After exploring the commercially available delivery technologies and developing a list of requirements for the delivery technology, you have received a grant to develop delivery solutions based on drone technology. Your partner, DropShip Inc, manufacturers drones for commercial shipping applications. Parcels are picked up by the drone and dropped off at the customer's doorstep. To adapt this technology, you must design, build, and test a vaccine container to integrate with DropShip's drones.

Anchoring Phenomenon/Design Problem: A global health organization needs to design a vaccine container that can be used by existing drone technology to quickly and safely deliver vaccines to health care workers located in remote villages.

The container needs to be: carried by a drone without decreasing its range below an acceptable level; able to carry a certain number of vaccine vials in a way that is quickly loadable; able to withstand drop/impact without damaging the container, vials, or other objects or people; and reusable for 1,000 delivery cycles.

Driving Questions:

- How can a container be designed for the safe delivery of vaccine vials by drone technology that meets the design criteria and constraints?
- How does an understanding of motion and forces help inform our design and testing of the vaccine container?

NEXT GENERATION SCIENCE STANDARDS

This lesson builds toward the following bundles of middle and high school level Performance Expectations (PEs) from the Next Generation Science Standards.

Middle School PEs:

- **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (With lesson extensions focused on re-design and optimization).
- **MS-PS3-5:** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

High School PEs:

- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-PS2-3:** Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Credit: *This activity was originally developed by* PATH, *a global health organization located in Seattle*, WA *and adapted for a* STEM *Global Teacher Workshop in April 2019. Authors include: Mike Eisenstein, PATH Product Development Shop Manager; Daniel Myers, PATH Product Development Coordinator; and Geneva Goldwood, PATH Product Development Engineer. Lesson plan adaptations supported by Kristen Bergsman of Laughing Crow Curriculum.*