UBC Geering Up
Engineering Outreach

DIY Equipment

Subject: Science & ADST	**Grade:** 4-10	**Duration:** 60 – 90 mins
Lesson Overview	Students work together on a hypothetical problem where they must design and prototype a device for handling a frog that produces a dangerous toxin. The device must be able to pick up and move the frog from place to place without harming the animal.	

Curriculum Ties (in addition to satisfying multiple core competencies):

ADST Core Competencies:

Communication: **E.g. Collaborating:** Share progress while making sure to increase feedback and collaboration.

Thinking: **E.g. Critical and Reflective Thinking**: Screen ideas against criteria and constraints first, students will brainstorm and think consciously about their decisions before executing their plan.

Personal & Social: **E.g. Social Responsibility:** Evaluate the influences of land, natural resources, and culture on the development and use of tools and technologies on the construction of their tower

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Content Objectives

- Having students explore the engineering design process and how it can be used in a scientific context.

Materials & Equipment Needed

Consumables:	Non-Consumables:
• String/yarn • Masking tape • Pipe cleaners • Paper cups • Popsicle sticks • Cardboard • Straws • Other crafting supplies as desired	• Hot glue guns (optional- but recommended) • Scissors • One hole punch (optional) • Plastic frog figurine (or other animal, as preferred)

Lesson & Activity

Lesson Stages	**Learning Activities**
Introduction	**Activity Overview: The Poisonous Frog Retrieval Challenge** **Team Size:** 2–3 students

	Objective: Design and build a working prototype device that allows a field scientist to safely capture and relocate a poisonous frog without harming the animal or exposing the handler to toxins. **Challenge Scenario** *"A field biologist in the rainforest needs to study a newly discovered species of poison dart frog. Your team must engineer a specialized collection tool that can securely lift and transfer the frog into a transport container. The tool must prevent any skin-to-skin contact with the handler while ensuring the frog experiences zero physical harm or stress."* **Key Design Constraints & Criteria** • **Safety:** Zero direct contact between the researcher and the frog. • **Ethics & Animal Welfare:** The mechanism cannot pinch, squeeze, drop, or injure the specimen. • **Mechanism:** Encourage dynamic design—devices should incorporate moving parts or mechanical advantage (e.g., grabber claws, levered scoops, iris-style traps). **Materials & Setup** • **Standard Mode:** Provide access to general makerspace and craft supplies (e.g., cardboard, craft sticks, rubber bands, string, pipe cleaners, paper cups, tape, split pins/fasteners). • **"Lunch Box EDC" Variant (Constrained Mode):** Package a mystery assortment of materials into individual brown paper bags. Teams may only use the exact items in their bag, forcing resourcefulness under strict limits.

Facilitator Tips & Flow

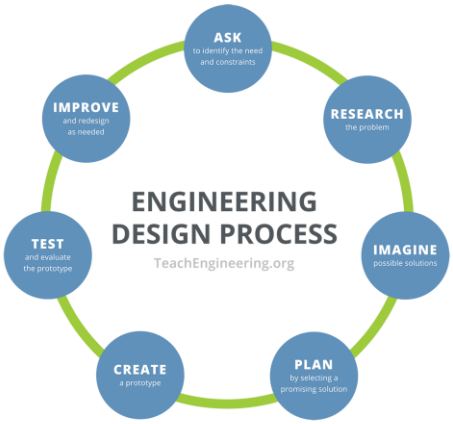
1. **Pre-Build Strategy:** Mandate a 5-minute planning phase before materials are touched. Teams should sketch and agree on a mechanism first.
2. **Emphasis on Innovation:** Push students beyond simple static cups on sticks; challenge them to think about grip strength, soft contact pads, and trigger mechanisms.
3. **Showcase Finale (Optional):** Conclude with a *Dragon's Den* / *Shark Tank* style pitch session where teams demonstrate their prototype's functionality, pitching its safety, reliability, and humane design to the "investors."

You just came back from a research trip in the tropics where you collected a new species of frog. This frog is known to release a toxin that can severely harm humans on contact. Your research lab wants to study the chemistry of this toxin since it has never been seen before. The normal procedure for handling a frog like this is to use sturdy gloves along with full body coverage (lab coat, long pants, closed-toed shoes, face shield, etc.) however last week you had a scare with a ripped glove and feel like these measures aren't enough. You've also noticed that mesh nets seem to irritate the frog's skin since they often thrash around when caught in a net. You and your lab partner do some brainstorming and decide to build a device that can pick up a frog and move it from place to place that will allow you to avoid using your hands or a net.

Use the engineering design process to design a prototype device as described above. Consider the ethics and safety of your design. How can you ensure that the frog will not be harmed during pick up or transfer? Given the above information, what other criteria does your device need to follow?

Activity	**Imagine:** • Give students time to brainstorm individually first. **Plan:** • Give students a set amount of time to bring their ideas together in a group and decide on a final design **Create:** • Give students a set amount of time to build their prototype
Closure	**Sharing:** • Students can present their device to the class. • Students can 'pitch' their device Dragon's Den style. **Post-Activity Discussion** ○ What was your process? Who was successful, why were they successful? If we did this challenge again, what might you do differently next time?
Step Ups & Step Downs	**STEP UP** Make groups smaller; less time to plan/build, add extra challenges (e.g. device must have a moving part), allow students access to motors or other such equipment. **STEP DOWN** Give more time and teacher assistance with building, skip the end sales pitch aspect

Background Knowledge



The Engineering Design Cycle:

- Ask
  - What is the problem we're trying to solve?
  - What are the limits that our solution needs to follow?

- Research
  - Has someone already created something like this?
  - Who are the experts in this field?

- Imagine
  - Brainstorm a large quantity and variety of ideas before narrowing the options.
- Plan
  - What criteria should we use to narrow down our ideas?
  - Which ideas need to be screened based on the original constraints we identified?

- Create
  - What kind of prototypes can we create? A sketch, scale model, CAD model, computer simulation, etc
- Test
  - What does our final design need to accomplish? Can we test this with the prototype we made?
  - Run an experiment
  - Create a computer simulation
  - What information are we looking to gain from these tests?

- Improve
    - Based on the results from the testing, what can we improve on our design?
    - Are there certain aspects we found too difficult to create?

Frog Biology

Depending on how you intend to use this activity in your classroom you may want to provide your students with background knowledge on frog biology, poisonous animals and ethics in science to supplement the activity.

Suggested lesson topics include:

- Frog anatomy and general biology
- Poisonous animals
    - Why are some animals poisonous?
    - How can poisons affect humans?
    - How should you act around unknown, potentially poisonous animals?
    - What is the difference between poisonous vs venomous?
- Ethics in science
    - Why do we study animals in science?
    - What is ethical science?
    - How do research projects get ethics approval?