UBC Geering Up
Engineering Outreach

Sustainable Fashion

Subject: Science/ ADST	**Grade:** 4-8	**Duration:** 2-3 hours
Lesson Overview	Students investigate how engineers and materials scientists choose fabrics by testing the properties of different natural and synthetic textiles (strength, absorbency, permeability) and learning about product life cycles and fast fashion. Using the engineering design cycle, they then upcycle old clothing or fabric into a new, functional garment or accessory that meets a specific purpose (e.g., hiking, rain, sports), integrating sustainability, creativity, and basic entrepreneurial thinking.	

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

ADST (Applied Design, Skills & Technologies):

ADST Curricular Competencies

- Understanding Context: Students will gather information from their peers and from their previous knowledge of clothing and fabrics to create a new useful product.
- Defining: Students will be able to identify the main objective for the design of their invention and any constraints by discussing with teachers and peers. Skills can be developed through play.
- Ideating: Students can work by themselves or in groups in order to generate potential ideas and add to others' ideas.
- Prototyping: Students will be given the opportunity to build a prototype from their potential ideas.

- Testing: Students will be able to test and present their prototype and gather feedback from teachers and peers.
- Making: After multiple rounds of testing and alterations, students will be able to construct the final product incorporating all the planned changes.
- Sharing: Students will present their design in the form of a fun fashion show!

Applied Skills

- During the multistep process the students will have ample opportunity to learn how to use their materials, tools, and technologies in a safe manner.
- Students will also be able to develop their design and presentation skills.

Science / Environmental Education

- Explore how material properties (absorbency, strength, permeability) relate to their everyday uses.
- Recognize that human activities and consumer choices affect the environment and waste systems.
- Connect sustainability concepts (reduce, reuse, upcycle) to product life cycles and more responsible consumption.

Content Objectives

- Use the engineering design cycle to create a needed product based on a client's needs.
- Analyse a product to determine the need it was designed to meet and the customers it was meant to attract.
- Understand the life cycle of products and how to prevent waste.
- Incorporate sustainability and upcycling products.
- Use entrepreneurial skills to invent and promote a new product.

Materials & Equipment Needed

Consumables: • Glue • Tape • Scissors • Old clothing / towels / fabrics • Optional: thread, needles, sewing machines	Non-Consumables: • For Lab: Each group needs: • One 8" x 6" sample of six types of fabrics. • Provide the following natural fabrics to test: cotton, linen, silk. • Provide the following synthetic fabrics: polyester, nylon, rayon. Use a permanent marker to write the fabric name on each sample. • Balance, either a beam balance or an electronic balance accurate to 0.01g. • watch with a second hand • 250ml beaker • ½ teaspoon • Scissors • Paper towels

Lesson & Activity

Lesson Stages	**Learning Activities**
Introduction	• Show 1–2 short videos about product life cycles, fast fashion, and sustainability. ○ https://www.youtube.com/watch?v=-9JRowyICbo ○ https://www.youtube.com/watch?v=tLfNUD0-8ts

	• Facilitate a brief discussion:
	  ○ What happens to our clothes before we buy them?
	  ○ What happens after we throw them away?
	  ○ Why might fast fashion be a problem for the environment?
	• Explain that students will be upcycling old clothing and fabrics that can no longer be used, turning them into something new and useful
	• Review the Engineering Design Cycle together (Ask → Research → Imagine → Plan → Create → Test → Improve)
	  ○ Ask: What problem are we trying to solve? (e.g., waste from clothing, need for functional garments)
	  ○ Research: How do different fabrics behave? What makes a fabric good for rain, sports, warmth, etc.?
	  ○ Tell students that in this lesson they will first test fabrics (Research), and then design and make an upcycled clothing item (Imagine, Plan, Create, Test, Improve).

Activity	**Part 1 – Fabric Testing Lab:**
	Goal: determine which fabrics work best for different purposes by testing strength, permeability, and absorbency.
	1. Divide the class into groups of 2–4 students.
	2. Have groups brainstorm different types of fabrics they know (e.g., cotton, polyester, denim, fleece, nylon, silk).
	3. Let students know they will test each sample for:
	  ○ Strength
	  ○ Permeability (how easily water passes through)
	  ○ Absorbency (how much water it can hold)
	4. The strength test must be done first, then permeability and

	absorbency using the divided fabric samples. **Strength test** • Make a ½-inch cut on the edge of each fabric sample. • Students grip on either side of the cut and gently pull until it tears. • Use a simple rubric to rate strength (1 = tears very easily, 5 = very difficult to tear). • Do this for each type of fabric. **Permeability test** • Place a fabric piece on a paper towel. • Put ½ teaspoon of water in the centre. • Time how long it takes for the water to pass through (until no "bubble" remains on top). • Rate permeability (1 = very fast, 5 = no visible permeation). • Do this for each type of fabric. **Absorbency test** • Use the dry fabric samples for this test. • Mass (weigh) a section from each of the cloth samples used in this test and record your results. • Place the fabric in a beaker (~250 ml) of water for 30 seconds. • Take the fabric out of the water and hold it until it stops dripping. • Mass (weigh) each of the cloth samples again and record your results. • Determine how many times its own weight a fabric can hold by dividing the mass (weight) when wet by the mass (weight) when dry. • Do this for each type of fabric.

5. Once all tests are complete, come together as a class to compare results and notice patterns.
6. Have students fill in Worksheet C: Characteristics of Fabrics, adding their test data to any prelisted properties.

	Cotton	Linen	Nylon	Polyester	Rayon	Silk
Quick drying			x	x		
Resists shrinkage			x	x		
Easily washed			x	x		
Prints well	x	x			x	x
No static problems	x	x			x	
No pilling problems	x	x			x	x
Resistant to*			O,C	C		
Price/yard **	$3.59	$5.00	$5.59	$8.59	$8.59	$15.59
Permeability						
Absorbency						
Strength						

7. Lead a short discussion on how natural fibres (cotton, linen, silk) compare with synthetic fibres (polyester, nylon, rayon). Use rayon as a prompt to talk about regenerated vs. fully synthetic fibres.

Part 2: Upcycled Clothing Design Challenge:

Students will engineer a new piece of clothing that serves a purpose, that will be upcycled from old materials, based on their findings from the previous experiment.

1. Divide students into groups or use same groups from the experiments.
2. Each group chooses a purpose for their design (e.g., hiking, rainwear, sports, casual wear, “runway” fashion, swimming cover-up).
3. Brainstorm different garment ideas that meet their chosen

	purpose. ○ Decide which fabrics make sense based on Part 1 data (e.g., more absorbent for towels, more water-repellent for rainwear, stronger for bags). ○ Sketch the design and label fabric choices, noting why each is appropriate 4. Create: Using old clothing, scrap fabrics, glue, and sewing tools (if available), students build a prototype of their product. Encourage them to think about both function and aesthetics. 5. If time allows, have someone briefly "test" the garment or accessory (move, stretch, simulate light rain with a spray bottle, etc.) and record quick observations.
Closure	• Once prototypes are complete, have groups share their designs. They should explain: ○ The purpose of their clothing item or accessory. ○ Which fabrics they chose and how the lab results informed those choices. ○ How their design considers sustainability and upcycling. • For a fun finish, run a simple "fashion show": one student is the model, another is the "announcer" describing the product's features, fabric choices, and target user. • Optional reflection prompts: ○ What would you change or improve if you had more time? ○ How can we make our clothing choices more sustainable in real life?
Step Ups & Step Downs	**Step Downs** • Offer pre-cut fabric samples and pre-selected upcycled items, instead of having students choose.

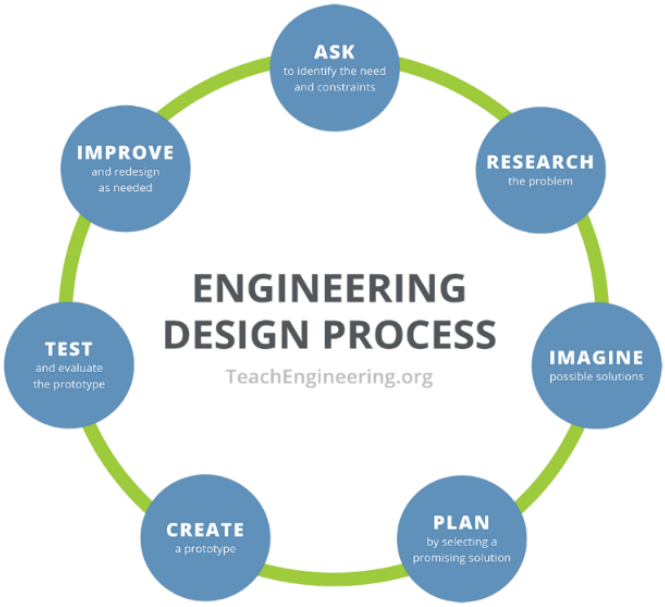
	• Give a simple pattern or template for the clothing item (e.g., tote bag, headband, arm band) so students focus on material choice rather than complex sewing. **Step Ups** • Ask students to graph their lab results (e.g., bar graphs comparing absorbency or strength). • Add a budget constraint: each fabric "costs" a certain amount and groups must design within a set budget. • Have groups write a short product pitch or "ad" highlighting target user, benefits, and sustainability features. • Introduce additional criteria. • Have students research the uses and characteristics of some other synthetic fabrics, including polyolefin, acetate and spandex. • Have students research the different chemical compositions of • synthetic materials. • React hexa-methylendiamine with adipoyl chloride to form nylon. • Do an interdisciplinary lesson with humanities exploring the history. **An extension:** https://www.teacherspayteachers.com/Product/Fashion-Design-Engineering-Challenge-and-heat-transfer-lab-3110928?st=2d8bbf141e3fef9234f61a892103c0dc

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?



Additional Resources

- Making nylon: https://www.youtube.com/watch?v=HTh_5CWMSoQ
- Environmental impact:
    - https://www.youtube.com/watch?v=BiSYoeqb_VY
    - https://www.youtube.com/watch?v=Bh8dnw67rE0