Unit Plan: Lifecycle of a T-shirt (for all grades)
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Context & Background

Snapshot:
This systems exploration focuses on the complex systems used to create common objects. It is designed to raise awareness of cycles, how systems interact, and our interdependence with both natural and human made systems. It could serve as an introduction to any one of the topics or disciplines that arise in the course of creating a systems map around a commonplace item.

What comes before?
Students should have some basic knowledge about how systems work, i.e., Systems Principles. (See the lesson, "What Is a System?")

This lesson is based on the systems concept of Life Cycle Thinking. In preparation, teachers should consider watching THIS TedTalk by designer Leyla Acaroglu, which is an excellent introduction to the idea of Life Cycle Thinking and the design priorities that can help or hinder environmental sustainability.

The TedTalk is appropriate for students in grades 4-12 as an introduction. It is helpful to chart the content of the video to refer back to as the lesson progresses.

What comes after?
The concept introduced in this lesson has multiple applications across subject areas. Students can transfer this understanding of life cycles to Science, Economics, Social Science, and Literature.

Research groups can be assigned to further investigate each step of the life cycle and report back to their peers (origins, extraction, manufacturing, transportation, packaging, marketing, uses, end of life).

What prior knowledge can students tap?
Students can refer to systems maps already generated in the classroom. They can also call upon their knowledge of cycles in nature (seasons, growth cycles, the water cycle). Since this lesson focuses on a familiar object (T-shirt), students bring many experiences with this object to the discussion as well.

Standards & Goals

(Note: This is a sampling of relevant standards for grades K-6. Many others apply.)

Related Common Core Standards:

- ***RI.K.1:*** With prompting and support, ask and answer questions about key details in a text.
- ***SL.K.3:*** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- ***W.1.7:*** Participate in shared research and writing projects.
- ***W.2.8:*** Recall information from experiences or gather information from provided sources to answer a question.
- ***W.4.7:*** Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- ***W.4.8:*** Recall relevant information from experiences or gather relevant information from print and digital sources.

Related Next Generation Science Standards:

- ***K-ESS3-3:*** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]
- ***LS1.B:*** Growth and Development of Organisms. Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.
- ***LS2.B:*** Cycles of Matter and Energy Transfer in Ecosystems.
- ***MS-LS1-5:*** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- ***MS-LS3-2:*** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
- ***5-LS2-1:*** Crosscutting Concepts: Systems and System Models
  A system can be described in terms of its components and their interactions.

Related Systems Principles:

- Systems are interconnected and interdependent
- Systems adapt and change
- Systems have cycles
- Systems require energy
- Systems have parts that work together
- Systems can break
- Systems can be natural or human-made
- Systems can be changed by people

Materials & Resources

Videos

- For teachers and older students: Leyla Acaroglu: "Paper beats plastic? How to rethink environmental folklore" (noted above)
- For all audiences:
  - Emma Bryce: "What really happens to the plastic you throw away?" on the life cycle of a plastic bottle
  - The Dodo: "Stunning Life Cycle of a Ladybug", a more traditional look at life cycles

Other materials

- Large butcher paper or poster paper to create systems map (for in-person learning)
- Padlet, Plectica, Google maps, or another online mapping tool (for distance learning)

Instruction

1. Preparatory Work:

Note that this lesson can be done using any common object that is familiar to all the students. The suggested questions are both specific to the T shirt and applicable to any object you or your students choose.

- View the video by Leyla Acaroglu, "Paper Beats Plastic? How to Rethink Environmental Folklore." (see above)
- Prepare a large paper/poster for creating a systems map. For distance learning, choose an application for mapping (see above).
- Consider bringing in a collection of T shirts to provide students with visual context (or examples of another object of your choosing).
- Plan for 1-3 sessions to complete the systems map, and further time if students research elements and processes in the systems map.

2. Introduction:

Refer to the Leyla Acaroglu video and say something like: "This video has really gotten me thinking about how all the things I use have a life cycle. When I put on this T-shirt this morning, I wondered about its entire life cycle, from the beginning to the end. I need you to help me go all the way back to where this object started. Where did the materials for this shirt come from?"

3. Systems Mapping and discussion:

Create a systems map divided into the following sections, including questions to elicit student's responses. Each category is a proxy for a system that can be investigated further:

- Growth: "What material is this made of? Where is it grown, or where does it occur naturally? What other natural or human created systems would be necessary for it to grow or exist?
- Extraction: How is this substance taken from its surroundings? What process is needed or used? Who is involved, and what other systems are required to harvest or extract it, and prepare it to be transported?
- Transportation: How is the material transported from the (field, mine, well, etc.) to the place where it will be manufactured? How did this mode of transportation come to be? Who operates this transportation?
- Manufacturing: How does the raw material get made into a useful product? What process is involved in manufacturing? What machinery and workers are needed?
- Packaging: How is the finished product packaged? What materials are used to make the packaging? How are the packages transported from the manufacturing plant to the retail location?
- Marketing: How do people find out about the product? What advertising is used to entice people to buy it? How is the price set? How does the company keep track of inventory?
- Uses: How do people find or buy this product? How is this product used by people? Are there multiple ways it can be used?
- End of life: What happens to the product when its usefulness comes to an end? Is it reused, repurposed, recycled? Where does it end up? What systems are used?
- Repeating the cycle: How long does the entire life cycle take? How and where does the cycle start over again?

In each step, continue to probe deeper. Keep redirecting students to dig for the origins of the object. Generic questions such as, "What came before that? Or "How did it get there?" "Who and what were used?" will help students think through each step of the process.

4. Follow Up:

Students can work in pairs or in larger research groups to further investigate each of these steps and present their findings to the class.

So What?

Relevance of this work

As students think about the number of steps needed to create a product they use, they will see how all the systems involved are intertwined. Hopefully they will become wiser consumers and seek lasting solutions to the environmental problems we face. Exploring the processes involved in bringing a product to market will lead the

next generation to design more efficient and sustainable systems and share the information and understanding they have gained. Finally, this exploration will raise their awareness of how consumer habits impact the environment. As they work through the process, they are accessing skills in research, reading and writing, math and economics, scientific concepts, and social studies.

Level of importance

Awareness of the complexities in bringing a product to market is the first step in making informed consumer decisions. It is a skill our children will need to survive and thrive in the 21st century. We will depend on their generation to find solutions to the environmental dilemmas we face, and it is crucial that they understand the impact of the products we use every day. This awareness and search for solutions will help them create a more sustainable future.

Assessments

Formative and summative

- Ask students to explain one or two of the systems principles in their own words
- Have students make their own systems map showing one or two of the principles
- Student reflection questions:
    - Why is it important for us to understand systems and how they work?
    - How will knowing about systems and their principles help us, our school, our community, our world?
    - Now that we know about Systems Principles, how can we use what we know to learn more about (_____)? *If you already have any idea of where you want your students to end up, you can introduce the next concept at the end of this lesson

Types of student work products (individual and group)

- Students can present to other classrooms, buddy classes, and the school community about what they have learned. They can discuss this information with their families and identify ways in which the family may decide to alter their buying habits.

Applications

Research groups can be assigned to further investigate each step of the life cycle and report back to their peers (origins, extraction, manufacturing, transportation, packaging, marketing, uses, end of life).

Students may want to do additional research on the issues around sustainability, and design social action to address those issues.