Your Hidden Water Footprint

Defining a Problem to Find a Solution

Grade levels: 6-8

Total activity time: 60 minutes

Materials needed:

- Student worksheet
- Supply Chain handout
- Supply Chain infographic
- Smartphone, leather boots, chocolate bar

The purpose of this activity is to give students practice *putting a design problem into perspective.* In this case, the class will explore the often surprising amount of water used in producing everyday products like cola, leather boots, smartphones, and chocolate bars. By taking on the imaginary role of Sustainability Chief for a company and being tasked with better understanding the water footprints of their company's product, students will practice identifying what they know, what they don't know, and what questions to ask to better understand the constraints of a design challenge.

This lesson is part of a larger unit in the **Flipside Science** series: ***Fresh Solutions: Water Use and Conservation.*** In this unit, students practice different steps in design thinking within the context of global water issues. At the end of this unit, you can challenge your students to participate in a design thinking challenge to tackle a water conservation issue at home or school.

Grade levels: 6-8

Essential questions

1. How do some of the goods we buy and use contribute to our water footprints?
2. How can we better understand what we know and don't know about an issue and what questions to ask to learn more?

Objectives

Students will

1. Develop insights into how the goods we buy and use can contribute to our indirect water footprint.
2. Practice establishing what they already know about a problem and what questions to ask to better understand the context and constraints of a design solution.
3. Learn about how water is used in the supply chains of four different products: a bottle of cola, leather boots, a smartphone, and a chocolate bar.

Terms for students

- **Water footprint:** the total volume of freshwater consumed and polluted for the production of the goods and services that are used by a consumer.
- **Supply chain:** all of the resources, information, and people involved in the production of a good, from growing/harvesting the materials to make it, to selling the product in a store.

Teacher note: *You can introduce your students to the concept of a supply chain with* ***this introductory lesson by TESA***

Materials needed

- Student Worksheets The Hidden Water Footprint: Part I and Part II (1 of each per student)
- ***How much water goes into that bottle of cola?*** Supply chain water footprint infographic for a 500-mL bottle of cola (from Your Water Footprint by Stephen Leahy)
- Supply Chain handouts (1 per student group)
- 1-2 smartphones (can use the students' if they have their own), 1 pair of leather boots, 1-2 chocolate bars

Activity prep

1. Print out one **Student Worksheet** per student (includes handouts for both Parts I and II)
2. Print out 1 **Supply Chain handout** per student

Pre-activity homework

Ask students to brainstorm a list of all the ways in which they use water (e.g., to take a shower). They should come to class ready to talk about these lists.

Activity Procedure

Total Activity Time: 60 minutes

Introduction to water footprints (15 min.)

1. Have table groups share with each other the ways in which they use water; give them five minutes to come up with the longest list they can. Make it a competition! Have your own list ready to share that includes not only direct personal water uses, like for bathing, drinking, washing clothes or dishes, etc., but also includes a list of products like clothing, technology, plastic, and processed or raw food items (chances are good that you will win with the longest list!). Students might or might not see right away how these products relate to their own water consumption. Use this time as a discussion that leads students into thinking about how they indirectly use water through the products and services they buy or use.
2. Once students have discovered the trend about the indirect use of water in the production of every-day products, explain to students that many of our everyday choices affect our **water footprints** in ways that are difficult to measure and that we might not directly observe. Your water footprint is the total amount of water that you use directly (e.g., to shower or drink) PLUS the total amount of water you use *in*directly, which includes the amount of water it takes to grow the food that you eat or make the clothes that you wear.

It is possible to measure the amount of water you use when you take a bath, but it is more difficult for you to directly measure the amount of water that was needed, for example, to grow the cotton used to make your t-shirt.

3. How would we determine how much water goes into making products? Take students ideas, and move them towards a definition of **supply chains.** A supply chain is all of the steps—including the people and resources—involved in making a product (like a t-shirt) from getting the materials, to putting them together, to getting the product to a store.

4. Project the infographic for ***How much water goes into that bottle of cola?***. Explain that this is an example of the water use involved in the supply chain for a bottle of cola. Review the supply chain water footprint of the cola with the class, taking note of what is most surprising or novel.

5. What kinds of problems do you identify from this supply chain? When you drink a bottle of cola, are you only consuming the amount of water that is physically in the bottle?

PART I: Gathering information about a design problem (15 min.)

Teacher tip: *In this brief activity, students will explore these hidden additions to their water footprints by brainstorming what they know, what they don't know, and questions they could ask to better understand how different goods are made and how they could be redesigned to use less water.*

1. Students will work in small groups to take on the role of Sustainability Chief for a company that produces one of the following products: **smartphones, leather boots, or chocolate bars.**

   Teacher tip: *You can either assign an equal number of students to each of these products to form larger groups, or have students randomly pick their assignment out of a hat. You will probably need to further subdivide product groups into smaller groups of 3-4 students. Students will work through the activity with their small groups.*

2. Set the context for this activity: *Around the globe, there is an increasing demand for freshwater and a decreasing supply of it. To be seen as an environmentally-responsible and sustainable organization, your company has hired you as their new Sustainability Chief to help them redesign the way they can produce a product that uses less water.*

3. Pass out the physical items (boots, smartphones, chocolate bars) to the groups. Hand out a **The Hidden Water Footprint: Part I** to each student and briefly explain that in order to design a solution to a problem, you first need to figure out what you already know about the problem. Give students about 10 minutes to work through Part I with their small groups.

PART II: Asking questions (20 min.)

1. Hand out a **The Hidden Water Footprint: Part II worksheet** to each student. Now they are going to think about what they *don't* know about their products and will brainstorm questions they could ask to better understand how water is used in making their products and how the products could be redesigned to use less water.

2. Students should spend no more than 10 minutes brainstorming unknowns and questions with their group. After 10 minutes, pass out the **Supply Chain handouts** to each student and ask them to take 5-10 minutes to work through the instructions on the back of the **The Hidden Water Footprint: Part II worksheet.**

Wrapping up (10 min.)

1. Ask for volunteers to briefly share the suggestion they made for how their product could be used with less water.
2. Display for students on a screen **page 13** of this report by the Friends of the Earth, which shows both food and water footprints of various products, including the three they explored today. Wrap up the activity by asking students to reflect on the differences between the water footprints of the three products. **Are they surprised by how these product compare? How could they use this information to make more sustainable choices about the things they buy?**
3. How did you act like a designer today, engineering a solution to a problem? You identified a problem. You put the problem into perspective, understanding the larger context in which the problem exists. You determined what you already knew, and what you needed to learn to start to design a solution.

Next steps

Introduce your students to some of the issues surrounding sustainable water use and conservation in the next activity in this Flipside Science unit, **Exploring Our Growing Need for Water.**

Fresh Solutions: Water Use and Conservation

- Your Hidden Water Footprint: Defining a Problem to Find a Solution
- Exploring Our Growing Need for Water
- Rapid Brainstorming: How Can We Conserve Our Water Resources?
- Sustainable Water Solutions: Weighing the Pros and Cons
- Fresh Solutions: Design Thinking Challenge

About Flipside Science

Flipside Science is a youth-powered series that tackles complex environmental topics and empowers viewers to make a difference. This engaging and upbeat collection of videos, hosted by Academy youth, explores how local communities are addressing environmental problems with solutions ranging from vertical farming to greywater recycling.

Head to **Flipside Science** to find the complete list of videos and activities in this series.

Next Generation Science Standards (6-8)

MS-ESS3.C: Human Impacts on Earth Systems: Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Engineering Design in the NGSS: *At the middle school level, students learn to sharpen the focus of problems by precisely specifying criteria and constraints of successful solutions, taking into account not only what needs the problem is intended to meet, but also the larger context within which the problem is defined, including limits to possible solutions.*

California's Environmental Principles and Concepts

- **Principle II:** The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. As a basis for understanding this principle:
    - **Concept a:** Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Principle IV:** The exchange of matter between natural systems and human societies affects the long-term functioning of both. As a basis for understanding this principle:
    - **Concept a:** Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.

Additional resources

- The land and water footprints of everyday products by Helen Burley at the Friends of the Earth (May 2015)
- What is a Supply Chain? Lesson for middle and high school students created by the The Toolbox For Education and Social Action (TESA)
- Additional infographic samples from Your Water Footprint by Stephen Leahy
- California Academy of Sciences: How Much Water Do You Eat? lesson (grade levels 3-12)

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This lesson uses information and figures from ***The land and water footprints of everyday products* by Helen Burley at the Friends of the Earth (May 2015)**.

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