

Water Diary

























Where in the water cycle do you get your drinking water and how much do you use?

1. Interview adults in your school and home to answer these two questions

Where does the water in your school come from? _____

Where does the water in your home come from? _____

2. Track your water use for ONE day. Do not forget even one drop!

What time did you use it?	What did you use it for?	About how much did you use? (check the best answer)
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My Water Budget

Objective

Students calculate their bodies' water budget, i.e. the water that enters and exits their body.

Ecological Question

How much water do I drink or eat, and how does it exit my body?

Grade Level 3 and up

Setting Classroom and Home

Duration 10 minute introduction, followed by frequent data recording for as many days as the class chooses.

Materials you will need (including handouts)

- Copies of the attached worksheet
- Scales used to measure people's weight (digital preferred)
- Beakers or some other tool for measuring liquid.

Background

Your body is an ecosystem that cycles water. In fact, you are made of about 65% water! For all animals, water 1) helps regulate body temperature, 2) remove waste from the body, 3) carries nutrients, oxygen, enzymes, hormones and glucose to the cells, 4) carries toxins and waste from the cells for elimination, 5) cushions joints and strengthen muscles.

We are constantly cycling water through our bodies and in a healthy human being, water input equals water output! About 90% of water intake comes from what we eat and drink. The remaining 10% is called metabolic water and is produced as the result of chemical reactions in the cells of the body's tissues. We also get a lot of water from the food we eat. Fruits and veggies are about 90% water, crackers and pretzels are 25%, potato chips are 10% and a sandwich is 75% water.

Activity

Students use the attached "My Water Budget" worksheet to calculate the inputs and outputs of their body ecosystem. Only the major inputs and outputs are calculated, i.e. water, food, urine and feces. This activity, while it may break out of people's comfort zone, helps students use systems thinking to calculate a water budget for the body, while also practicing data collection and basic math. After this activity, students could more easily calculate the water budget of a water body or building (see activity 3).

Students will fill out the top half of the worksheet every time they eat or drink (inputs) or use the restroom (outputs). Once the top half is completed, they can fill out the calculations on the second half. A sample worksheet is provided for clarification. If it is not possible for them to do this for an entire day, they can do it for the time they are at school or even for part of the day at school. Their results will be better, and more scientific, if they do this activity more than once. In other words, it is better to do this activity more than once for a shorter amount of time than once for a whole day.

(Hint: this activity works better if they drink more water than other drinks!)

My water budget

1. INPUTS (+)

Food and liquid weight. You can either weigh yourself before and after eating and calculate the difference OR weigh your food and drinks.

Weight of food _____

Amount of liquid (Liters) _____

Weight of food _____

Amount of liquid (Liters) _____

Weight of food _____

Amount of liquid (Liters) _____

Solid Total _____

Liquid Total _____

Divide by .45 to get pounds of water=

Total inputs (solid + liquid) _____

2. OUTPUTS (-)

Urine

Your weight before  _____


Your weight after  _____

Change in weight  _____

+ _____ + _____

Total daily liquid output = _____

Feces

Your weight before  _____

Your weight after  _____

Change in weight  _____

+ _____ + _____

Total daily solid output = _____

Total outputs (solid + liquid) _____

Total Inputs=

Total Outputs=

What else is happening in your body?

My water budget SAMPLE

1. INPUTS (+)

Food and liquid weight. You can either weigh yourself before and after eating and calculate the difference OR weigh your food and drinks.

Weight of food 1.5 lbs

Amount of liquid (Liters) .5 L

Weight of food .75 lbs

Amount of liquid (Liters) 2 L

Weight of food 1.75 lbs

Amount of liquid (Liters) 1 L

Solid Total 4 lbs

Liquid Total 3.5 L

Divide by .45 to get pounds of water= 7.7lbs

Total inputs (solid + liquid) 11.7 lbs

2. OUTPUTS (-)

Urine

Your weight before  104 lbs 102 lbs 102.5 lbs

Your weight after  101 lbs 99 lbs 100.5 lbs

Change in weight - 3 lbs + 3 lbs + 2 lbs

Total daily liquid output = 8 lbs

Feces

Your weight before  103 lbs 102.5 lbs _____

Your weight after  101 lbs 101 lbs _____

Change in weight - 2 lbs + 1.5 lbs + _____

Total daily solid output = 3.5 lbs

Total outputs (solid + liquid) 11.5 lbs

Total Inputs= 11.7 lbs

Total Outputs= 11.5 lbs

What else is happening in your body?

School water budget

Objective

Students calculate their schools' water budget, i.e the water that enters and exits the school. This will require surveying the campus, identifying different types of land cover that might hold or transmit water differently, and then estimating the total area of each of these land covers to come up with a budget of the amounts of water entering each part of the campus.

Ecological Question

How much water enters our school ecosystem, and by what pathways?

How much leaves that system, and by what pathways?

Grade Level 5-12 (for 5-6 grade, the pre-activity alone may be most appropriate)

Setting Classroom

Duration Two 45 minute-1 hour sessions.

Materials you will need (including handouts)

One aerial photo of a your school building and schoolyard per group (can be easily printed from Google Earth)

Long meter tape (10m-30m)

Rulers

Clipboard, pencil or pen

Pre- activity

1. Pose this challenge question to students: What do you need to know in order to answer the question: *Will this school-as-ecosystem run out of water?*
2. Ask students to list everything they would need to know or research to answer the question. This will help them think about water moving into and out of the school.
3. Ask students to draw a diagram of the school-as-ecosystem, showing pathways of water into, within and out of the ecosystem. Upper elementary through high school students can then test their diagram and calculate actual input and output numbers.

Activity for students

A. Form a group and make a preliminary survey of the campus.

1. Get a sense for the overall mix of cover types of the property from the aerial photo.
2. Survey the property to identify the different kinds of land cover or surfaces there. Try to identify surfaces that you think will hold or transmit water differently. *For younger students, ask them to name no more than 3 cover types* (such as lawn, asphalt, and roof)
3. Name those cover types.
4. Using the map and your field observations, mark the map with the boundaries of each patch of land cover or surface.

B. Estimate the area of each category of land cover on the property.

1. Choose a “pacer” and estimate her or his pace length by measuring the distance covered after taking 10 paces. Divide this number by 10. Record this in meters/pace.

2. Pace the length and width of each patch to estimate its size. You can do this by breaking down a patch into geometric shapes and then using formulas for calculating the area of a rectangle, square and triangle. Calculate and record the area in meters², then divide by 100 to get cm²

C. Examine each patch of each cover type and determine where water will go once the rain falls on that patch.

1. Look for pathways for water flow - pipes, drains, holes, cracks, wet spots, etc.
3. Record proposed pathways on the map or your data sheet.

D. Calculate water input budget for each cover type.

1. Calculate the amount of water represented by an average annual rainfall hitting each of these total areas:
 - a. The average precipitation in New York is 40inches/year (or 102 cm/yr).
 - b. Multiply 102cm by the area (in cm²) of each cover type.
 - c. This answer, in cm³ is the volume of water that hits that area in one year. Cm³ is the same as mL
2. Calculate total water input for the school by adding water inputs of each cover type.

E. Speculate on the fate of the water input for each cover type.

1. Think about the most common next steps in the movement of water once it has entered each part of the campus ecosystem. The average absorption rate of soil is 50%. Of course, this is highly variable depending on the type of soil, plant cover, and degree of saturation. Students can determine the absorption rate experimentally, through research or use the 50% average. Average absorption of asphalt is nearly 0%. Evapotranspiration, in New York, is 20 inches/yr. More data can be found in the *Water Cycle in New York* background reading.
4. Create a diagram of the school with numbers that describe how much water enters, what pathways it follows when it arrives and an estimate of how much follows each pathway.

F. Estimate human-mediated water inputs and outputs.

1. Think about the most important routes by which water may be brought into the campus. So far, we have only calculated precipitation!
2. Draw in human-mediated pathways into your diagram and calculate the amount of water used at your school based on the school population. On average, a person uses 10 gallons of water per day for drinking, washing, flushing a toilet, etc.

G. Present your results to the rest of the class.

How much water does it take to grow a hamburger?

Objective

Students analyze and diagram the resources that create the main ingredients of a hamburger (or other meal of choice).

Ecological Question

What does it take to have a hamburger?

Grade Level 3-8

Setting Classroom

Duration 20-30 minutes

Materials you will need (including handouts)

Paper and pencil

Activity

1. Begin by asking the students, “How much water does it take to grow our food?” If you have access to internet in class, you can ask them to go to <http://ga.water.usgs.gov/edu/sc1.html>. If not, give them some foods and ask for guesses about how much water is used to produce a serving of rice, an orange, a head of lettuce, a watermelon, a glass of milk or a hamburger!
2. Here are some answers (for one serving, unless indicated otherwise)

Orange: 14 gallons	Rice : 35 gallons
French Fries: 6 gallons	Tomatoes: 3 gallons
Hamburger patty: 1,300 gallons	Watermelon: 100 gallons
Lettuce: 6 gallons	1 Egg: 120 gallons
Milk: 65 gallons	Loaf of bread: 150 gallons
3. Ask them to draw a diagram or concept map (the best method for this information) breaking down a hamburger, or some other meal of choice, into its main ingredients and then listing the inputs needed to make or produce each ingredient.

Some helpful data:

- a. Lettuce uses about 7 inches of water. In 2002 306,849 acres of lettuce was harvested in the US. So, about $1.24 \times 10^{13} \text{ cm}^3$ of water was used by lettuce in the country.
- b. Wheat uses about 13 inches of water in a growing season. In 45,519,976 acres of wheat was harvested in the US. So, about $1.84 \times 10^{15} \text{ cm}^3$ of water was used by wheat in the country.
- c. Corn uses about 20 inches of water in a growing season. In 68,230,523 acres of corn was harvested in the US. So, about $2.1 \times 10^{15} \text{ cm}^3$ of water was used by corn in the country.

Extension

Ask students to move beyond water in their concepts maps to consider other resources needed to grow or transport the ingredients in a meal.

Some helpful data:

- a. Lettuce and tomatoes are grown in California, 3000 miles from NY. As a whole, the US put 43,000 tons of fertilizer in 2002 and 1,229 tons of pesticides in 1997 on lettuce. In 1997, US farms used approximately 112,125 tons of fertilizers and 13,323 tons of pesticides on tomato crops.
- b. Wheat is grown primarily in North Dakota, Oklahoma and Kansas; all of which are about 1500 miles from NY. As a whole, the United States put 2,000 tons of fertilizers on US wheat crops in 2006 and 12,882 tons of pesticides in 1997.
- c. Corn, which is the main feed for cows, comes from Iowa and Illinois about 1000 miles from NY. As a whole, the United States put 8,000 tons of fertilizers on our corn crops in 2006 and 112,720 tons of pesticides in 1997.

Data Sources:

Crop water use maps for North Dakota <http://www.ext.nodak.edu/weather/cropwater/>

Fresh Market Tomato Production. Douglas C. Sanders. Department of Horticultural Science. North

National Center for Food and Agricultural Policy. <http://www.ncfap.org/pesticide.htm>

USDA Economic Research Service. <http://www.ers.usda.gov/Data/FertilizerUse/>

USDA Census of Agriculture. <http://www.nass.usda.gov>

USGS water science for schools information website. <http://ga.water.usgs.gov/edu/>

Water Use in Vegetables: Western Head Lettuce. University of Arizona cooperative extension.