



# Lesson 2:

## What Happens to PPCPs? - Wastewater Treatment

 <b>9-12 Grade</b>	 <b>45 Minutes</b>
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**Subjects:**  
Biochemistry, Engineering



**Setting:**  
Home and Classroom



**Pre-Homework:**  
List items (other than toilet paper and body waste) they have flushed down the toilet in the past or what items they have seen family members flush.

Read the State of Washington Department of Ecology FAQ sheet:

<http://bit.ly/1MLqJek>

**Materials:**

- Internet Access (for research or instruction)
- Materials for drawing, construction, and brainstorming

**DSRP Vocabulary:**

- ▷ Domestic wastewater
- ▷ Industrial wastewater
- ▷ Pharmacokinetics
- ▷ Septic system

### INTRODUCTION

When pharmaceuticals and personal care products are flushed down the toilet they are basically “out-of-sight, out-of-mind,” but where do they go from there? Eventually, many of those chemicals end up in the waterways that we use for our drinking water and recreation. From municipal wastewater treatment systems to private septic fields, knowing what happens after you flush may create a new perspective on what you flush in the future.

### STUDENT OBJECTIVES

1. Determine if they have a private septic system or are part of a larger public wastewater treatment facility.
2. Describe the current issues in wastewater treatment and brainstorm some possible solutions to those issues.
3. Design possible improvement(s) to current toilet design or to wastewater treatment plants that may help reduce what is released into public waterways.

Be sure to consider the trade-offs of those improvement(s).

### DAILY ASSESSMENT

Students should be able to discuss the topic in depth, clearly state the problem, and create a plausible solution.



## STATE AND NATIONAL STANDARDS

**COMMON CORE**

**Math:** MP.2  
MP.4

**NAAEE GUIDELINES**

3.1  
3.1.A  
3.1.B  
3.1.C  
3.1.D

**NGSS**

HS-ETS1-2  
HS-ETS1-4

## The Take-Away

*A better understanding of how wastewater is treated using public or private water systems.*

(All instructions that begin with an \* are found on the Illinois-Indiana Sea Grant Resource or YouTube Page)

### Conventional Classroom Procedure:

1. Ask students to talk about items they have flushed down the toilet.
2. \*On the board, write down the items they list. Compare that list to *11 Things You Should Never Flush Down the Toilet* at or video *10 Things You Should Not Flush Down the Toilet* (Clean My Space) on) (5:01) (list also attached). How many of the items that the students listed were on these “no-no” lists?
3. \**Watch Wastewater: Where does it go?* (8:43). This video refers to the Canadian city of Windsor and the Detroit River. The information may apply to your local wastewater treatment plant.
4. \*If your students live in areas where septic systems are prevalent, (5:03) *How does a septic system work?* or *Septics 101* (19:02) will be helpful.
5. \*Now focus on pharmaceuticals. Review the video on biochemistry of pharmacology.
6. In groups, have students create a design that will improve the function of the toilet, i.e., how to prevent objects that shouldn't be flushed from entering the waste stream or develop a modification to wastewater treatment facilities that would help screen and/or separate out excreted pharmaceutical metabolites. Have the students talk about their ideas and suggest any improvements to their designs.
7. Discuss the constraints involved in the new design (cost, safety, reliability, aesthetics) as well as any social, cultural, and environmental impacts of the new design. (Whatever isn't finished is homework.)

### Flipped Classroom Procedure:

1. The **night before class**, students should:
  - a. \*Read the State of Washington Department of Ecology's FAQ sheet.
  - b. Fill out student handout *Flushing Trouble*.
  - c. \*Compare that list to *11 Things You Should Never Flush Down the Toilet* at (Illinois-Indiana Resource Page) or *10 Things You Should Not Flush Down the Toilet* (Clean My Space) (5:01) (list also attached).
  - d. \**Watch Wastewater: Where does it go?* This video refers to the Canadian city of Windsor and the Detroit River. The information may apply to your local wastewater treatment plant. If your students live in areas where septic systems are prevalent, *How does a septic system work?* or *Septics 101* will be helpful.
  - e. \*Learn about biochemistry of pharmacology.
  - f. Fill out DSRP vocabulary
2. In class:
3. In groups, have students create a design that will improve the function of the toilet, i.e., how to prevent objects that shouldn't be flushed from entering the waste stream. They can develop a modification to wastewater treatment facilities that would help screen and/or separate out excreted pharmaceutical metabolites, reducing the amount of pharmaceuticals that reach the

watershed. Have the students talk about their ideas and suggest any improvements to the designs.

- a. Discuss the constraints involved in the new design (cost, safety, reliability, and aesthetics) as well as any social, cultural, and environmental impacts of the new design.
- b. If time, discuss the wastewater load of pharmaceuticals when they are directly dumped into the toilet compared to when they are excreted. Refer to the Water Resources Center document in the Resources for Research.
- c. If there are any student groups that show feasible plans, talk to them about further developing them as the unit project.

**Resources:**

- Regents of the University of Minnesota. (2010). Medication and your Septic System, Onsite Sewage Treatment Program (Illinois-Indiana *Resource* Page)

**Extensions or Possible Student Projects:**

- Contact your local wastewater treatment facility to see if tours are available for classes. If so, plan a field experience. If not, consider inviting a spokesperson from a wastewater treatment facility as a guest speaker to class. If your area predominately has septic systems, consider a guest speaker.
- Have students create a “What Not to Flush” public service announcement that is 30 -60 seconds in length as part of their class project.
- Students can further develop ideas on improving wastewater disposal/treatment designs through engineering practices.

Name \_\_\_\_\_ Block/Period \_\_\_\_\_

## Flushing Trouble



What items have you flushed down the toilet?

1.

2.

3.

4.

5.

*Add more on the back as needed*

How many of the items on your list were on the “do not flush” list (in class)?

If you flushed an item down the toilet that caused a clog that you were not able to clear out, how much would it cost (estimate) to have a plumber fix the problem?

Show your research numbers and math.

## 11 Things You Should Never Flush Down the Toilet - Care2.com

<http://www.care2.com/greenliving/11-things-you-should-never-flush-down-the-toilet.html>

There are many things that should never EVER be flushed down the toilet. Doing so, you risk significant plumbing problems as well as environmental pollution.

- 1. Bathroom Wipes** – These “moist towelettes” or as I like to call them “adult baby wipes” are becoming an increasingly popular bathroom accessory. Despite the fact that they’re marketed to be flushed like toilet paper, these wipes are creating clogs and backups in sewer systems around the nation. “An industry trade group this month revised its guidelines on which wipes can be flushed, and has come out with a universal stick-figure, do-not-flush symbol to put on packaging.” (Same thing goes for actual baby wipes and cleaning wipes).
- 2. Condoms** – They probably seem small and very similar to toilet tissue, but these latex prophylactics are like kryptonite for septic tanks and sewage treatment plants. “I’ve been down the sewers in central London and seen what appear to be fish on the surface. They’re actually condoms filled with air, bobbing around. It is pretty grim.”
- 3. Cotton Balls & Swabs** – They’re just cotton, right? It might seem like these small bathroom toiletries would just get soggy and eventually break down in the watery pipeline, but they don’t. They eventually gather together in bends of the pipe, causing massive blockages.
- 4. Prescription Medication** – Don’t need the rest of those pills? Many people feel like they’re doing the safe thing, keeping meds out of the wrong hands by flushing them, but it’s actually very dangerous. These drugs destroy bacteria, contaminate groundwater supplies, and can have terrible effects on wildlife downstream.
- 5. Paper Towels** – These household favorites are extremely wasteful; reusable rags/napkins are much better. However, if you do use paper towels, know that they’re NOT designed to break down in water like toilet paper. Flushing them can cause BIG problems.
- 6. Cigarette Butts** – Not only do they look nasty when floating in the toilet, they’re full of incredibly toxic chemicals that just end up in the water supply. Also, think of all the water you’re wasting to get rid of ONE tiny butt!
- 7. Band-aids** – These are made from non-biodegradable plastic, which is terrible for the environment and can cause terrible clogs in the sewage system.
- 8. Dental Floss** – Despite feeling like string, dental floss is not biodegradable. Once flushed, it loves to wrap itself around other objects in the pipeline, making tiny clogs grow bigger in an instant.
- 9. Fats, Oil, and Grease** – This is a tough one, and everyone has done it at one point, but cooking fats should NEVER go in the drain or garbage disposal. It seems like a liquid when it’s hot, but as soon as this grease hits the drain, it cools and congeals, becoming pipe-clogging wax. Scrape it into the trash, or, if it’s clean bacon fat, save it in a jar for reuse.
- 10. Cat Litter** – I can understand how this would seem ok — it’s just the cat’s poop and pee, right? But cat litter is made from clay and sand, two things that you should NEVER be put down a toilet. Not to mention that cat waste contains toxins and parasites that shouldn’t be in our water system.
- 11. Disposable Diapers** – just because there’s poop in it, doesn’t mean it belongs in the toilet. Diapers are made from toxic plastic that’s designed to expand when it comes in contact with water. In the slim chance you actually get it down the drain, it will instantly be caught in the u-bend, and cause a terrible back up.