



What Scientists Do With #1 and #2



Summary: Students learn how we use Science to clean 50 million gallons of wastewater every day

Grade: HS

Subject Areas: Science

Activity Materials for 12 groups:

Supplies:

- Laminated wastewater cards
- Laminated map of the wastewater system for each pair
- Kitty litter and a scoop so they can put 1 – 2 tbsp in their toilet
- Small squeeze bottles of yellow water (with vinegar)
- Play doh for poop divided into small balls
- Cups -- 4 per group (water, sludge, trash, toilet)
- Plastic straws cut up – you'll need enough pieces so each group can have 2
- Water balloons – each group has 1 - 2
- Cotton balls torn into small pieces
- Sieve -- one per group
- Spoons – one per group
- Water container to fill toilets
- 3 labelled bins to collect trash, water, sludge
- Link to pictures of microorganisms on website

Posters: How to set up, Equations: nitrogen cycle, anaerobic digestion

Common Core Standards and Benchmarks

Speaking and Listening Standards Grade 8:

Engage effectively in collaborative discussions with diverse partners

Solve real world and mathematical problems

NextGen Science Standards and Benchmarks

Science and Engineering Practices

Develop a model to illustrate the relationships between components of a system (HS-PS1-4)

Developing Possible Solutions: when evaluating solutions (i.e. how to manage/treat wastewater) it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural and environmental impacts (ETS1.B)

LS1.C: Organization for Matter and Energy Flow...as matter and energy flow through different systems, chemical elements are recombined in different ways to form different products (Nitrogen Cycle, Production of methane gas)

NM Science Standards and Benchmarks

I.I.III.8.2 Create models to describe phenomena

Benchmark II Explain the physical processes involved in the Transfer, change, and conservation of energy.

III.I.I.8.3 Describe how technological revolutions have significantly influenced societies (treatment of wastewater)

What Scientists Do With #1 and #2

Introduction (5-6 min)

Talking Points:

- ABCWUA -- provides our drinking water and treats our wastewater.
- Southside Water Reclamation Plant (SWRP) = wastewater treatment plant
- SWRP is different from the Drinking Water Treatment Plant (DWTP). The DWTP takes water from the river at the north end of town. The water is sent to homes and businesses in town. The wastewater flows to the south part of town where it is cleaned and returned to the river.
- Explain the difference between the pipes that bring us:
 - drinking water (water that comes from DWTP, through our faucets, toilets, hoses)
 - wastewater (water that goes down our drains, through a sewer system that relies on gravity to send it to SWRP where it is cleaned and added to the Rio Grande.
 - stormwater (water/precipitation that goes down the road into storm drains, then directly into the river or water body- Does NOT get cleaned)
- 99.9% of all wastewater is actually water. The other thousandth is sludge and trash.

Warm Up Activity: Sort laminated cards

- Show students each laminated wastewater card and ask them into which category the item fits: water, trash or sludge. Place cards in corresponding bin.
- Mention weird things that have ended up at the SWRP. It's expensive and dangerous to deal with things that should have gone into the trash instead of our water system.

Activity: Make and clean wastewater (15-20 minutes)

- Show the poster of what each group needs to pick up.
- Kids put waste into toilet. While they make small poop, you fill their water glass about half full and explain it is the water in the tank of their toilet.
- Simulate a real flush -- all at once -- like what happens on SuperBowl Sunday. Don't flush until everyone is ready. 1-2-3- Flush, then STIR. You've got to keep the whole mess moving through the pipes! Don't let it settle at first.
- Let it sit for one minute.
- Now sort everything, just like they did during the warm up with the laminated wastewater cards.
 - Pour water into their water cup.
 - Use sieve for garbage and put it in the trash cup.
 - Spoon out the poop and put it in sludge. The sand goes back into the trash cup.
- Students bring their sorted cups to the front of the room and dump into the appropriate bucket (trash, water, sludge)

Explain Treatment Process Using Laminated Mat showing Wastewater System (10 minutes)

- Trash – goes to the dump (no chemistry here)
- Water – Nitrification and denitrification (Poster of the nitrogen cycle.) Bacteria remove nitrogen from wastewater by twostep biological processes: nitrification followed by denitrification (*urea changes to ammonia naturally in the pipes so by the time it gets to us we start with ammonia – see poster for details about what molecules are formed and bacteria that is active*).
- Finally water goes through UV disinfection which technically sterilizes the microorganisms so they can't reproduce. This water goes into the river.
- Because of EPA standards, any water that goes into a pipe has to have chlorine added. Our reuse water needs chlorine because it goes into a pipe. Reuse water from SWRP = for irrigating parks and other turf areas in the south part of the city. Amounts to 1-5 million gallons per day. Sodium

hypochlorite is used to disinfect the water before it goes into pipes. EPA rule says Show the equation – explain how we put an anode and cathode into saltwater to form a weak bleach sodium hypochlorite.

- Sludge – show the steps for anaerobic digestion. Where do these bacteria come from? Our guts. What are they producing? Farts. Talk about methane gas and how it is used to make electricity to run the plant (supplies about 50% of what we use). Time permitting – show slides of microorganisms from our website: http://www.abcwua.org/education/SWRP6_MicroActivity.html

Wrap Up/ Discussion (5-10) minutes

Ways that we can clean the wastewater stream:

- Keep out plastics like wrappers, toys, and feminine hygiene applicators. “Disposable” wipes should not be flushed
- Don’t flush leftover or expired medicine.
- Cool it, can it, chuck it.
- Rule of thumb: If the river can’t clean it, don’t put it down your drains.