Combined Sewer Overflow Lab

Name _____

Date _____

Period _____

mrsajdak.com/sewer-overflow · Low-write · © Ryan Sajdak · CC BY-NC-SA 4.0

In older cities like Buffalo, one pipe carries sewage from homes and rain from the streets. **m³/s** = cubic meters of water per second. **m³** = cubic meters of water in all.

☐ I can use a model to explain how a pipe that carries both sewage and rain ends up spilling into a river.

☐ I can use numbers from a simulation to compare ways to cut sewer overflows and defend the best one.

Part 1. One pipe, two jobs (starting settings)

SEP 2, 4 · CCC Systems and System Models

Leave every slider where it starts. Drag the **time slider** under the picture to each hour (click it, then use the arrow keys). Read **Homes** and **Storm drains** in the top right corner, the flow **to the treatment plant** at the bottom, and the **storage tank**.

Example: homes 0.05 + storm drains 1.00 = combined flow 1.05 m³/s. If the storm drains read **dry**, write 0.

1. Fill in the table.

Hour	Raining? (yes / no)	Homes (m³/s)	Storm drains (m³/s)	Combined flow (m³/s)	To the plant (m³/s)	Water in the tank (m³)
0.5						
2.5						
6.0						
12.0						

2. Hour 2.5: storm drains _____ ÷ homes _____ = about _____ times as much water.

3. Hour 2.5: combined flow _____ m³/s, but only _____ m³/s goes to the plant.

Watch the **Regulator** as the storm plays. Number the rest in order: ____ the river ____ the storage tank ____ over a low wall

READ FIRST. A **combined sewer** carries sewage and rain in one pipe. Buffalo still has them. The **interceptor** pipe to the treatment plant can only carry 0.21 m³/s. Extra water goes to a **storage tank**. When the tank is full, water spills over a low wall (a **weir**) and out the **outfall** into the river, with no treatment. That spill is a **combined sewer overflow (CSO)**. Sewage carries *E. coli* bacteria, so a beach downstream has to close.

4. Hour 6: no rain. The plant gets 0.21 – homes 0.05 = _____ m³/s of extra water.

That extra comes from ☐ the storage tank ☐ the river ☐ the rain. My table shows the tank going from _____ to _____ to _____ m³.

An empty tank helps because ☐ it has room for the next storm ☐ it cleans the water.

Part 2. Storms and streets (storm presets)

SEP 4, 5 · CCC Cause and Effect

First row: the starting storm (12 mm/h for 2 h). Then press each **storm preset**. Read the boxes under **What happened in 24 hours**.

Example: total rain = intensity × length. 10 mm/h for 3 h = 10 × 3 = 30 mm.

5. Fill in the table.

Storm	Intensity (mm/h)	Length (h)	Total rain (mm)	Peak stormwater runoff (m³/s)	Overflow to river (m³)	Swimming closed (h)
Starting storm						
Light drizzle						
Thunderstorm						
All-day soaker						

6. Soaker overflow _____ ÷ thunderstorm overflow _____ = about _____ times as much.

The thunderstorm rains harder, but the soaker drops ☐ more ☐ less total rain (_____ mm against _____ mm).

The plant and tank can only take so much. The soaker keeps the sewer over that limit for ☐ a short time ☐ many hours, so more of it spills.

7. Set the storm back to 12 mm/h for 2 h. Change only **Paved and roofed area**.

Paved and roofed area	Peak runoff (m^3/s)	Overflow (m^3)
10%		
65%		
95%		

Rain on pavement and roofs ☐ soaks in ☐ can't soak in , so it runs into the storm drains.

More pavement means ☐ more ☐ less runoff and ☐ more ☐ less overflow.

Part 3. Fix the sewer (one change at a time)

SEP 5, 6 · CCC Systems and System Models

Paved area back to **65%**. Press **Thunderstorm**. Make one change, read **Overflow to river**, then put that slider back before the next change. Then do it all again with **All-day soaker**.

8. Fill in the table.

Upgrade	Thunderstorm overflow (m^3)	All-day soaker overflow (m^3)
No upgrade (starting values)		
Double the storage tank (10,000 m^3)		
Green infrastructure 40%		
Double the interceptor (6×)		

9. Bigger tank. Thunderstorm: _____ – _____ = _____ m^3. Soaker: _____ – _____ = _____ m^3.

The cut is the same because the extra tank holds ☐ a set amount, 5,000 m^3 ☐ more in a bigger storm, and both storms ☐ fill it up ☐ leave it empty.

10. Best for the thunderstorm: ☐ tank ☐ green ☐ interceptor

Best for the soaker: ☐ tank ☐ green ☐ interceptor

A short, hard storm can be caught by ☐ a tank ☐ nothing. A long storm sends more water than any tank holds, so the best fix works ☐ the whole time it rains ☐ only until it is full.

Part 4. The river (Thunderstorm, no upgrades)

SEP 4, 6 · CCC Scale, Proportion, and Quantity

Tank, green infrastructure and interceptor back to their starting values. Press **Thunderstorm**, then change only **River flow**. A **+** means still closed at midnight.

11. Fill in the table.

River flow (m^3/s)	Peak *E. coli* (CFU/100 mL)	Closed (h)
2 (dry summer)		
6		
15 (snowmelt)		

Dilution = the same sewage mixed into more water.
Flushing = moving water carries the dirty water away.

12. Bigger river: peak *E. coli* goes ☐ up ☐ down because of ☐ dilution ☐ flushing.

Bigger river: hours closed go ☐ up ☐ down because of ☐ dilution ☐ flushing.

13. River flow back to 6. On the graphs, the rain stops at hour 1.5 and the overflow stops at hour _____, but swimming stays closed until hour _____.

When the overflow stops, the bacteria already in the river
☐ disappear right away ☐ stay until the river carries them away.

Wrap it up

SEP 7 · CCC Cause and Effect

14. My city should pay for: ☐ a bigger tank ☐ more green infrastructure ☐ a bigger interceptor

Thunderstorm overflow went from _____ to _____ m^3. Soaker overflow went from _____ to _____ m^3.

One cost or drawback: _____

NYSSLS: building toward HS-ESS3-4, HS-ETS1-3 and HS-ETS1-4 (DCI ESS3.C, ETS1.B). A made-up city with real rules: the rational method for runoff, 300 L of sewage per person per day, and the 235 CFU/100 mL beach advisory level.