

# Weak tea

Below you'll find data about the quantities of various chemicals entering and leaving the wastewater treatment plants located in Silverthorne, Colorado, (operated by the Joint Sewer Authority) and near the Snake River, Colorado. These plants take in wastewater, treat it, and then output treated water to the Dillon Reservoir, which provides drinking water for Denver, Colorado. What exactly is in this reservoir water? How effective is this wastewater treatment?

In this worksheet, all quantities are given in *grams per day*.

drug	date	Joint Sewer Authority		Snake River	
		Influent	Effluent	Influent	Effluent
Cocaine	1/27/2010	15.14	0.1514	1.83	0.03
Cocaine	10/12/2010	14.45	0.32	4.54	0.03
Cocaine	6/16/2011	10.43	0.15	2.32	0.03
Cocaine	9/8/2011	8.46	0	6.51	0.03
Cocaine	5/24/2012	2.76	0	.65	0.03

1. Graph the influent and effluent quantities of cocaine against time.
2. Use a Riemann sum to estimate the total amount of cocaine entering the Joint Sewer Authority wastewater treatment plant between January 1, 2010 and June 1, 2012.
3. Use a Riemann sum to estimate the total amount of cocaine departing the Joint Sewer Authority wastewater treatment plant and entering the Dillon Reservoir between January 1, 2010 and June 1, 2012.

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Naproxen is a non-steroidal anti-inflammatory drug. The quantities in the chart are in grams per day.

drug	date	Joint Sewer Authority		Snake River	
		Influent	Effluent	Influent	Effluent
Naproxen	1/27/2010	15.14	0.38	2.66	0.22
Naproxen	10/12/2010	166.56	19.38	18.89	0.57
Naproxen	6/16/2011	147.63	3.36	38.26	0.38
Naproxen	9/8/2011	199.87	6.34	40.65	0.03
Naproxen	5/24/2012	180.19	12.23	33.21	0.07

- Graph the influent and effluent quantities of naproxen against time.
- Use a Riemann sum to estimate the total amount of naproxen entering the Joint Sewer Authority wastewater treatment plant between January 1, 2010 and June 1, 2012. Do the same for the Snake River wastewater treatment plant. Who uses more Aleve?
- Use a Riemann sum to estimate how much naproxen the Joint Sewer Authority wastewater treatment plant removed from the water supply between January 1, 2010 and June 1, 2012. Do the same for the Snake River wastewater treatment plant. Which plant removed more by weight? Which plant removed more by percent?
- Use Riemann sums to estimate how much naproxen entered Dillon Reservoir from both the Snake River and the Joint Sewer Authority between January 1, 2010 and June 1, 2012.

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Hydrocodone is an opioid pain reliever used for moderate to severe pain. The quantities in the chart are in grams per day.

drug	date	Joint Sewer Authority		Snake River	
		Influent	Effluent	Influent	Effluent
Hydrocodone	10/12/2010	0.26	0.52	0.14	0.11
Hydrocodone	6/16/2011	0.53	0.42	0.16	0.08
Hydrocodone	9/8/2011	1.79	0.78	0.07	0.08
Hydrocodone	5/24/2012	0.25	0.37	0.05	0.09

- Graph the influent and effluent quantities of hydrocodone against time.
- Use a Riemann sum to estimate the total amount of hydrocodone entering the Joint Sewer Authority wastewater treatment plant between October 1, 2010 and June 1, 2012. Do the same for the Snake River wastewater treatment plant.
- Use a Riemann sum to estimate how much hydrocodone entered Dillon Reservoir from the Joint Sewer Authority wastewater treatment plant between October 1, 2010 and June 1, 2012. Do the same for the Snake River wastewater treatment plant.
- Compare your graphs of influent and effluent. Do they make sense? How effective is current wastewater treatment at removing hydrocodone?