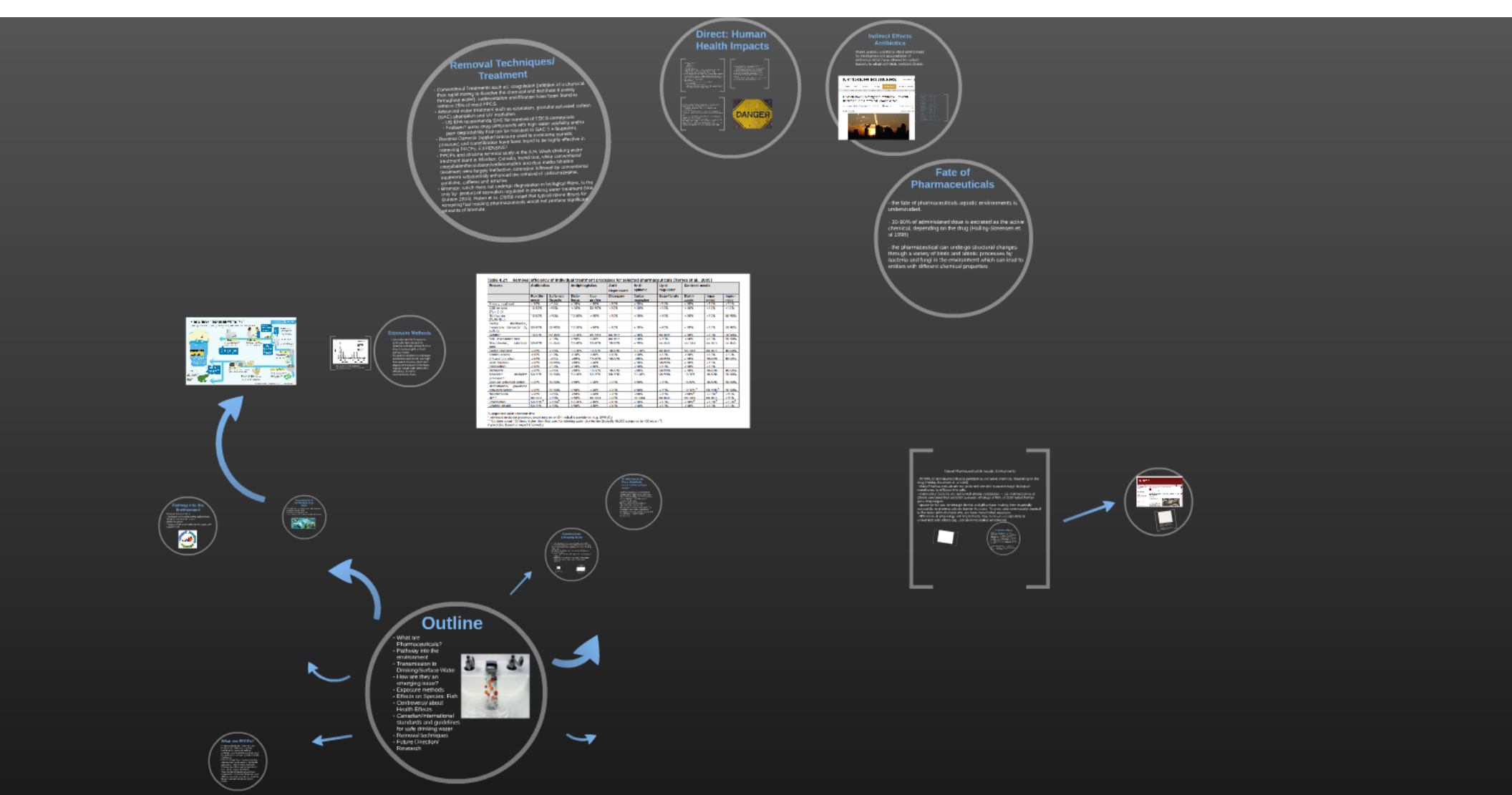

Syntonix Pharmaceuticals Harvard Case Solution & Analysis

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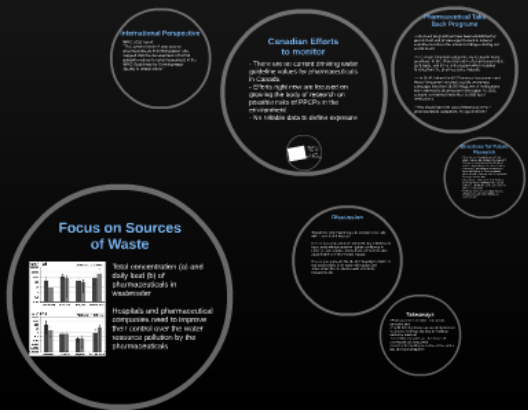

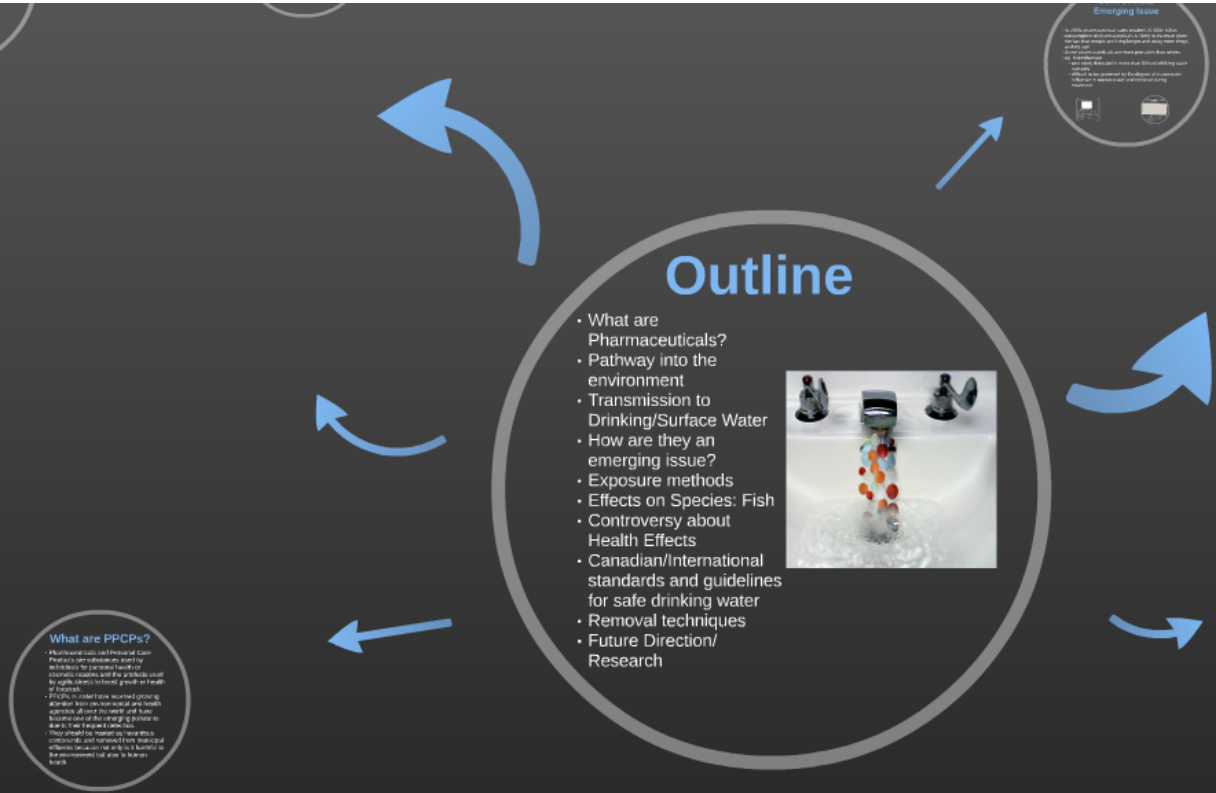

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Outline

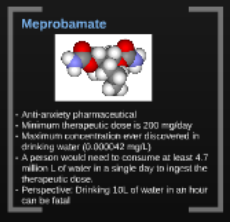
- What are Pharmaceuticals?
- Pathway into the environment
- Transmission to Drinking/Surface Water
- How are they an emerging issue?
- Exposure methods
- Effects on Species: Fish
- Controversy about Health Effects
- Canadian/International standards and guidelines for safe drinking water
- Removal techniques
- Future Direction/ Research

What are PPCPs?

- Pharmaceuticals and Personal Care Products are substances used by individuals for personal health or cosmetic reasons and the products used by agribusiness to boost growth or health of livestock.
- PPCPs in water have received growing attention from environmental and health agencies all over the world and have become one of the emerging pollutants due to their frequent detection.
- They should be treated as hazardous compounds and removed from municipal effluents because not only is it harmful to the environment but also to human health.

Controversial Emerging Issue

- In 2008, pharmaceutical sales totaled US $602 billion
- consumption of pharmaceuticals is likely to increase given the fact that people are living longer and using more drugs as they age
- Some pharmaceuticals are more prevalent than others
- eg. Meprobamate
  - one study detected in more than 50% of drinking water samples
  - difficult to be governed by the degree of wastewater influence in source water and removal during treatment.



Pharmaceuticals are Ubiquitous

Table 3. Concentrations of selected pharmaceuticals found in European surface waters

Compound	Median (maximum) concentrations (ng/l)				
	Austria	Finland	France	Germany	Switzerland
Bezafibrate	20 (160)	5 (25)	102 (430)	350 (3100)	—
Carbamazepine	75 (294)	70 (370)	78 (800)	25 (110)	30–150
Diclofenac	20 (64)	15 (40)	18 (41)	150 (1200)	20–150
Ibuprofen	nd	10 (65)	23 (120)	70 (530)	nd (150)
Iopromide	91 (211)	—	7 (17)	100 (910)	—
Roxithromycin	nd	—	9 (37)	< LOQ (560)	—
Sulfamethoxazole[a]	nd	—	25 (133)	30 (480)	—

LOQ, limit of quantification; nd, not detected (below the detection limit)

[a] Includes the human metabolite N^4-acetyl-sulfamethoxazole.

Source: Ternes et al. (2005)

Studies have shown that pharmaceuticals in trace amounts are ubiquitous in surface water, but occur at low frequency and concentration.

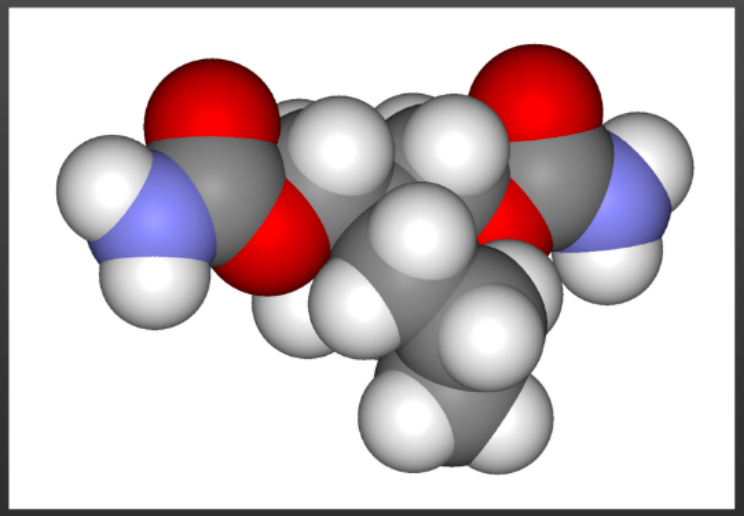
1mg = 1 000 000 ng

1mg = 1000 ug

At what levels do these chemicals occur in the surface water?

- Study conducted by U.S Geological Survey report published in 2002 found detectable quantities of PPCPs in 80% of a sampling of 139 susceptible streams in 30 states.
- Most common pharmaceuticals detected were steroids and nonprescription drugs; detergents, fire retardants, pesticides, natural and synthetic hormones, and an assortment of antibiotics and prescription medications.

Meprobamate



- Anti-anxiety pharmaceutical
- Minimum therapeutic dose is 200 mg/day
- Maximum concentration ever discovered in drinking water (0.000042 mg/L)
- A person would need to consume at least 4.7 million L of water in a single day to ingest the therapeutic dose.
- Perspective: Drinking 10L of water in an hour can be fatal