

Supporting information

Teaching and assessing systems thinking in first-year chemistry

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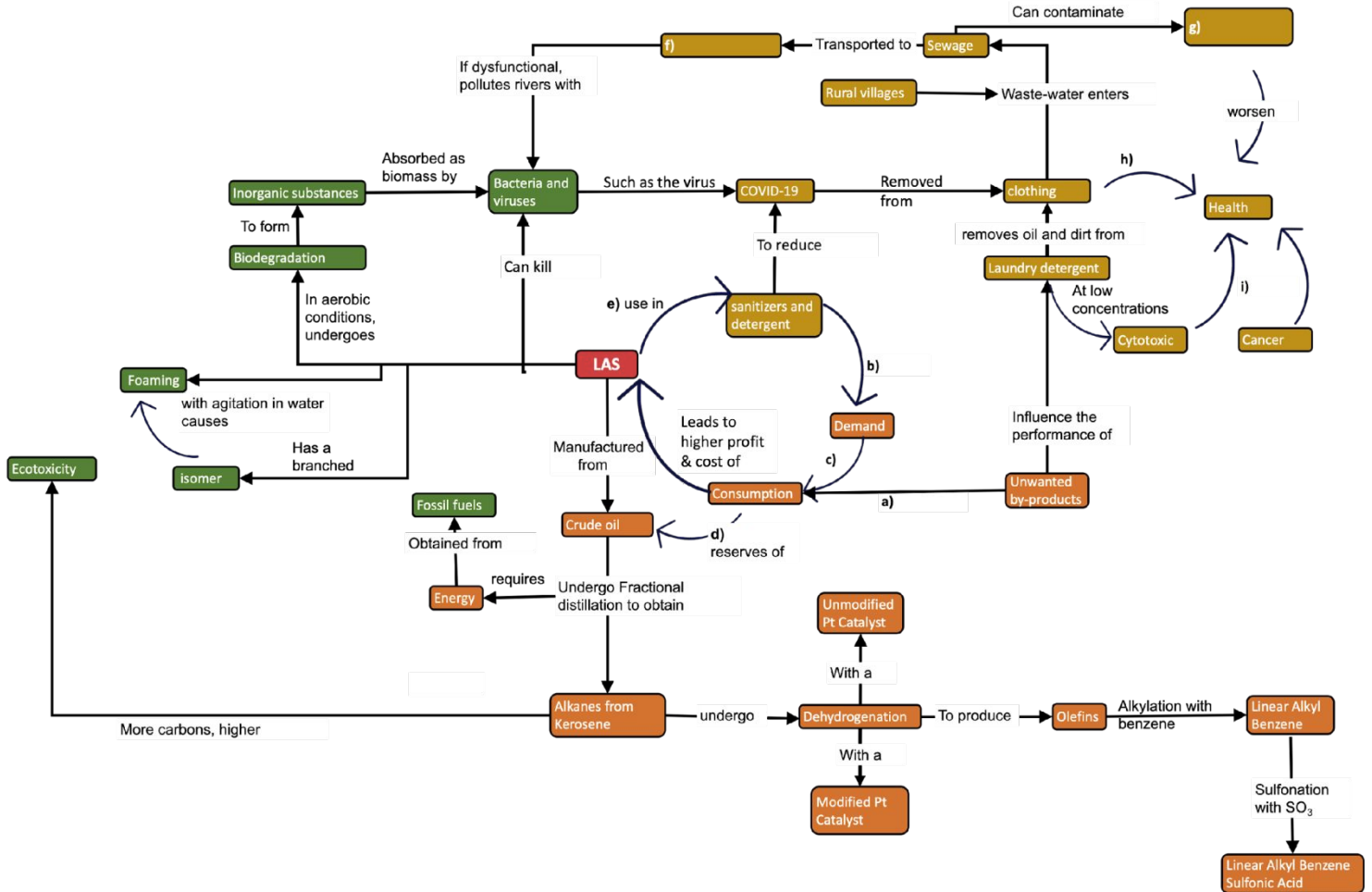
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Group Quiz 2

Description

This quiz is based on the partial SOCME of Linear Alkylbenzene Sulfonate.



Instructions

In your home group, answer the following questions that relate to the provided partial SOCME.

Total questions

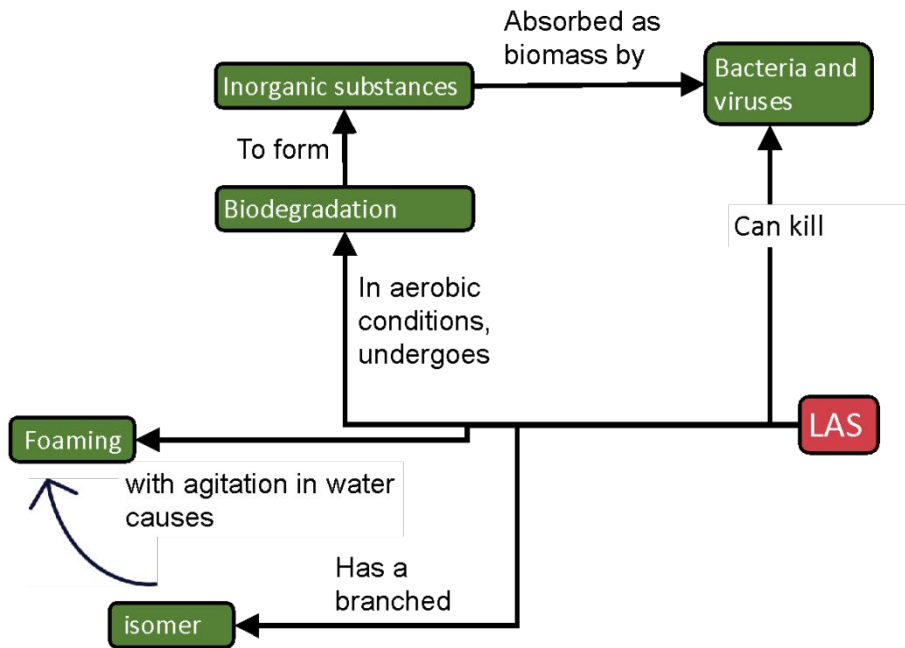
11

Total points

20

Question 1 (Hotspot- 1 mark)

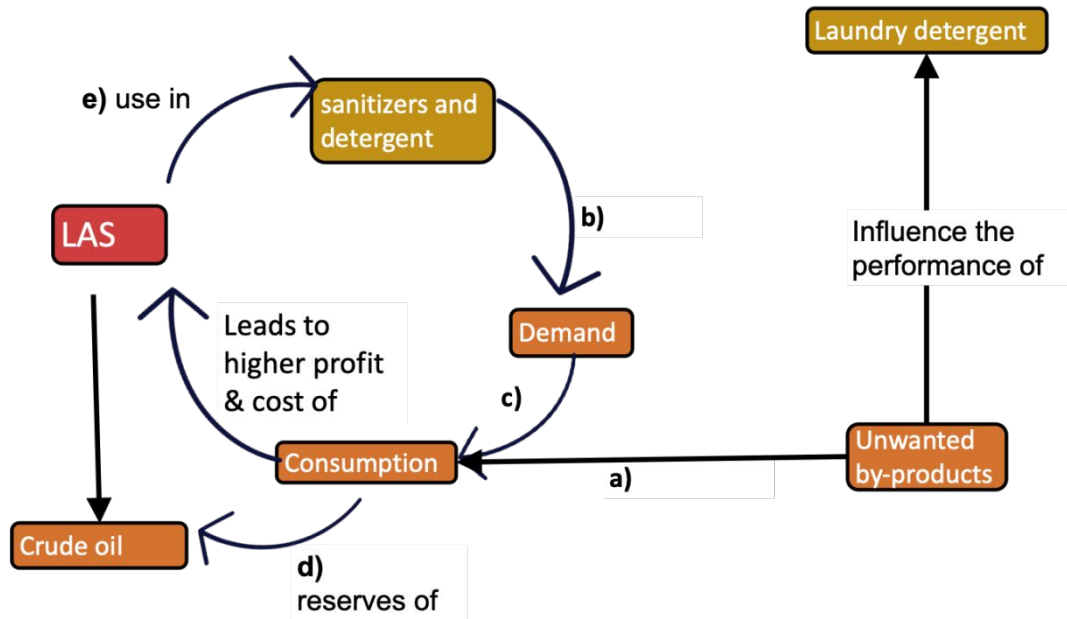
Linear alkylbenzene sulfonate can undergo biodegradation in aerobic conditions to form inorganic substances that can be absorbed by bacteria and viruses. **Click on the arrow** within this biodegradation cycle where the process of biodegradation is considered to be complete.



Question 2 (Jumbled sentence- 5 marks)

Examine the feedback loop and for the letters a)-e) choose the correct linking word that describes the cyclic behaviour in the system of linear alkylbenzene sulfonate.

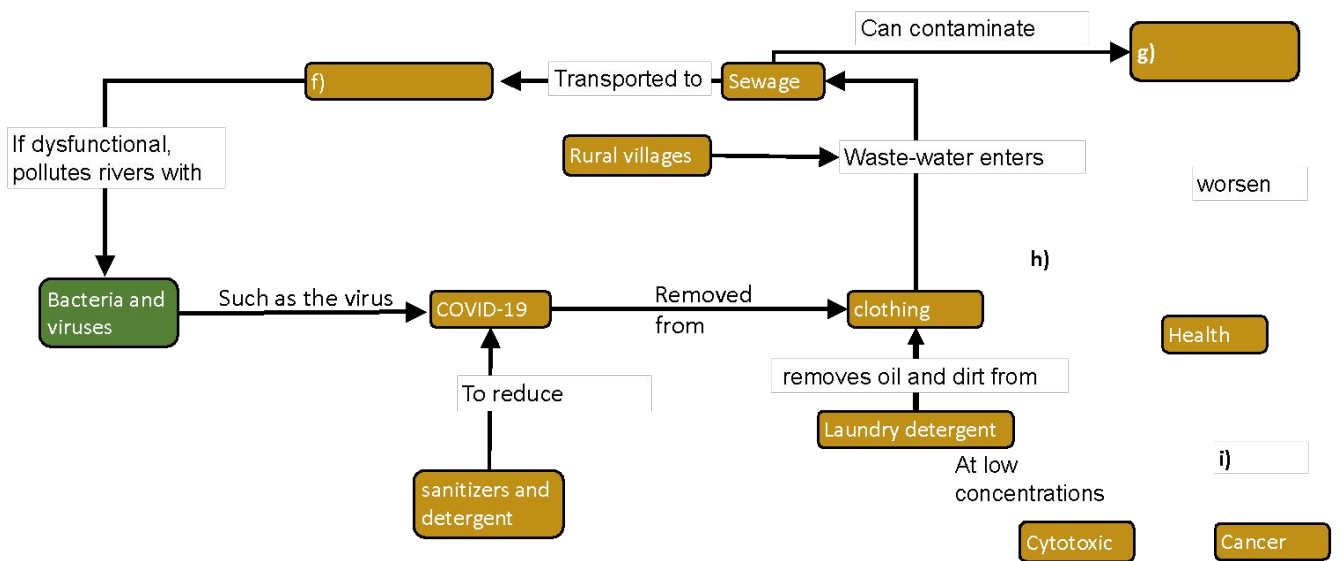
Unwanted by-products [a] the consumption of LAS which results in a higher profit and cost of LAS. Since LAS can be used to break the lipid bilayer of COVID-19, the usage of LAS in sanitizers and detergents can [e] and contribute to a/an [b] in demand. This results in a/an [c] in consumption, which can [d] reserves of crude oil.



Question 3 (Jumbled sentence- 4 marks)

Examine the feedback loop and identify the relevant concept or linking word for the letters f-i).

Laundry detergents remove oil and dirt from clothing. Wastewater from washing clothing enter sewage, which will be transported to [a] (shown as f) on partial SOCME). However, if the infrastructure is dysfunctional, high concentrations of LAS can contaminate [b] (shown as g) on partial SOCME), which can potentially worsen our health. The COVID-19 virus can be removed from clothing with the presence of LAS in laundry detergents, which will better hygiene and [c] (shown as h) on partial SOCME) our health. It was reported in a study that LAS at non- cytotoxic concentrations, can increase the growth rate of colon cancer cells, which can [d] (shown as i) on partial SOCME) our health.



Drop-down list of answers

- Reservoirs
- Waste Water Treatment Plants
- The atmosphere
- Drinking water and food
- improve
- worsen

Question 4 (Multiple answers- 2 Marks)

This photo shows extensive foaming on the Hennops river in 2019. The foaming in the Hennops river resulted from form dysfunctional wastewater treatment plants and the washing of laundry by rural communities that don't have access to municipal water.

IN PICS – The killing of the once-scenic Hennops River **The Citizen**



<https://www.citizen.co.za/news/2168993/in-pics-the-killing-of-the-once-scenic-hennops-river/>

Describe how foaming in rivers can change the rate of biodegradation of linear alkylbenzene sulfonate by clicking on the correct statements. (Select the correct answer/s)

- A. foaming blocks sunlight and reduces the photosynthesis of plants in the river, therefore, reducing the available oxygen in the river for aquatic life
- B. foaming traps sunlight in the river, which increases plant photosynthesis in the river, therefore, increasing the available oxygen in the river for aquatic life
- C. biodegradation requires anaerobic conditions and will be limited as foaming creates aerobic conditions
- D. biodegradation requires aerobic conditions and will be limited as foaming creates anaerobic conditions

Question 5 (Multiple Answer- 2 marks)

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Describe how foaming in rivers can influence the concentration of linear alkylbenzene sulfonate (Select the correct answer/s)

- A. the concentration of LAS won't change if biodegradation occurs within the river system.
- B. as a result of limited biodegradation in anaerobic conditions, the concentration of LAS will not decrease and LAS will persist for longer in the river system.
- C. as a result of increased biodegradation in anaerobic conditions, the concentration of LAS will decrease and LAS will not persist long in the river system.

Question 6 (Multiple answer- 2 marks)

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Describe how foaming in rivers can alter the ecotoxicity of LAS in an aquatic environment. (Select the correct answer/s)

- A. The ecotoxicity will be increased with more foaming, due to the slower biodegradation rate and the high concentration of LAS that persists for longer.
- B. Biodegradation won't change the chain length, and hence the ecotoxicity will be the same
- C. The chain length of LAS becomes shorter upon biodegradation, and therefore shorter chain lengths are less ecotoxic.
- D. Foaming will increase biodegradation, resulting in a decreased LAS concentration and a short lifetime in the river, hence reducing the ecotoxicity

Question 7 (Multiple Answer- 5 marks)

Tick the box with the correct linking words that you could possibly add to the partial SOCME diagram to relate concepts together within the environmental subsystem.

- Increased carbon chain length, higher ecotoxicity
- Shorter carbon chain length, higher ecotoxicity
- Foaming blocks photosynthesis and increase oxygen in the river
- Foaming decreases river health as oxygen in the river reduces
- LAS concentration persists longer in anaerobic conditions
- Aerobic conditions are required for biodegradation
- LAS with a dodecane chain is more ecotoxic than other surfactants with longer chains
- LAS concentration must be equal to or exceed 3.2 mg/l to kill 50% of *Pimephales promelas*