Supporting information

Teaching and assessing systems thinking in first-year chemistry

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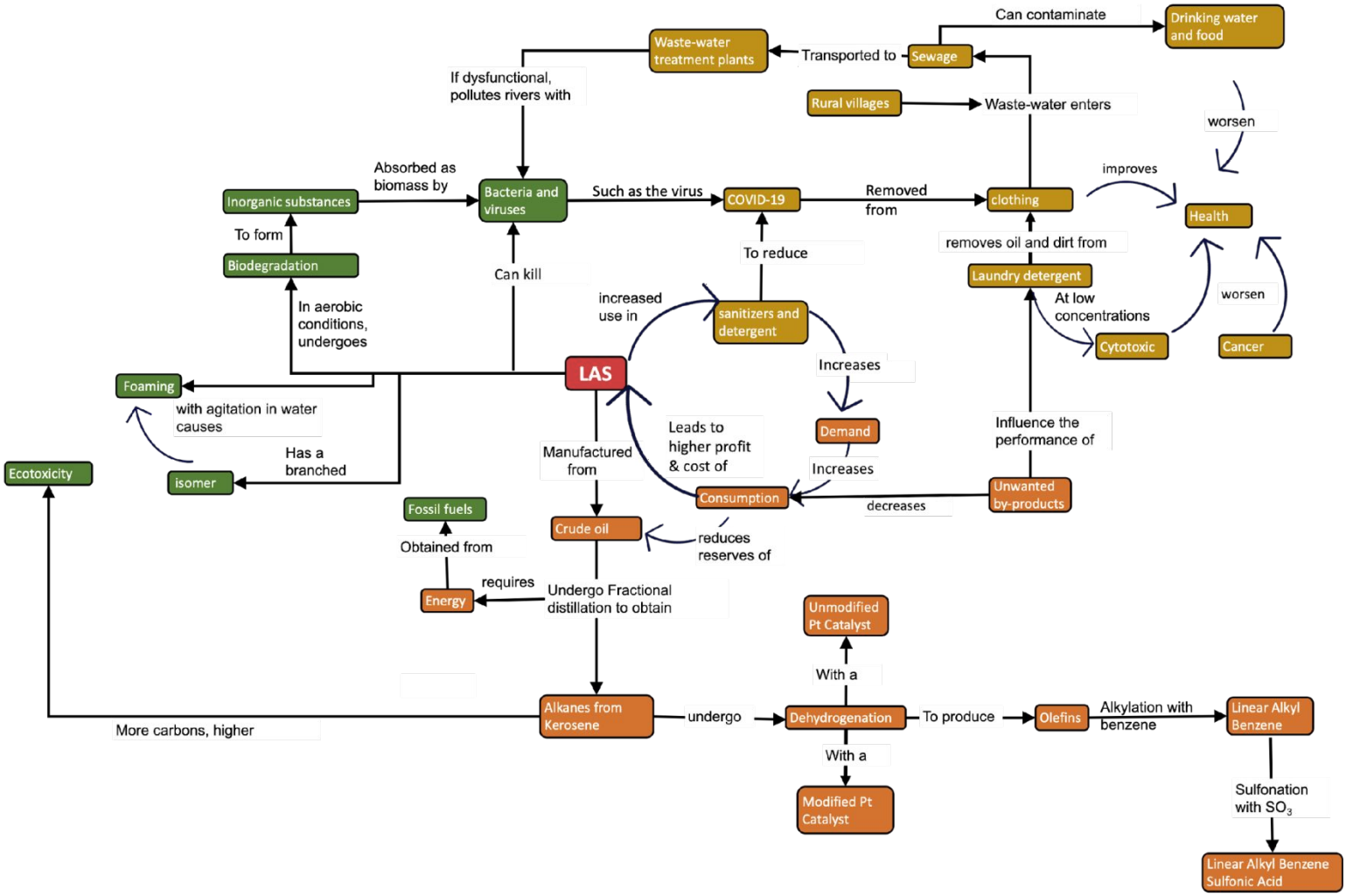
Practical Activity 2

SECTION A

Description
The following questions are there to guide your group in constructing a SOCME diagram from the above partial SOCME diagram provided above.



Instructions
Complete the following questions before constructing your SOCME in section B

Total questions
4
Total points
0

Question 1 (Fill in multiple blanks- 0 marks)

Study the following diagram and discuss in your group, whether you think the economic gain outweighs the environmental or societal impacts.

Fractional Distillation vs. Global warming	Sulfonation vs. Acid Rain/ Spills	Good quality LABSA vs. Heavy metals
Non-renewable energy (fossil fuels) is used to maintain high temperatures to obtain kerosene during fractional distillation. 	Acid rain and spills as a result of reagents used during the sulfonation process to produce linear alkylbenzene sulfonic acid. 	Modified Platinum catalysts for higher yield and better-performing detergents, despite the heavy metals used to modify the catalysts. 

The marks for this question can potentially be awarded on your SOCME diagram

Fractional distillation vs. global warming

South Africa produces the majority of its energy from burning [a] in coal-fired power stations. High temperatures in fractional distillation require more [b]- which results in increased burning of fossil fuels. This emits more [c] into the atmosphere and can contribute to global warming and ocean acidification. Even though, the kerosene obtained from crude oil enables the production of LAS, which is the main active ingredient in laundry detergents. Laundry detergents are essential, not only during the [d] pandemic but also for keeping good [e] and clean clothing for everyday use, as a group we, therefore, think that the economic gain [f] (outweighs/does not outweigh) the environmental consequences.

Sulfonation vs. acid rain/spills

Sulfonation uses [g] and sulfuric acid which could lead to acid rain and acid spills into groundwater, which deteriorates the environment and can cause aquatic death. Together with this, laboratory workers can get exposed to [h] acids, which contributes to a large societal impact with regard to [i]. Nevertheless, the sulfonation process is required for the production of LAS which has many benefits to society. Therefore, think that the economic gain [j] (outweighs/does not outweigh) the environmental consequences.

Good quality LABSA vs. Heavy metals

Modified Platinum catalysts are used to obtain a [k] yield of olefins, used for the manufacturing of LAS. It also [l] waste by-products, produces high quality LABSA and better-performing detergents. With this being said the use of [m] metals during the dehydrogenation reaction can contribute to toxic waste and environmental and societal damage. As a group we have decided that the economic gain [n] (outweighs/does not outweigh) the environmental consequences.

Question 2 (multiple choice- 0 marks)

Choose **either** question 4 **OR** question 5 to use to expand your partial SOCME as you include concepts and linking words that relate to the question. If you choose question 4, ignore question 5 and vice versa.

- **Predict** how carbon dioxide emitted during the manufacturing of LAS, can contribute to global warming and expand on the impacts of global warming and its contribution to climate change.

- As the inland river water migrates towards the ocean **predict** how rivers with low oxygen and high concentrations of LAS can threaten surface water sources on its way to the ocean.

Question 3 (Essay- 0 marks)

Prediction A

In South Africa, coal-fired power stations depend on fossil fuels for the generation of electricity. SASOL uses the electricity for the fractional distillation to obtain the kerosene used in the manufacturing of linear alkylbenzene sulfonate. When coal is burned, carbon dioxide is emitted. The emitted carbon dioxide can be absorbed by aquatic systems, such as oceans. If excessive carbon dioxide is absorbed, ocean acidification can result, which threatens the life of coral reefs.
Predict how carbon dioxide emitted during the manufacturing of LAS, can contribute to global warming and expand on the impacts of global warming and its contribution to climate change.
You can expand on any examples of your choice, these can include changes in global temperatures, the frequency of natural disasters, malaria and typhoid outbreaks, the impacts of ocean acidification and acid rain on terrestrial and aquatic life.
Use the space provided as a piece of "draft paper" to write down a few concepts and linking words that your group would like to add to the above partial SOCME.

Question 4 (Essay- 0 marks)

Prediction B

The Balfour village is one example of a rural community that washes its laundry in the river. There are many other rural and urban communities that don't have access to water and thus also wash their laundry in the nearby rivers. The river water from these communities can be polluted with high concentrations of LAS and be oxygen-deficient. River water with decreased oxygen content can influence the rate of LAS biodegradation, the health of aquatic organisms as ecotoxicity changes, ecotourism, and the health of other community members.
As the inland river water migrates towards the ocean predict how rivers with low oxygen and high concentrations of LAS can threaten surface water sources on it's way to the ocean.
You can expand on any examples of your choice, these can include changes in LAS concentrations, river health, ecotoxicity, biodegradation, ecotourism, human health, water-borne diseases, and biodiversity loss.
Use the space provided as a piece of "draft paper" to write down a few concepts and linking words that your group would like to add to the above partial SOCME

Practical Activity 2
SECTION B

Group Assignment

Instructions:

STEP 1: **Download** the provided PowerPoint Presentation that contains the instructions and the partial SOCME.
STEP 2: Put your **names onto the PowerPoint document**
STEP 3: **Construct YOUR GROUP'S** final SOCME **onto PowerPoint SOCME (use the colour red for new added concepts and be creative! You can add, delete and change concepts/linking words to make it unique to your group's learning experience)**
STEP 4: Add **your own new subsystems**, by drawing your own **boundaries** and grouping concepts together (see example SOCMEs under resources for practical 5) and **name the new subsystems**
STEP 5: **The presenter** must **submit the SOCME** on behalf of the group.

Attachments

1. Rubric

SOLO TAXONOMY RUBRIC (SHORT VERSION)

SOLO level	Sub-level	Description of student responses	Score	Examples of verbs students illustrate
Pre-structural		No new concepts, linking words, or relevant information were added and SOCME looks like the original provided partial SOCME.	0	
Unistructural		Mentions at least one relevant piece of information (one new concept)	10	Identify, name, recall, state
Multi-structural	Low	Contains only 2 or 3 new independent relevant concepts, without further elaboration (without linking words and connections)	10	Combine, describe, classify
	Medium	Contains more than 3 new concepts, but is presented in isolation with no (or some) connections or linking words between concepts	10	
	High	Contains more than 3 concepts with appropriate linking words and connections between concepts	10	
Relational	Low	Connections are drawn between variables and concepts within one or two subsystems	10	Analyse, apply, argue, compare, relate, contrast
	Medium	Connections are drawn between variables and concepts within all three subsystems	10	
	High	Shows connections within AND between subsystems	10	
Extended abstract		At the extended abstract level, students can generalise, make predictions, and organize systems components to understand the whole system	10	Create, formulate, reflect, generalise, predict, evaluate

2. PowerPoint Presentation

NAMES OF **HOME** GROUP MEMBERS

Partial SOCME of LAS- Practical activity 2

Group member	Student Number	Surname	Name
1			
2			
3			
4			
Please write in the block which prediction your group chose to indicate in the SOCME (Prediction A or B)