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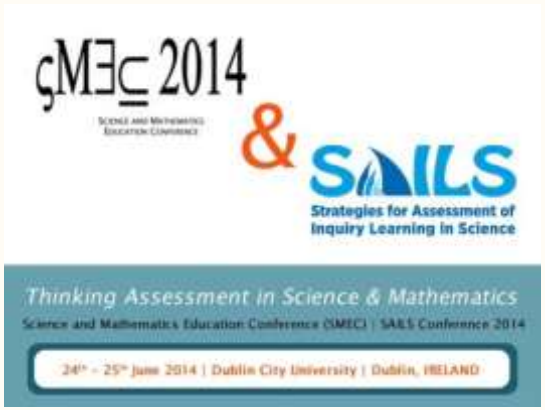

BLACK TIDE - OIL IN THE WATER: A TEACHER'S PERSPECTIVE ON STUDENTS ASSESSMENT

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SAILS Case Study

Topic: Black tide – oil in the water

Inquiry Skills: Planning Investigations

Black tide – oil in the water: Inquiry Activity

Introduction: Since the mid-nineteenth century, we learned to distill oil and separate it into various components such as gasoline, diesel, kerosene (fuel used in airplanes) and oil tar, the demand for oil worldwide has been increasing. Given that it is a natural resource which is not regularly distributed across the planet, it is necessary to ship it from centers and countries of production to where it is consumed. One of the main ways of oil transportation is by sea. Therefore, large ships equipped with big reservoirs are used. They are known as tankers and may reach above 400 m in length and a capacity beyond 500 000 tons of burden.

The oil is a viscous black liquid and when a tanker has an accident, it may be spilled at sea and its removal is very difficult. Recently, scientists have been working to find ways to remove spilled oil from the water, but they have not had much success. What will happen to oil when spilled into the ocean?

Introduction

Some properties of oil

Components obtained from its distillation

The importance of oil as a resource

Black tide – oil in the water: Inquiry Activity

How does the oil behave when spilled into the ocean? To answer to this question, we propose you to plan an experiment on the oil's behavior (in this case represented by vegetable oil) when poured into water mass.

1. **Think**, with your colleagues, of possible answers to the previous question.

2. Now you are going to **plan**, **with your colleagues**, **an experiment** that helps you to find an answer to the previous question. On the laboratory bench it is some of the available material, which is listed below, and that can be used in your planning. You must take into account the different natural factors that interfere with the ocean activity - currents, waves, winds... - In order to consider them in your planning.

Material:

- Glass or plastic bowls
- Spoon
- Water
- Simulated Oil (you can prepare simulated oil mixing 12 tablespoons of vegetable oil and 8 tablespoons of cocoa powder)

If you consider that it is necessary another type of material that is not in the list above, please request to your teacher.

How does oil behave when spilled in water?

Formulate a hypothesis

Plan an investigation

Take into account the different natural factors that affect the activity of the oceans - currents, waves, winds (Control of variables)

Black tide – oil in the water: Inquiry Activity

When planning the experiment don't forget to identify the different variables: the independent variable (which varies), the dependent variable (what will you measure or observe) and the controlled variables (what you are you going to keep constant).

2.1. Discuss with your teacher the plan of your group before you carry out the experiment.

2.2. Write down what you predict will happen as a result of the experiment that you planned with your colleagues. **Present a justification** for this prediction.

2.3. Perform the experiment, with the help of your colleagues.

2.4. Record the results.

2.5. Compare the prevision presented in 2.2., with the obtained results. Do you find it's necessary to re-evaluate your initial prevision?

2.6. Explain the results registered in 2.4. If you need, you may consult bibliography or websites that help you build an explanation.

2.7. Answer the initial question.

Make predictions

Execute experiments

Organize data

Explain their ideas based on evidences and draw conclusions

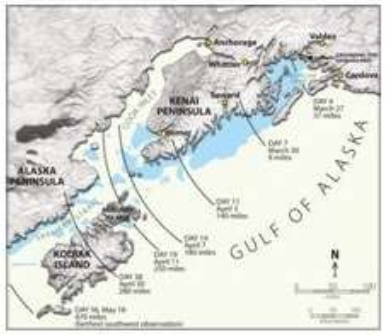
Black tide – oil in the water: Inquiry Activity

3. In the following figure you can observe the extension affected by the oil spill, released during an accident with the tanker Exxon Valdez, which occurred on March 24, 1989 near Valdez town, Alaska. The sea regions demarcated in blue (or light gray) denotes the affected area over the 56 days after the accident.
This map shows the distances in imperial units (miles). For a better understanding of the disaster scale is useful to convert these values to kilometers, since you're more familiar with this length unit. Knowing that 1 mi = 1, 61 km, convert and register the value in the map. Convert the value of the affected area indicated in the map legend to km^2. Confirm the results with your teacher.

3.1. Based on the conclusions you made from the previous experience, explain the expansion of the oil spill from the Exxon Valdez.

3.2. Find a justification for the statement of the text: "In recent years, scientists have been working to find ways to remove the spilled oil from the water, but have not had much success."

3.3. To get a better idea of the spill extent, use Google Maps and try to have an image similar to that one in the figure.



(Exxon Valdez Oil Spill Trustee Council - http://www.evostc.state.ak.us/)

Apply their newly acquired skills or concepts to a real situation: Exxon Valdez Oil Spill

Black tide – oil in the water: Inquiry Activity

4. As you can imagine, the oil spill of the Exxon Valdez had not only environmental impact, but also economic and social. Do a little research on the implications of this accident on marine life and human populations in the affected coastal areas. Write a story for a newspaper telling what happened, the adverse consequences of the accident and the effect it had on the establishment of new rules for the oil sea transport.

Exxon Valdez
(Wikimedia Commons)

Journal/newspaper piece about Exxon Valdez Oil Spill

* Focus on the environmental, economic and social impact

* Consequences for the establishment of new rules for oil sea transport (students search, analyze and select information; communicate their findings)

In the Classroom

- **Student Group**:

  7th grade

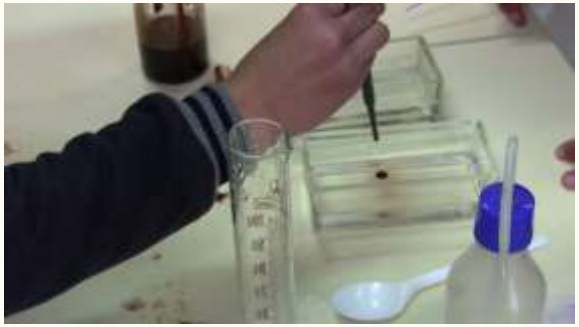
  20 students: 13 girls and 7 boys

  Ages between 12 and 14 years old

- **Inquiry activity applied trough 4 lessons of 90 minutes**

In the Classroom

- Students worked in groups of three or four elements



Assessment

Skill: Planning investigations

Three dimensions:

- set objectives
- define strategies and procedures
- identify and select appropriate resources

Assessment

An assessment instrument: three levels of performance (level 1 corresponds to lower level and level 3 to the highest level)

Before using the assessment instrument:

Teacher´s written feedback on students´ work

- What they did well
- What they had to improve

Element of IBSE	Operations/ actions involved	Performance Levels		
		1	2	3
Planning Investigations	**Define goals**	Does not define coherent goals, according to the proposed problem.	Defines some coherent goals, according to the proposed problem.	Defines coherent goals, according to the proposed problem.
		Does not operationally define the variables.	Defines the variables under study with some difficulty.	Operationally defines the variables under study.
	Define strategies and procedures	Does not define the necessary strategies and procedures to accomplish its goals.	Defines with some difficulty the necessary strategies and procedures to accomplish its goals.	Defines the necessary strategies and procedures to accomplish its goals.
		Unclear planning, requiring reformulations.	Planning well-presented, but requiring reformulation.	Clear, concise and complete planning.
	Identify resources and choose them properly	Does not select adequate resources according to goals and strategies.	Selects some resources that are adequate to goals and strategies.	Selects resources that are all adequate to goals and strategies.

Example of performance: level 1

Experiments (planning)

You do not indicate the material they will use.

1st - Water with oil or oil with water.

The question asked was: How does oil behave when it is spilled on water?

Occurrence of oil in water.

For one graduated cylinder of water, use half graduated cylinder of oil.

What is the volume of water in the graduated cylinder?

Recipient 1 – ~~First one puts~~ In a trough, one added salt water and then added the simulated oil (should indicate the used volumes).

The oil fell to the bottom and immediately afterwards it rose and spread. The observations are presented in 2.4.

Occurrence of water in oil

For one graduated cylinder of oil use half graduated cylinder of water

Recipient 2 – First, we placed the oil and then the water was added. The oil remained at the bottom and the water rose to the surface.

I realize you are curious, but the aim was not to answer this question.

Comparison – If there is more water than oil, the oil falls to the bottom and then rises up to the top. If there is more oil than water, the oil stays on the bottom and the water rises up to the top.

How have you made this observation? Did you try this? Was this what you observed?

Example of performance: level 1

2nd – Effects of the currents, waves and wind

How does the mixing of oil and water occurs due to currents, waves and winds?
For one graduated cylinder of water, use half graduated cylinder of oil.
Waves: shaking the trough;
Winds: blowing through a straw;
Tides: using a glass rod.
The planning should be detailed.
The observations are presented after the planning in the answer to the question 2.4.
Recipient 1: Waves
The oil spreads on the water's surface clouding it.
Recipient 2: Wind
The oil creates a surface layer on the water, also clouding it.
Recipient 3: Currents
The oil was on the bottom and the water was clouded.
The oil was not on the bottom as it was on the previous situations? Was the same simulated oil used?
Recipient 4: With nothing. What does "with nothing" means?
The oil was on the top and on the bottom?
Carefully see what you have registered for recipient 1 (page one).
Comparison: We have observed that at all the recipients the water was clouded, except at the recipient 4.

Example of performance: level 2

2) *Students do not indicate the material they will use.*

1st step – Put water in the recipient and add a mixture of 12 tablespoons of vegetable oil and 8 tablespoons of cocoa powder. This mixture of vegetable oil and cocoa is the simulated oil.

What was the volume of water used? Did you use that amount of simulated oil? You need to be clearer in your planning, that is, your planning needs to be more detailed.

2nd step – In that recipient, we will ~~put~~ use a fan to simulate the wind.

3rd step – In another recipient, we will use the same volume of preparation, equal to the one used before (with water and simulated oil). We will shake the recipient to simulate the waves.

4th step – In another equal preparation, we will agitate it with a glass rod to simulate the currents.

5th step – In another recipient, we will put the preparation and we will do nothing else.

6th step – ~~Compare all recipients~~. Observe and register the results.

Example of performance: level 3

2.1. *Students do not indicate the material they will use.*

Wind's effect

1st – Prepare simulated oil: mix 12 tablespoons of vegetable oil with 8 tablespoons of cocoa powder.

2nd – ~~Trough with water and simulated oil as~~ control. Explain how.

3rd – Put 75 ml of water in a trough. Add 2 tablespoons of simulated oil. ~~Trough~~ with water and simulated oil to simulate the wind. How do you simulate the wind?

4th – ~~Compare control tough with simulated wind trough~~. Register the observations.

1st ~~5th~~ – In a ~~Each~~ trough put ~~has~~ 75 ml of water.*

2nd ~~6th~~ – Add ~~Each trough has~~ 2 tablespoons of simulated oil.*

** These should be the initial steps.*

Example of performance: level 3

Waves' effect

1st – Trough with simulated oil as control.

2nd – Trough with water and simulated oil to simulate the waves. How did you simulate the waves?

3rd – ~~Compare both troughs~~. Register the observations.

4th – Each trough with 75 ml of water.

5th – Each trough with 1 tablespoon of simulated oil.

The previous steps are subjected to the recommendations as the previous ones. You should alter the sequence of the steps and the plan is incomplete.

Current's effect

1st – Trough with simulated oil as control.

2nd – Trough with water and simulated oil to simulate the current.

**4th – Each trough with 75 ml of water.*

**5th - ~~Each trough with~~ 1 tablespoon of simulated oil. The volume of simulated oil should be the same.*

** These should be the initial steps of your plan.*

Concluding Remarks

- **In the classroom**

All students, with greater or lesser teacher´s guidance, managed to define strategies that enabled the control of variables.

- **Analysis of students´ work**

These ideas were not always present or explicit in the planning procedure.

Feedback

Concluding Remarks

Teacher´s Initial Difficulties

To define level 2 of performance:

- Design of the assessment instrument
- Assessment of student´s work

Concluding Remarks

To overcome some of these initial difficulties

- First analysis

  Writen feedback on student´s work

- Second analysis

  Evaluate with the assessment instrument

Assess the competence of planning and categorize the students' work using the performance levels.