LES 8

O B S E R V A T O R Y
SCIENCE AND TECHNOLOGY (ST)
ENVIRONMENTAL SCIENCE AND TECHNOLOGY (EST)
APPLIED SCIENCE AND TECHNOLOGY (AST)
Teacher's Guide A
Second Year of Secondary Cycle Two

IS THERE A MONSTER IN THE LAKE?

STUDENT LOG

WORKING DOCUMENTS

EVALUATION DOCUMENTS

PROCEDURE AND EVALUATION: SSC2 – SCIENCE

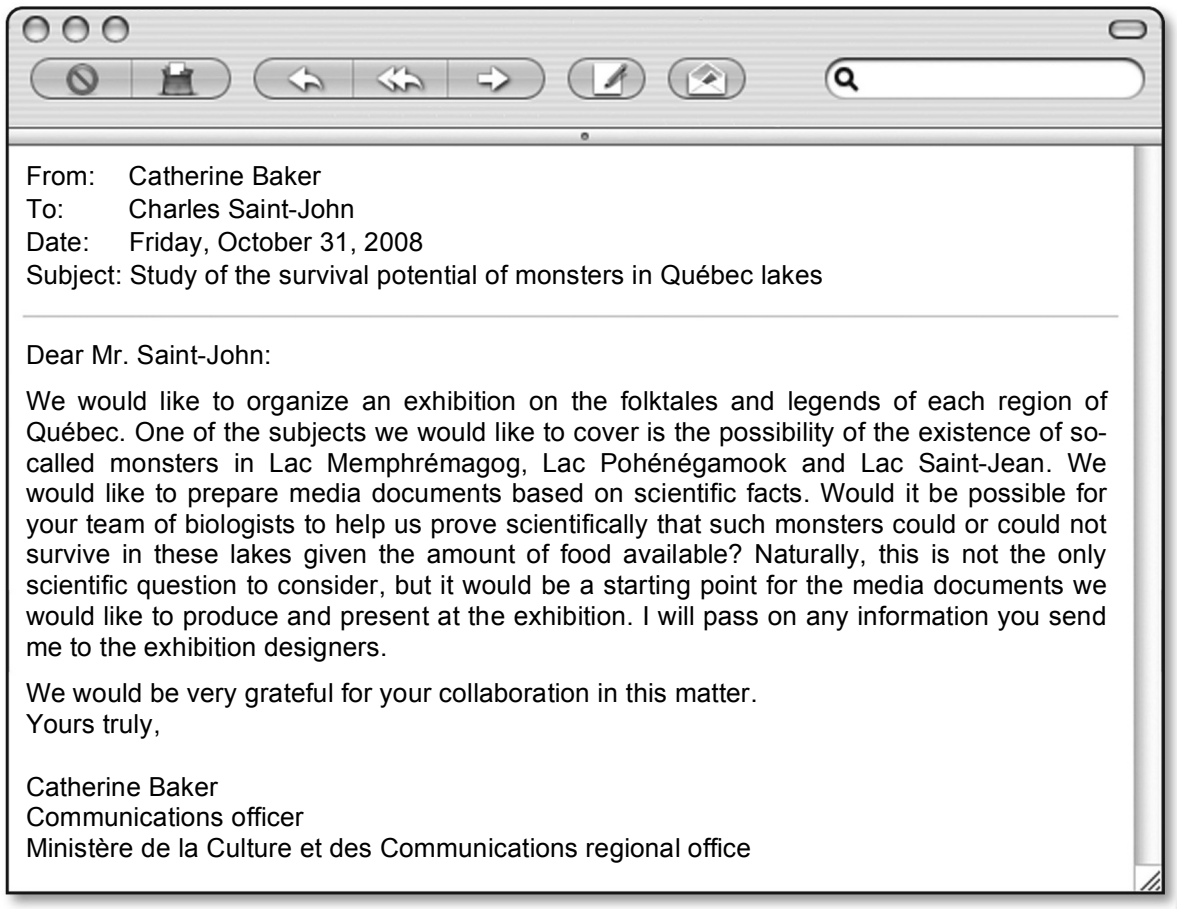
Observatory / Guide
11129-A

Name: _____ Group: _____ ST EST AST

The case study

Memphre: myth or reality?

Magog (Estrie) – When the first Europeans settled in our region at the beginning of the 19th century, the local Aboriginal people warned them about a sea serpent in Lac Memphrémagog. Since then, many sightings of the monster have been reported. In 1994, the giant serpent was even given a name: Memphre. Other such monstrous creatures supposedly live in Lac Saint-Jean (Ashuaps) and Lac Pohénégamook (Ponik). Some people claim that these monsters are the fruit of human imagination, created to explain the inexplicable. Others believe that there is some truth behind the legends and that these creatures represent as yet undiscovered species. In the coming months, an exhibition on the folktales and legends of Québec will include a scientific look at the question. Is it even possible for Memphre and its fellow serpents to survive in our lakes?



From: Catherine Baker
To: Charles Saint-John
Date: Friday, October 31, 2008
Subject: Study of the survival potential of monsters in Québec lakes

Dear Mr. Saint-John:

We would like to organize an exhibition on the folktales and legends of each region of Québec. One of the subjects we would like to cover is the possibility of the existence of so-called monsters in Lac Memphrémagog, Lac Pohénégamook and Lac Saint-Jean. We would like to prepare media documents based on scientific facts. Would it be possible for your team of biologists to help us prove scientifically that such monsters could or could not survive in these lakes given the amount of food available? Naturally, this is not the only scientific question to consider, but it would be a starting point for the media documents we would like to produce and present at the exhibition. I will pass on any information you send me to the exhibition designers.

We would be very grateful for your collaboration in this matter.
Yours truly,

Catherine Baker
Communications officer
Ministère de la Culture et des Communications regional office

In this context, you will first play the role of a hydrobiologist who must determine whether there is enough food in one of the three lakes for one or more monsters to survive.

Then, you will take on the role of a designer of a media document to explain the facts and results of the hydrobiology study to exhibition visitors.

The case study (*continued*)

The hydrobiologists will base their case study on the following information.

Possible characteristics and needs of the monsters

- According to eyewitness accounts, the monsters sighted in Québec lakes would be approximately 12 m long. Based on this characteristic, their mass could be estimated at roughly 3500 kg.
- To survive, a monster of this size would need at least 7.7 kg of food per day. This requirement is expressed as an amount of carbon per day (7.7 kg/day).
- The monsters could be either planktivorous or carnivorous (see the food chain below), but their daily requirements would be the same in both cases.
- The amount of food available in the lake for each level of the food chain (trophic level) must be determined to see if the food requirements of one or more monsters could be satisfied by this amount.
- Since the animal populations of the lake are competing for the food available, we estimate that only 20 percent of the food would actually be available to the monster or monsters.

Lake ecology

- Lake ecosystems in Québec usually contain several food chains. The lakes in this study are home to carnivorous fish, planktivorous fish (fish that eat zooplankton) and zooplankton, which feed on phytoplankton. The general pattern of the food chain is as follows:

phytoplankton → zooplankton → planktivorous fish → carnivorous fish

- A 90-percent loss of energy occurs at the first level of the food chain, an 85-percent loss at the second level and an 80-percent loss at subsequent levels. For example, 90 percent of the energy generated by the phytoplankton is lost, and the zooplankton absorb only 10 percent of it.

Characteristics of the lakes under study

The table and graph on the following page present some of the characteristics of the lakes in this case study. The light penetration depth (see Table 1), or *euphotic zone*, is the upper layer of a lake exposed to enough light for photosynthesis to occur. It is an important parameter to consider when studying the primary productivity of the phytoplankton in a lake. The chlorophyll concentration is an indicator of the biomass of the phytoplankton.

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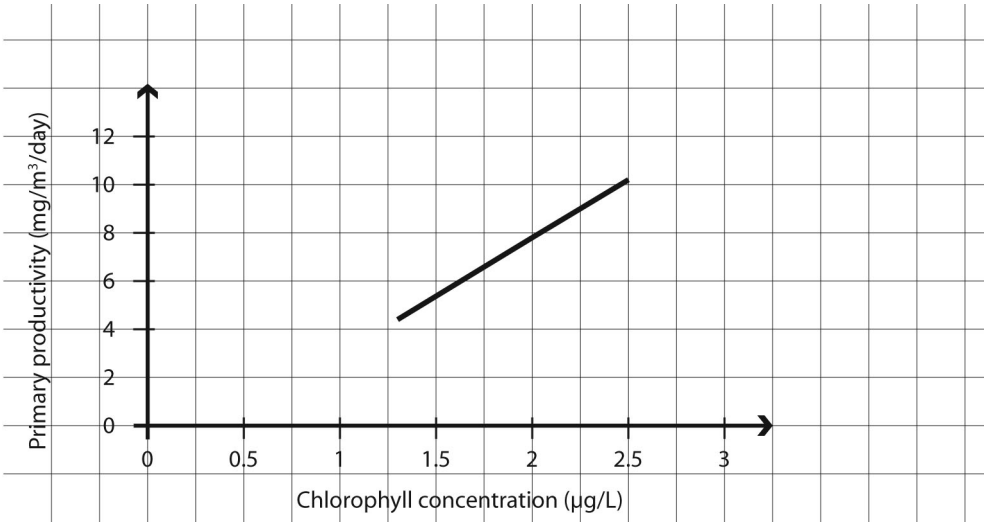
The case study (*continued*)

TABLE 1: Characteristics of the lakes

	Average area	Average depth	Average light penetration depth	Chlorophyll concentration
Lac Memphrémagog	95.3 km^2	107 m	4.5 m	2.0 µg/L
Lac Pohénégamook	13.6 km^2	41 m	4.0 m	2.5 µg/L
Lac Saint-Jean	1350.0 km^2	20 m	5.0 m	1.3 µg/L

GRAPH 1: Primary productivity (in mg of carbon per m^3 of water per day) as a function of chlorophyll concentrations



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Creating the context

Choose the lake you will write about in your media document from the three lakes in the case study: Memphrémagog, Pohénégamook or Saint-Jean.

I ask myself questions

1. What is a food chain?

2. What are plankton?

3. What is phytoplankton? How does it feed?

4. What is zooplankton? How does it feed?

5. What would be the difference between a planktivorous monster living in the lake and a carnivorous monster living there?

6. What is chlorophyll? What is the connection between chlorophyll and photosynthesis?

7. What is a concentration?

8. Who are the main players in this case study?

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Creating the context (*continued*)

9. Who is the target audience for your media document?

10. What questions should guide the biologists in their information gathering?

11. What questions should guide the media document designers in their document production?

I must

12. Reformulate the goal of the case study.

I think

13. Do you think it is possible that a monster lives in the lake you have chosen? Justify your answer.

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Creating the context (*continued*)

What I know and what I must find out

14. Write the information you already know and the information you need to find out.

What I know	What I must find out

I prepare my work

15. Where will you find the information you need to do your work?

16. What technological resources are available for you to create your media document?

17. Define the main steps of your case study in chronological order.

Reflection

	Yes	No
Do I fully understand what I have to do?	☐	☐

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Gathering information

I do research

1. What factors define an aquatic biome?

2. What is an ecosystem?

3. What are trophic relationships?

4. Write the trophic level of each link in the food chain you are studying.

Phytoplankton	→	Zooplankton	→	Planktivorous fish	→	Carnivorous fish

5. What would be the trophic level of the monster in the lake?

6. What happens to the energy in an ecosystem as it passes from one trophic level to the next?

7. What is the biomass?

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Gathering information (*continued*)

8. What is primary productivity?

_____

_____

9. In this case study:

- Which organisms determine the primary productivity?

_____

- What indicator can we use to estimate the biomass of these organisms?

_____

- Why is it important to know the light penetration depth to estimate the primary productivity?

_____

_____

10. How will you determine the primary productivity in mg of carbon per m^3 of water per day ($mg/m^3/day$)?

_____

_____

_____

_____

11. To calculate the total primary productivity, you have to calculate the volume of water in the euphotic zone.

- How will you calculate the area of the lake in m^2?

_____

_____

- How will you calculate the volume of water in the euphotic zone?

_____

_____

12. How will you calculate the amount of food available at each of the consumer trophic levels?

_____

_____

_____

Name: _____ Group: _____ ST EST AST

Gathering information (*continued*)

I apply my research results

Perform the following calculations for the lake you have chosen.

13. Determine the primary productivity in $mg/m^3/day$ for the lake you have chosen.

14. What is the volume of water in the euphotic zone of the lake?

15. Calculate the total primary productivity in mg/day.

16. Calculate the total primary productivity in kg/day.

17. Calculate the amount of food (carbon) available to the first-order consumers.

18. Calculate the amount of food (carbon) available to the second-order consumers.

19. Calculate the amount of food (carbon) available to the third-order consumers.

Reflection

	Yes	No
Do I fully understand the scientific concepts covered in this situation?	☐	☐

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Completing the case study

I make suggestions

1. Calculate the amount of food (carbon) available to planktivorous monsters in the lake, taking interspecies competition into account.

2. Calculate the amount of food (carbon) available to carnivorous monsters in the lake, taking interspecies competition into account.

3. According to your results, could one or more planktivorous monsters survive in the lake you have chosen? Explain your answer with further calculations.

4. According to your results, could one or more carnivorous monsters survive in the lake you have chosen? Explain your answer with further calculations.

5. What form will your media document take (a brochure, slide show, short video, poster)?

_____

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Completing the case study (*continued*)

6. Prepare the plan for your media document.

a) Write down the main scientific data that the case study has revealed and that you would like to communicate in your media document.

b) What elements will you add to your media document (real or fictional eyewitness accounts, images, photos, recordings, charts, etc.)?

7. Create your media document, taking care over its appearance as well as its content.

Reflection

	Yes	No
Have I considered other presentation approaches for my media document?	☐	☐

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Validating the case study

I justify my approach

1. Does your media document fulfill the communications officer's expectations? Explain your answer.

2. Is the vocabulary in your media document suitable for your target audience? Explain your answer.

3. Do you think that the content of your media document is based on scientific fact? Explain your answer.

4. From a scientific point of view, is the information in your media document limited in some way? Explain your answer.

5. Suggest improvements to your media document.

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My evaluation

Use the evaluation grid on the following page to evaluate yourself. Write A, B, C, D or E in the "Me" column of the chart below.

SSC2—Makes the most of his/her knowledge of science and technology				
Criteria*	**Observable elements**	**Me**	**Teacher**	**Comments**
1	**Creating the context** Definition of the goal and formulation of the questions for gathering information		☐ With help	
2	**Gathering information** Calculation of the amount of food available at each trophic level		☐ With help	
3	**Completing the case study** Production of the media document		☐ With help	
4	**Validating the case study** Justification of the form and content of the media document		☐ With help	

***Evaluation criteria**

1 Formulation of appropriate questions

2 Appropriate use of scientific and technological concepts, laws, models and theories

3 (ST) (EST) Relevant explanations or solutions
(AST) Relevant explanations, solutions or actions

4 (ST) (EST) Suitable justification of explanations, solutions, decisions or opinions
(AST) Suitable justification of explanations, solutions or actions

Name: _____ Group: _____

Evaluation grid

SSC2 Makes the most of his/her knowledge of science and technology

Criteria*	Observable indicators	A	B	C	D	E
1	**Creating the context** Definition of the goal and formulation of the questions for gathering information	The goal of the case study is very clearly defined, and all the questions for gathering information are relevant to the case study.	The goal of the case study is clearly defined, and most of the questions for gathering information are relevant to the case study.	The goal of the case study is not very clearly defined, OR only some of the questions for gathering information are relevant to the case study.	The goal of the case study is not very clearly defined, AND only some of the questions for gathering information are relevant to the case study.	The work must be done again.
2	**Gathering information** Calculation of the amount of food available at each trophic level	All of the data collected are accurate. All the calculations have been performed correctly.	Most of the data collected are accurate. All the calculations have been performed correctly or contain minor errors.	Most of the data collected are inaccurate, OR the calculations contain many errors.	Most of the data collected are inaccurate, AND the calculations contain many errors.	The work must be done again.
3	**Completing the case study** Production of the media document	All of the information in the media document is based on scientific data. The conclusions are based on accurate calculations.	Most of the information in the media document is based on scientific data. The conclusions are based on accurate calculations.	Some of the information in the media document is based on scientific data, OR the calculations contain errors.	Some of the information in the media document is based on scientific data, AND the calculations contain errors.	The work must be done again.
4	**Validating the case study** Justification of the form and content of the media document	The justifications are relevant and very clear. They are all based on scientific data collected during information gathering.	The justifications are relevant and clear. Most are based on scientific data collected during information gathering.	The justifications are not very relevant, OR only some are based on scientific data collected during information gathering.	The justifications are not very relevant, AND only some are based on scientific data collected during information gathering.	The work must be done again.

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