Name: _____ Group: _____

THE PROBLEM

Adventure tourism

Enjoy outdoor activities? Seeking adventure? Good at problem solving? If this describes you and a career as an adventure guide excites you, take part in our training workshop. Below is an overview:

Expedition to the Far North

You are about to take part in an expedition to the Far North. Since the equipment you will carry must be light and compact, you will be taking along some freeze-dried food, which has to be rehydrated. Rehydrating calls for the abundant water reserves of the Far North—snow and ice—which you can easily melt with fuel. To do this, you must calculate, via experiment, the exact amount of fuel required to obtain enough water from the snow or ice for your daily meal preparations.

To meet this challenge, you are to:

- Choose a fuel.
- Calculate your energy requirements for a typical day on this expedition.
- Plan your meals based on your daily energy needs.
- Calculate the amount of water needed for your daily meal preparations.
- Design an apparatus that allows you to melt snow or ice as efficiently as possible.
- Conduct an experiment that enables you to calculate the amount of fuel needed for daily meal preparations.

In this exercise, you are to play the role of a participant at an adventure tourism workshop and you must solve the problem outlined above.

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LEARNING CONCEPTS

1. The amount of energy our bodies need varies based on the type of activities we do. It also varies according to other factors. Table 1 shows the daily energy needs of an active person during adolescence, by gender. Given that an expedition to the Far North involves intense activities such as walking in snow, another 1 200 kJ per hour of intense activity must be added to these daily energy needs.

Table 1
Daily energy needs of an active person during adolescence, by gender

Gender	Daily energy needs (kJ)
Female	9 600
Male	12 800

2. Freeze-drying is the most efficient way to dry food while preserving its texture and flavour. Table 2 illustrates some examples of freeze-dried foods and the amount of energy they provide. The table also takes into account the amount of water needed to rehydrate these foods, and at what temperature.

Table 2
Energy provided by freeze-dried foods based on required water volume and temperature

Foods requiring 200 mL of water at 5°C	Energy provided (kJ)	Foods requiring 400 mL of water at 50°C	Energy provided (kJ)
Applesauce	840	Chili con carne	2 510
Muesli	1 215	Seafood chowder	2 720
Cocoa	1 635	Couscous with beef	2 095
Pasta with vegetables	1 255	Spaghetti with beef	2 720
Chicken couscous salad	1 215	Minestrone soup	1 675
Tabbouleh	965	Scrambled eggs	1 255
Pork and rice	1 380	Pasta with shrimp	2 510
Ham omelette	1 505	Vegetable soup	1 050
Fruit salad	315	Rice pudding	2 510
Tuna plate	1 465	Tapioca with raisins	2 095

Name: _____ Group: _____

CREATING THE CONTEXT

I ask myself questions

1. What is energy?

2. What form of energy does fuel represent?

3. What forms of energy are released when fuel burns?

4. Why do fuels not all release the same amount of energy when they burn?

5. What is thermal energy?

6. What is heat?

7. A burning candle. Melting snow. What type of change do you associate with each of these statements? Justify your answer.

8. Explain the role of energy when snow melts.

Name: _____ Group: _____

CREATING THE CONTEXT *(continued)*

I must

9. Reformulate the problem to solve.

_____

_____

_____

_____

10. What is the independent variable of your experiment?

_____

_____

11. What is the dependent variable of your experiment?

_____

_____

I think

12. Which fuel did you choose? What apparatus do you plan on using to melt snow or ice? Formulate a hypothesis and justify it.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Reflection

	Yes	No
Do I understand the following concepts:		
• forms of energy?	☐	☐
• physical changes?	☐	☐
• particle model?	☐	☐

Name: _____ Group: _____

PLANNING THE PROBLEM SOLVING

I plan

1. Calculate your energy requirements for a typical expedition day based on the activities you expect to do.

Types of activities	Daily energy needs (kJ)
Intense activities (energy per hour (kJ) _____ × _____number of hours)	
Daily activities	
Total	

2. Determine your menu for a typical day on the expedition. Then calculate the amount of water you will need.

Freeze-dried foods	Quantity	Energy provided (kJ)	Water (mL)	
			5°C	50°C
	Total			

Name: _____ Group: _____

PLANNING THE PROBLEM SOLVING *(continued)*

3. List the materials you will need. Make sure your apparatus can support the weight of the snow or ice you will be melting. Also ensure it is safe and fire-resistant.

4. Determine the steps in your procedure. Be sure to measure the following elements:

- the amount of fuel used to obtain water at the desired temperatures
- the amount of water you obtain
- the amount of time needed to melt the snow or ice

Be sure to let the containers cool before handling them.

Name: _____ Group: _____

PLANNING THE PROBLEM SOLVING *(continued)*

5. What safety rules should you follow during your experiment?

_____

_____

_____

_____

_____

6. Create a table for recording your results. Keep the following details in mind:

- Each measuring instrument (e.g. balance, thermometer, graduated cylinder) used will provide data that should be recorded in the table.
- The arrangement of data in the table should facilitate calculations.
- The table must contain spaces reserved for the results of simple calculations.

Reflection

	Yes	No
Have I envisaged other scenarios?	☐	☐

Name: _____ Group: _____

INITIATING THE PROBLEM SOLVING

I experiment

1. Conduct your experiment. Be sure to follow your established safety rules and protocol. Record your results in the table you created on page 7 in your student log.

2. Make all the necessary calculations for analyzing your results. Remember that you must determine the total amount of fuel you will need for daily meal preparations on a typical expedition day.

3. Did you work safely? Justify your answer with two examples.

Reflection

	Yes	No
Did I record and justify any modifications made to my plan of action?	☐	☐

Name: _____ Group: _____

ANALYZING RESULTS AND DRAWING CONCLUSIONS

I analyze my results

1. What kind of intense activities did you foresee doing on a typical day on your expedition? For how many hours?

_____

_____

2. Would the menu you planned allow you to meet your energy needs for a typical day on your expedition? Justify your answer.

_____

_____

_____

_____

3. Based on your planned menu, how much water would you need each day to prepare your meals?

Water at 5°C: _____

Water at 50°C: _____

4. According to the results of your experiment, how much fuel would you need each day to prepare your meals?

_____

5. Was your experiment conducted in conditions similar to those that would exist on an expedition to the Far North? Explain your answer.

_____

_____

_____

_____

6. What are the pros and cons of the fuel you chose?

_____

_____

_____

_____

Name: _____ Group: _____

ANALYZING RESULTS AND DRAWING CONCLUSIONS *(continued)*

7. What are the pros and cons of your apparatus?

I draw my conclusions

8. Do you think the amount of fuel you calculated would really be enough to meet your daily food needs during an expedition to the Far North? Justify your answer.

Name: _____ Group: _____

MY EVALUATION

Use the evaluation grid on the next page to do a self-evaluation. Write A, B, C, D, or E in the appropriate space.

SSC1 Seeks answers or solutions to scientific or technological problems				
Criteria*	**Observable indicators**	**Me**	**Teacher**	**Comments**
1	**Creating the context** Definition of the goal and formulation of a hypothesis		☐ With help	
2	**Planning the problem solving** Relevance of the elements in the plan of action: materials and procedure		☐ With help	
3	**Initiating the problem solving** Accuracy of the results and calculations		☐ With help	
4	**Analyzing results and drawing conclusions** Suitability of fuel choice and the drawing of conclusions		☐ With help	

*** Evaluation criteria**

1 Appropriate representation of the situation
2 Development of a suitable plan of action for the situation
3 Appropriate implementation of the plan of action
4 Development of relevant conclusions, explanations or solutions

Name: _____ Group: _____

EVALUATION GRID

SSC1 Seeks answers or solutions to scientific or technological problems

Criteria*	Observable indicators	A	B	C	D	E
1	**CREATING THE CONTEXT** Definition of the goal and formulation of a hypothesis	The goal and hypothesis are very clearly defined and linked to the problem to be solved.	The goal and hypothesis are clearly defined and linked to the problem to be solved.	The goal and hypothesis are more or less clearly defined or are not linked to the problem to be solved.	The goal and hypothesis are not clearly defined and are not linked to the problem to be solved.	The work needs to be redone.
2	**PLANNING THE PROBLEM SOLVING** Relevance of the elements in the plan of action: materials and procedure	The list of materials is complete. The procedure is very clearly stated and appropriate.	The list of materials is complete. The procedure is clearly stated and appropriate.	Several elements are missing in the list of materials OR the procedure is more or less clearly stated and appropriate.	Several elements are missing in the list of materials AND the procedure is poorly stated and inappropriate.	The work needs to be redone.
3	**INITIATING THE PROBLEM SOLVING** Accuracy of the results and calculations	All the recorded results are pertinent and all the calculations are done correctly.	All the recorded results are pertinent, but the calculations contain some minor errors.	Some of the recorded results are pertinent and the calculations contain some minor errors.	The calculations contain major errors.	The work needs to be redone.
4	**ANALYZING RESULTS AND DRAWING CONCLUSIONS** Suitability of fuel choice and the drawing of conclusions	The pros and cons of the fuel choice are very clearly stated. The conclusions are linked to the problem to be solved.	The pros and cons of the fuel choice are clearly stated. The conclusions are linked to the problem to be solved.	The pros and cons of the fuel choice are more or less clearly stated OR the conclusions are not linked to the problem to be solved.	The pros and cons of the fuel choice are more or less clearly stated AND the conclusions are not linked to the problem to be solved.	The work needs to be redone.

* Evaluation criteria

1 Appropriate representation of the situation
2 Developpment of a suitable plan of action for the situation
3 Appropriate implementation of the plan of action
4 Development of relevant conclusions, explanations or solutions