Name: _____ Group: _____

# THE PROBLEM

### PATIENCE IS A VIRTUE!

**OTTAWA (CP)** – A recent study demonstrates that fever increases the rate of reaction of the human immune system. When the body fights an infection, its temperature often rises, leading to a fever. A fever may bring discomfort, but according to researchers, it promotes healing and limits the proliferation of certain germs.

"The human body is a collection of physical and chemical changes. When a person eats a potato chip, we can see the salt dissolving in the mouth. When a person inhales, there is the oxidation of carbohydrates," explain the authors of the study. They claim that a rise in temperature speeds up the rate of reaction of physical and chemical changes in the human body.

In the event of a fever, the best advice is to rest the body and let the organism defend itself. The researchers emphasize, however, the importance of quick intervention if the body's temperature rises to 40°C.

### WANTED: EXPERIMENT PROTOCOLS

Studies have shown that physical and chemical changes occurring in the human body speed up when a person has a fever. The magazine *Exploration* is organizing introductory science workshops to test if a rise in temperature provokes a similar effect on other physical and chemical changes. The editorial team is looking for experimental protocols that make it possible to observe the effects of a rise in temperature on the rate of reaction during dissolution, precipitation and oxidation.

The protocols must permit comparison of the rate of change at room temperature (about 25°C) and at 40°C. Experiments therefore must be able to be done at two temperatures. Individuals who wish to submit a proposal must demonstrate the effectiveness of their protocol and record their observations every minute for five minutes. The editorial team also wishes to receive the conclusions of the experiment.

A protocol must focus on one of the following experiments:

1. Dissolution of 1 g sodium chloride in 20-mL distilled water
   NaCl solid $\rightarrow$ NaCl solution
2. Precipitation of mixture of 10-mL 142 g/L sodium sulphate solution with 10-mL 110 g/L calcium chloride solution
   $Na_2SO_4$ solution + $CaCl_2$ solution $\rightarrow$ 2 NaCl solution + $CaSO_4$ solid
3. Oxidation of copper wire dipped in 20-mL 170 g/L silver nitrate solution
   Cu solid + 2 $AgNO_3$ solution $\rightarrow$ 2 Ag solid + Cu $(NO_3)_2$ solution

In this learning situation, you will submit a report for one of the experiments.

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# CREATING THE CONTEXT

## I ask myself questions

**1.** What is a physical change?

**2.** What is a chemical change?

**3.** What clues permit distinguishing between a chemical change and a physical change?

**4.** What is oxidation?

**5.** What is decomposition?

**6.** What is precipitation?

**7.** What is dissolution?

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# CREATING THE CONTEXT (*continued*)

**8.** What is a fever?

**9.** What is temperature?

**10.** What form of energy is associated with a rise in temperature?

**11.** How can the effect of a rise in temperature on the rate of change be observed?

## I must

**12.** Restate in your own words the goal of the problem solving.

**13.** What is the independent variable?

**14.** What is the dependent variable?

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# CREATING THE CONTEXT (*continued*)

## I think

**15.** What effect would a rise in temperature have on the rate of change being observed? Formulate a test hypothesis and explain.

**16.** What observations will be able to be made during the change?

## Reflection

| Do I understand? | Yes | No |
|---|---|---|
| forms of energy (thermal) | ☐ | ☐ |
| physical change | ☐ | ☐ |
| chemical change | ☐ | ☐ |
| dissolution | ☐ | ☐ |
| decomposition | ☐ | ☐ |
| synthesis | ☐ | ☐ |
| oxidation | ☐ | ☐ |
| precipitation | ☐ | ☐ |

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# PLANNING THE PROBLEM SOLVING

## I plan

**1.** Make a list of materials and substances needed for your experiment.

**2.** Describe the protocol of your experiment.

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# PLANNING THE PROBLEM SOLVING (*continued*)

**3.** Prepare a table for recording your observations; remember to give the table a title.

**4.** Which safety rules must you respect during your experiment?

## Reflection

| | Yes | No |
|---|---|---|
| Did I envision different possibilities? | ☐ | ☐ |

Name: _____ Group: _____

# INITIATING THE PROBLEM SOLVING

## I experiment

**1.** Perform your experiment and record your observations in the table you prepared.

**2.** Did you modify your plan of action during the experiment? If yes, explain your answer.

**3.** Did you work safely during the experiment? Explain giving two examples.



## Reflection

| | Yes | No |
|---|---|---|
| Did I note and explain each modification I made to my plan of action? | ☐ | ☐ |

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# ANALYZING RESULTS AND DRAWING CONCLUSIONS

## I analyze my results

**1.** Name the change observed during your experiment and explain how it occurred.

_____

_____

_____

**2.** What clues allowed you to conclude that the change observed was a physical change or a chemical change? Explain your answer.

_____

_____

_____

**3.** What is the effect of a rise in temperature on the change being observed? Explain your answer using the results of your experiment.

_____

_____

_____

_____

**4.** Explain the effect of an increase in thermal energy on the rate of change.

_____

_____

_____

_____

**5.** What are possible causes of errors in your experiment? Suggest ways to correct them.

_____

_____

_____

Name: _____ Group: _____

# ANALYZING RESULTS AND DRAWING CONCLUSIONS (*continued*)

## I draw my conclusions

**6.** Was your test hypothesis correct? Explain.

_____

_____

_____

**7.** What conclusions can you draw from your experiment? What is the effect of a rise in temperature on the change you observed?

_____

_____

_____

_____

**8.** Does this conclusion allow you to confirm that a fever increases the rate of reaction of the body's immune system? Explain your answer.

_____

_____

_____

_____

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# MY EVALUATION

Use the evaluation grid on the following page to do a self-evaluation. Write A, B, C, D or E in the appropriate box in the table below.

| SSC1 Seeks answers or solutions to scientific or technological problems | | | | |
|---|---|---|---|---|
| **Criteria*** | **Observable indicators** | **My** | **Teacher** | **Comments** |
| **1** | **Creating the context**<br>Definition of the goal and formulation of a test hypothesis | | ☐ With help | |
| **2** | **Planning the problem solving**<br>Relevance of the elements in the plan of action: materials and procedure | | ☐ With help | |
| **3** | **Initiating the problem solving**<br>Accuracy of results and respect for safety rules | | ☐ With help | |
| **4** | **Analyzing results and drawing conclusions**<br>Analysis of results and reflections on the problem solving | | ☐ 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

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# EVALUATION GRID

## SSC 1 Seeks answers or solutions to scientific or technological problems

| Criteria* | Observable indicators | A | B | C | D | E |
|---|---|---|---|---|---|---|
| 1 | **CREATING THE CONTEXT**<br>Definition of the goal and formulation of a test hypothesis | Goal and test hypothesis are formulated very clearly and related to problem. | Goal and test hypothesis are formulated clearly and related to problem. | Goal and test hypothesis are formulated more or less clearly or not related to problem. | Goal and test hypothesis are not formulated clearly and not related to problem. | The work needs to be redone. |
| 2 | **PLANNING THE PROBLEM SOLVING**<br>Relevance of the elements in the plan of action: materials and procedure | List of materials is complete. Procedure is formulated very clearly and relevant. | List of materials is complete. Procedure is formulated clearly and relevant. | List of materials is missing elements.<br>OR<br>Procedure is formulated more or less clearly and relevant. | List of materials is missing elements.<br>AND<br>Procedure is formulated poorly and not relevant. | The work needs to be redone. |
| 3 | **INITIATING THE PROBLEM SOLVING**<br>Accuracy of results and respect for safety rules | Experiment has been done safely. All results are noted adequately. | Experiment has been done safely. Most results are noted adequately. | Experiment has been done safely. Some results are noted adequately. | Experiment has not been done safely.<br>OR<br>Results are not noted adequately. | The work needs to be redone. |
| 4 | **ANALYZING RESULTS AND DRAWING CONCLUSIONS**<br>Analysis of results and reflections on the problem solving | Analysis shows role of rise in temperature very clearly. Relationship with fever is established very clearly. | Analysis shows role of rise in temperature clearly. Relationship with fever is established clearly. | Analysis shows role of rise in temperature more or less clearly.<br>OR<br>Relationship with fever is not established. | Analysis shows role of rise in temperature more or less clearly.<br>AND<br>Relationship with fever is not established. | The work needs to be redone. |

### * 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