GAME FOR SCIENCE

Teacher’s Guide

3rd edition – April 2016
Summary

The game *Brought to You by Ship* gives students a chance to run a shipping company, using their logistics skills to manage its growth, profitability and environmental impact.

Buying and storing cargo and fuel, hiring crew members and deciding which orders to give are just some of the tasks players have to carry out.

Incidents can arise without warning at sea, stopping the ship or slowing it down. The students must correct these situations by answering quiz questions about the St. Lawrence River.

The game helps them realize the important role the marine industry plays in our lives and become aware that it is the greenest way to transport goods.

The game includes interactive educational activities on angles and the Cartesian plane. Learning these concepts is contextualized, helping students understand some of shipping’s many facets, including docking ships using tugboats and locating obstacles using satellites.

The *Brought to You by Ship* Teacher’s Guide is designed for elementary school, Cycle Three teachers. It draws on video game concepts and links them to the Québec Education Program (English Language Arts; Mathematics; Science and Technology; Geography, History and Citizenship Education).

The Guide contains the following sections:

**Links with the Québec Education Program (p. 2)**
- Broad area of learning
- Subject-specific competencies
- Essential knowledge

**Planning (p. 4)**
- Activity details at a glance

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- Notes on the Guide and the game

**Teaching notes (p. 9)**
- Notes on how to use each activity

**Answer key (p. 26)**

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**Links with the Québec Education Program**

**Broad area of learning**

**Environmental Awareness and Consumer Rights and Responsibilities**

**Educational aim**
To encourage students to develop an active relationship with their environment while maintaining a critical attitude towards exploitation of the environment, technological development and consumer goods.

**Focus of development**
Construction of a viable environment based on sustainable development.

**Subject-specific competencies**

**English Language Arts**
*To write self-expressive, narrative and information-based texts*
  * To integrate her/his knowledge of texts into own writing
  * To follow a process when writing
  * To construct profile of self as a writer
  * To use writing as a system for communicating and constructing meaning
  * To self-evaluate her/his writing development

**English as a Second Language**
*To write texts*
  * To prepare to write texts using strategies
  * To compose texts using strategies
  * To self-evaluate her/his writing using strategies

**Mathematics**
*To solve a situational problem related to Mathematics*
  * To decode the elements of the situational problem
  * To model the situational problem
  * To applies different strategies to work out a solution
  * To validate the solution
  * To share information related to the solution
Science and Technology

To propose explanations for or solutions to scientific or technological problems

- To identify a problem or define a set of problems
- To use a variety of exploration strategies
- To assess his/her approach

Essential knowledge

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Planning

Activities can be used separately.

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**INTEGRATION**

**Brought to You by Ship: Conclusion**

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**INTEGRATION**

**Brought to You by Ship: Conclusion**

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**GENERAL NOTES**

The activity durations are guidelines and may vary depending on class needs.

To save time, have the students “Register” on the *Game for Science* website ahead of time.

**Instructions for accessing the video game:**

1. Access the *Brought to You by Ship* website through the link: [http://www.gameforscience.com/broughttoyoubyship](http://www.gameforscience.com/broughttoyoubyship), and click on “Play! Click here”.

2. a) If the player has already registered for Game for Science: Complete the “Entrance for registered players” section.

2. b) If the player has not yet registered for Game for Science: Click on “Register!” and complete the identification information.
3. Accept Captain Harbor’s quest.

4. Do the tutorial to understand how the game works.
5. The port evolves with play. Once a player has 200 points, the bulk loading dock becomes available and new terminals (iron, road salt, wood pellets) and a new ship (bulk carrier) are unblocked. New destinations become accessible based on the player’s level as follows:

- Cabin boy: Gourmania
- Sailor: Mathematicos
- Second Officer: Rana
- First Officer: Vitalis
- Captain: Genomia

The player’s level is shown here:

The port interface (maximum evolution) is available in the Appendices, p. 84.

Interactive educational activities can be accessed at all times by clicking on this icon:
Worksheet: *Brought to You by Ship: Tutorial*

Work method: Variable  
Duration: One period  

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- Ask the students what they know about shipping. Write their answers on the board in the form of a brainstorm:

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- Keep these answers.  
- Ask the students to do the *Brought to You by Ship* tutorial. Note:
  - It is strongly suggested that you try the game yourself before having the students play it so as to familiarize yourself with the control keys and to be able to answer their questions.  
  - If need be, present the game and tutorial to the class before having the students play it.  
- Ask the students to complete the worksheet.
USE

Worksheet: Questions about the marine industry
Subject: English as a Second Language
Concept: Question words

**POL:** Contextual language and functional language – Useful expressions - Requests for information – Asks W-questions; Uses question words in context

Work method: Variable
Duration: 20 minutes + playing time
Reproducible material: Student’s Guide, p. 4

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.
- Ask the students to play *Brought to You by Ship* until their ship is stopped, and then to write down the question they are asked. Note:
  - Encourage the students to choose orders bound for *Gourmania*. Their ship will definitely be stopped on the way.
  - If in-class playing time is limited, this step can be done as homework.
- Ask the students to answer Questions 1 and 2.
- Ask the students to go around the class to find three classmates who have different questions. Ask them to answer Question 3.
- Afterwards, discuss the activity with the class. Go through all of the game’s questions. The answers are in the *Appendix, p. 77-83*.
- The activity can be repeated. This time, with the questions to answer for paying port fees.

Worksheet: The great journey
Subject: English Language Arts, English as a Second Language
Concept: Writing a narrative text

Work method: Individual
Duration: 2 periods
Reproducible material: Student’s Guide, p. 5-7
• Read the scenario with the students.
• The sidebar contains theory. It can be used to:
  o Begin studying the concept with the students;
  o Review the concept before performing the task.
• Ask the students to complete the worksheet.
• Note that to answer Question 1, the students must have played *Brought to You by Ship*.
• Afterwards, discuss the activity with the class. Encourage the students to read their text to their classmates or make their stories available for reading.

**Variant – Multidisciplinarity – Visual arts**

Ask the students to draw a scene from their story. This drawing could be used as the cover page of their text.

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**Worksheet: Types of ships**

*Subject: English Language Arts, English as a Second Language*

*Concept: Writing a descriptive text*

Work method: Individual
Duration: 2 periods
Reproducible material: Student’s Guide, p. 8-10

• Read the scenario with the students.
• The sidebar contains theory. It can be used to:
  o Begin studying the concept with the students;
  o Review the concept before performing the task.
• Ask the students to choose a type of ship.
• Ask them to do a document search on the subject. If need be, suggest that they use the following websites:
  o [http://www.csmoim.qc.ca/Secure/En/Information_about_the_marine_industry/Merchants_and_ships.html](http://www.csmoim.qc.ca/Secure/En/Information_about_the_marine_industry/Merchants_and_ships.html)
• The students can click on a ship on the world map to see a description of it. They can then use this information in their writing.
• Ask the students to complete the worksheet.
• Note that the third element is not mandatory. A few suggestions: size, equipment, capacity, speed, etc.
• Afterwards, discuss the activity with the class. Encourage the students to read their text to their classmates or make their stories available for reading.

Worksheet: All aboard!
Subject: English as a Second Language
Concept: Verb tense and mood

POL: Language conventions – Verb tense and mood – Forms verb tenses and moods; Uses knowledge of verb tenses to construct meaning

Work method: Variable
Duration: 20 minutes
Reproducible material: Student’s Guide, p. 11-12

• This activity can be done individually, in teams or with the whole group.
• Read the scenario with the students.
• There is no sidebar for this worksheet since it is a review activity.
• Ask the students to complete the worksheet.
• Discuss the activity.

This activity can be done online by clicking on the “Access to activity cards” icon:
Interactive educational activity: Approach angles

**Subject:** Mathematics  
**Concept:** Angles

**POL:** Measurement – D. Angles – 1. Compares angles / 2. Estimates and determines the degree measurement of angles

**Work method:** Variable  
**Duration:** 45 minutes  
**Reproducible material:** Student’s Guide, p. 13-14

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- The sidebar contains theory. It can be used to:  
  - Begin studying the concept with the students;  
  - Review the concept before performing the task.

This activity must be done online by clicking on the “Access to activity cards” icon:

The goal of the activity is to measure angles using a protractor and convey this information to the tugboats that pivot the ship to help it berth in the port.

*Note: This activity is also available on the Brought to You by Ship website* ([http://www.gameforscience.com/broughttoubyship](http://www.gameforscience.com/broughttoubyship))

- Ask the students to do the interactive educational activity.  
- Note that the game levels are increasingly complex:  
  - Indicate the type of angle (acute, right or obtuse);  
  - Indicate the measurement of each angle (protractor);  
  - Indicate the measurement in degrees of each angle (bevel protractor).

- Ask the students to complete the worksheet.  
- Afterwards, discuss the activity with the class.
Interactive educational activity: Iceberg Warning!

Subject: Mathematics
Concept: Cartesian plane

POL: Geometry – A. Space – 4. Locates points in a Cartesian plane (a. in the first quadrant, b. in all four quadrants)

Work method: Variable
Duration: 45 minutes
Reproducible material: Student’s Guide, p. 15-16

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.

This activity must be done online by clicking on the “Access to activity cards” icon:

The goal of the activity is to determine the location, on a Cartesian place, of icebergs hidden by a dense fog so that ships can navigate without hitting them.

Note: This activity is also available on the Brought to You by Ship website (http://www.gameforscience.com/broughtyoubyship)

- Ask the students to do the interactive educational activity.
- Note that the game levels are increasingly complex:
  - First quadrant of the Cartesian plane
  - First and second quadrants of the Cartesian plane
  - All four quadrants of the Cartesian plane
- Ask the students to complete the worksheet.
- Afterwards, discuss the activity with the class.
Worksheet: Let’s go!
Subject: Mathematics
Concept: Time

**POL:** Measurement – G. Time – 1. Estimates and measures time using conventional units / 2. Establishes relationships between units of measure

Work method: Variable
Duration: 30 minutes + playing time
Reproducible material: Student’s Guide, p. 17-18

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.

- Ask the students to play *Brought to You by Ship*. Note:
  - The students begin by writing down the time.
  - The students then gather the relevant information from the order book. Tell them that if the orders on the first page of the book are not all available, they can make other orders appear by clicking on the green button at the upper right:

![Brought to You by Ship game interface](image)

  - If in-class playing time is limited, these steps can be done as homework.
- Ask the students to complete the worksheet. If they need more calculation space, tell them to use additional sheets.
- Afterwards, discuss the activity with the class.
- Note that the activity becomes more complex as new destinations are unlocked: delivery times are longer for each new destination.
Worksheet: Exchanging Polo$ and Talent$

Subject: Mathematics
Concept: Division

**POL:** Arithmetic – Operations involving numbers – A. Natural numbers – 7. Develops processes for written computation (multiplication and division)

Work method: Variable
Duration: 20 minutes + playing time
Reproducible material: Student’s Guide, p. 19-20

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.
- Ask the students to play *Brought to You by Ship*. Note:
  - The students must gather the relevant information from the gold Polo$ purchasing system:
    - If in-class playing time is limited, these steps can be done as homework.
- Ask the students to complete the worksheet. If they need more calculation space, tell them to use additional sheets.
Worksheet: Information about orders
Subject: Mathematics
Concept: Arithmetic mean, rounding numbers

POL: Arithmetic – Operations involving numbers – A. Natural numbers – 1. Approximates the result

POL: Statistics – 5. Understands and calculates the arithmetic mean

Work method: Variable
Duration: 30 minutes + playing time
Reproducible material: Student’s Guide, pp. 21-22

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.
- Ask the students to play Brought to You by Ship. Note:
  - The students gather the relevant information from the order book. Tell them that if the orders on the first page of the book are not all available, they can make other orders appear by clicking on the green button at the upper right:
  - If in-class playing time is limited, these steps can be done as homework.
- Ask the students to complete the worksheet. If they need more calculation space, tell them to use additional sheets.
- Afterwards, discuss the activity with the class.
Worksheet: Container content!
Subject: Mathematics
Concept: Fractions (representing and reducing)

POL: Arithmetic – Meaning of operations involving numbers – C. Fractions – 1. Uses objects, diagrams or equations to represent a situation and conversely, describes a situation represented by objects, diagrams or equations (use of different meanings of addition, subtraction and multiplication by a natural number)

POL: Arithmetic – Operations involving numbers – B. Fractions (using objects or diagrams) – 2. Reduces a fraction to its simplest form (lowest terms)

Work method: Variable
Duration: 30 minutes + playing time
Reproducible material: Student’s Guide, p. 23-25

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.
- Ask the students to play Brought to You by Ship. Note:
  - The students can deduce the answer to the question by consulting the order book.
  - If in-class playing time is limited, these steps can be done as homework.
- Ask the students to complete the worksheet.
- Afterwards, discuss the activity with the class.

Worksheet: Adapted materials
Subject: Science and Technology
Concept: Permeability and impermeability

POL: The Material World

A. Matter

1. Properties and characteristics of matter
   c. Distinguishes between materials that are permeable to water and those that are not
   j. Describes various other physical properties of an object, a substance or a material (e.g. elasticity, hardness, solubility)
   k. Recognizes the materials of which an object is made
Work method: Variable  
Duration: 15 minutes  

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- The sidebar contains theory. It can be used to:  
  o Begin studying the concept with the students;  
  o Review the concept before performing the task.  
- Ask the students to complete the worksheet.  
- Afterwards, discuss the activity with the class.

Worksheet: In bulk!  
Subject: Science and Technology  
Concept: Solubility and buoyancy

POL: The Material World  
A. Matter

1. Properties and characteristics of matter
   h. Associates the buoyancy of a volume of liquid in an identical volume of a different liquid with the densities of these liquids (relative density)  
   i. Explains the buoyancy of a substance in another substance, using their respective densities (relative density)  
   j. Describes various other physical properties of an object, a substance or a material (e.g. elasticity, hardness, solubility)  
   k. Recognizes the materials of which an object is made

Work method: Variable  
Duration: 30 minutes + playing time  
Reproducible material: Student’s Guide, p. 28-30

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- The sidebars contain theory. It can be used to:  
  o Begin studying the concept with the students;  
  o Review the concept before performing the task.  
- Ask the students to play Brought to You by Ship. Note:
To be able to do the activity, the students must have reached the Sailor level (bulk loading dock, bulk terminals (wood pellets, iron, road salt) and bulk carrier). If they have not reached the level:

- Ask them to reach the level as homework;
- Take the game to the desired level in front of the class;
- Project or print the Appendix “Game Interface” p. 84.

- Ask the students to complete the worksheet.
- Note that the worksheet’s last question is more complex because it introduces the concept of average density. If need be, prepare the students using the additional information provided in the Answer Key, p. 58.
- Afterwards, discuss the activity with the class.

---

**Worksheet: Essential fuel!**

**Subject:** Science and Technology

**Concept:** Sources of energy

**POL:** Earth and Space

**B. Energy**

1. **Sources of energy**
   - b. Identifies natural sources of energy (sun, moving water, wind)
   - c. Identifies fossil fuel-based energy (e.g. oil, coal, natural gas)

3. **Transformation of energy**
   - a. Describes what renewable energy is
   - d. Explains what non-renewable energy is
   - e. Explains that fossil fuels are non-renewable sources of energy
   - f. Names fuels derived from petroleum (e.g. gasoline, propane, butane, fuel oil, natural gas)

Work method: Variable

Duration: 15 minutes + playing time

Reproducible material: Student’s Guide, p. 31-32

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- The sidebar contains theory. It can be used to:
  - Begin studying the concept with the students;
  - Review the concept before performing the task.
- Ask the students to play *Brought to You by Ship*. Note:
  - The students can find the answer to Question 1 on the “Fuel” tank:
• Ask the students to complete the worksheet.
• Afterwards, discuss the activity with the class.

Worksheet: Storm on the horizon!
Subject: Science and Technology
Concept: Climate-related natural phenomena

POL: Earth and Space

A. Matter
3. Transformation of matter
d. Describes certain natural phenomena (e.g. erosion, lightning, tornado, hurricane)
e. Describes the impact of certain natural phenomena on the environment or on the well-being of individuals

Work method: Variable
Duration: 20 minutes + playing time
Reproducible material: Student’s Guide, p. 33-34

• This activity can be done individually, in teams or with the whole group.
• Read the scenario with the students.
• The sidebar contains theory. It can be used to:
  o Begin studying the concept with the students;
  o Review the concept before performing the task.
• Ask the students to play Brought to You by Ship until an incident stops their ship, and then to write down the incident. Note:
Encourage the students to choose orders bound for Gourmania. Their ship will definitely be stopped on the way.

Since the incidents occur randomly, some students may not encounter an incident related to a natural phenomenon. If need be, ask the students who encounter such incidents to share their answers with the rest of the class.

If in-class playing time is limited, this step can be done as homework.

• Ask the students to complete the worksheet.
• Hand out page 2 only once page 1 has been completed, because the answers to Question 1 are on page 2.
• Afterwards, discuss the activity with the class.

Worksheet: High tide, low tide
Subject: Science and Technology
Concept: Tides

POL: Earth and Space

C. Forces and motion

2. The tides

   a. Describes the ebb and flow of the tides (rise and fall of sea levels)

Work method: Variable
Duration: 20 minutes
Reproducible material: Student’s Guide, p. 35-37

• This activity can be done individually, in teams or with the whole group.
• Read the scenario with the students.
• The sidebar contains theory. It can be used to:
   o Begin studying the concept with the students;
   o Review the concept before performing the task.
• Ask the students to complete the worksheet.
• Note that additional information about draught and waterways is provided in the Answer Key.
• Afterwards, discuss the activity with the class.
**Worksheet: A waterway**

**Subject:** Geography, History and Citizenship Education  
**Concept:** Techniques specific to Geography  

**POL:** Techniques specific to geography and history – 1. Interprets simple maps

Work method: Variable  
Duration: 30 minutes  
Reproducible material: Student’s Guide, p. 38-39

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- Ask the students to complete the worksheet.  
- Note that the students will only indicate some of the ports on their map. Complete the map with them.  
- Afterwards, discuss the activity with the class.  
- Use the following websites to obtain more information about the ports on the St. Lawrence:

---

**Worksheet: Shipping, then and now**

**Subject:** Geography, History and Citizenship Education  
**Concepts:** Time lines, means of transportation, transportation routes, trade, bodies of water  

**POL:** Techniques specific to geography and history  

- 2. Constructs a time line  
- 3. Interprets a time line

Work method: Variable  
Duration: 15 minutes  
Reproducible material: Student’s Guide, pp. 40-41

- This activity can be done individually, in teams or with the whole group.  
- Read the scenario with the students.  
- Ask the students to complete the worksheet.  
- Afterwards, discuss the activity with the class.
Worksheet: A key transportation route
Subject: Geography, History and Citizenship Education
Concepts: Time lines, means of transportation, transportation routes, trade, bodies of water

POL: Techniques specific to geography and history
   2. Constructs a time line
   3. Interprets a time line

Work method: Variable
Duration: 15 minutes
Reproducible material: Student’s Guide, p. 42

- This activity can be done individually, in teams or with the whole group.
- Read the scenario with the students.
- Ask the students to complete the worksheet.
- Afterwards, discuss the activity with the class.

Worksheet: Delivery plan
Subject: Mathematics
Concept: Situational problem (multiplication, division, using a calculator, decimals, lengths, capacity)

POL:
Arithmetic – Operations involving numbers – A. Natural numbers – 7. Develops processes for written computation (multiplication and division) 15. Uses a calculator and... b. becomes familiar with its × and ÷ functions
Arithmetic – Operations involving numbers – C. Decimals – 3. Develops processes for written computation
Measurement – A. Lengths – 4. Estimates and measures the dimensions of an object using conventional units - metre, decimetre, centimetre, millimetre and kilometre
Measurement – E. Capacities – 1. Estimates and measures capacity using conventional units

Work method: Individual
Duration: 60 minutes
Reproducible material: Student’s Guide, p. 43 to 45

- Problem-solving is done individually.
- Read the scenario with the students.
• Ask the students to complete the worksheet.
  o If they need more calculation space, allow them to continue their calculations on a separate sheet of paper.
  o Tell the students that the delivery plan’s “Verification” column is used to validate whether the answers correspond to the initial constraints.
• Afterwards, discuss the activity with the class.

**Evaluation guidelines**

**Competency: To solve a situation problem related to Mathematics**

• To decode the elements of the situational problem.
  o The student highlights all of the relevant information.
  o The student’s calculations take all of the problem’s constraints and data into account.
• To model the situational problem.
  o The students re-states the problem in his own words.
• To apply different strategies to work out a solution.
  o The student clearly shows the steps involved in arriving at the solution.
  o The student makes no conceptual errors.
  o The student makes no procedural errors.
• To validate the solution.
  o The student validates whether the solution takes all of the constraints into account.
• To share information related to the solution.
  o The student coherently explains the problem’s solution.

**INTEGRATION**

**Activity: Brought to You by Ship: Conclusion**

Work method: With the whole group
Duration: 15 minutes
Reproducible material: None

• Look at the answers to the brainstorm that was done during the preparation activity. Complete it with the student’s current knowledge.
Brought to You by Ship

Answer Key
**Brought to You by Ship: Tutorial**

_**Brought to You by Ship**_ is a video game in which you run a shipping company. Using ships, you deliver goods to the different islands of the _Game for Science_ world. Will you manage your company well? This activity will help you complete your first delivery successfully.


2. Accept the quest proposed by Captain Habor and complete the entire tutorial. In the process, answer the following questions:

   a. What is the cost of each terminal?

   ![Terminal Costs](image)

   - 0 gold Polo$[^1]
   - 1,500 gold Polo$[^2]
   - 3,000 gold Polo$[^3]
b. Write the following labels at the right place on the order below:

Number of sets of containers required

Reward

Amount of fuel required in litres

Delivery time

c. Which incident prevented your ship from moving forward?

*Variable answer.*

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
d. In the order book, which icon do you have to click to display new orders? Draw your answer in the box below:

![Icon](image)


e. What happens if you click on the number of gold Polo$ that you have?

*An interface allowing me to buy gold Polo$ with Talent$ opens.*

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________

f. What does clicking on this icon tell you?

*There are three interactive activities: one on conjugation, one on angles and one on the Cartesian plane.*

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________
Questions about the marine industry

Question words

In playing *Brought to You by Ship*, you have probably noticed that ships can run late for various reasons. To continue, you had to answer quiz questions. By analyzing these questions, you will learn more about interrogative sentences.

An interrogative sentence is used to ask a question.

It ends with a question mark (?)..

It can:

- contain a question word (*Example: Where is the captain?*);
- require an inversion of the noun/pronoun and the verb (*Example: Are you the captain?*).

1. Play *Brought to You by Ship* until an incident stops your ship. Write down the question you are asked.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

2. Circle the interrogative word in the sentence.

3. Write down three different questions that your classmates were asked. For each, circle the interrogative word.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Answer Key Worksheet – Questions about the marine industry

Answer Key – Questions to answer when the ship is stopped

What does the expression “merchant marine” refer to?

What is this type of ship called?

In the shipping world, what is a “flag”?

Approximately how many ships travel on the St. Lawrence each year?

How many commercial ports are there in Québec?

On average, how many days does it take for a ship leaving a St. Lawrence port to reach Europe?

When is a whistle or siren used on a ship?

During which seasons do you think ships travel on the St. Lawrence?

What percentage of the goods you use, and that come from outside the North American continent, is transported by ship?

Up to how many containers do you think a container ship can carry?

How many iPads do you think a container ship can transport?

How many trucks are needed to carry the same amount?

What is a ship owner?

Who is the “boss” aboard ship?

About how many people work on a ship transporting goods on the St. Lawrence?

Answer Key – Questions to answer for paying port fees

Once the cargo has been unloaded, how is it taken to its final destination?

The average load carried by ships that navigate the St. Lawrence is 25 000 tonnes. How long do they take to unload?

What do we call the people who work in ports and who load and unload the cargo?

What do you think a “docking pilot” is?

In what year was the first lighthouse on the St. Lawrence built?

Where does the road salt used as an abrasive on Québec roads in winter come from?
What year did the St. Lawrence Seaway open?

What does the word “ballast” mean?

How long does it take for a St. Lawrence Seaway lock to fill?

What is the “Automatic Identification System” (AIS)?

Which word below does not refer to a part of the ship?

Which energy source is not used to power a ship?

What is a double-hulled ship?

What allows a ship to maintain buoyancy?
**Writing a narrative text**

Imagine that you are the captain of a cargo ship! Your mission is to make sure that the ship’s crossing goes smoothly. In this activity, you must write a narrative text about your adventures as a captain.

The purpose of a narrative text is to tell a story. Here are the different parts of a narrative text:

**Setting**
- Who is the character?
- Where does the story take place?
- When does the story take place?

**Problem**
- What is the problem that the character must face?

**Action**
- What are the actions or the events that occur?

**Resolution**
- Has the problem been solved?
  - If so, how?
  - If not, why?

**Outcome**
- How does the story end?

1. Use your experience of playing *Brought to You by Ship* to complete the following chart.

<table>
<thead>
<tr>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Who?</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
2. Circle the problem that you choose for your text:

<table>
<thead>
<tr>
<th>Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distress call from another ship</td>
</tr>
<tr>
<td>Mechanical breakdown</td>
</tr>
<tr>
<td>Ship stuck in ice</td>
</tr>
<tr>
<td>Ship attacked by pirates</td>
</tr>
<tr>
<td>Sick crew member</td>
</tr>
</tbody>
</table>

3. Fill in the following chart, which is devoted to the last three parts of a narrative text:

<table>
<thead>
<tr>
<th>Action</th>
<th>Resolution</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Write your text.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
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______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Writing a descriptive text

Some of the ships that can be observed on the St. Lawrence are: bulk carrier, tanker, container ship and tugboat. In this activity, you must do a document search about one of these ships and write a descriptive text on the subject.

The purpose of a descriptive text is to describe a phenomenon, place, object, etc. It has the following parts:

Introduction
- Get the reader’s attention
- Present the subject
- Present the elements that will be explored in the body of the text

Body
- Element 1
- Element 2
- Element 3

Conclusion
- Reminder of the essential elements of the text
- New information

1. Choose a ship and circle it.
   - Bulk carrier
   - Tanker
   - Container ship
   - Tugboat

2. Do a document search about the ship. Take notes on the outline on the next page.
Drawing of the ship

Element 1: Description of the ship

Element 2: What the ship is carrying

Element 3:___________________________
3. Write your text.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Shipping has existed for a very long time. As such, it’s a perfect subject for using different verb tenses! Past, present or future, this activity will help you to review verb tenses and moods.

1. Use the verb form indicated (proper mood and tense).

**Present indicative**
I (make) *make* a list of all the advantages of shipping.

**Present conditional**
You (like) *would like* to work as a sailor.

**Future perfect indicative**
In two months, he (finish) *will have finished* his navigation officer training.

**Present perfect indicative**
We (go) *have gone* to visit the port.

**Simple past indicative**
You (come) *came* aboard the ship for the first time.

**Present conditional**
They (wear) *would wear* a safety helmet.

**Future progressive**
I (need) *will be needing* your advice about buying a ship.

**Simple future indicative**
You (be) *will be a* qualified sea captain!

**Present indicative**
She (say) *says* hello to her friends who come aboard.
Perfect conditional
By looking to that side, we (see) **would have seen** the ship arrive.

Simple past indicative
You (be) **were** eager to sail away!

Present perfect indicative
They (eat) **have eaten** the food prepared by the ship’s cook.
Angles

Berthing or putting out to sea, that is, docking in a port or leaving it, are two complex maneuvers. Ships often use tugboats to help. In this interactive activity, you will have to tell the tugboats the angles needed for them to be able to pivot the ship without endangering other vessels or port facilities.

An angle is a geometric figure formed by two rays converging on a common point. Angles are measured in degrees.

There are different types of angles, depending on their measurements:

- Acute angle: less than 90°
- Right angle: 90°
- Obtuse angle: between 90° and 180°
- Straight angle: 180°
- Full angle: 360°

To measure an angle, we use a protractor:
1. Do the interactive activity. Check off all the levels you complete successfully.

2. Using your protractor, draw the following three angles:

- 90°
- 25°
- 155°
Cartesian plane

When a ship navigates at sea, it must avoid all of the obstacles on its course: rocks, icebergs, other vessels, etc. To locate these obstacles, the captain can use powerful satellites. In this activity, you will have to determine where on the Cartesian plane the icebergs are located so that your ship can reach its destination.

A Cartesian plane is a plane formed by two perpendicular axes, the x axis (horizontal axis) and the y axis (vertical axis). These two axes can be extended infinitely and are graduated. Each region of the Cartesian plane is called a quadrant.

We can locate a point on the Cartesian plane using a pair of coordinates: (x, y). The first number indicates the point’s position on the x axis and the second number indicates the point’s position on the y axis. The coordinates of the point where the two axes meet, called the origin, are (0, 0).
1. Do the interactive activity. Check off all the levels you complete successfully.

2. On the Cartesian plane below, plot the following coordinates: (-5, 8); (3, -9); (4, 4); (-2, -6); (8, -1); (0, -3).
Let’s go!

Time

2 hrs 52 min

The goods travelling on the St. Lawrence come from all around the world. Every day, ships from Europe, the United States, Asia and Oceania dock in different ports in Québec. Their journeys are very long: days and even weeks. In Brought to You by Ship, the journeys are much shorter. In this activity, you will use journey length to perform various calculations.

Time corresponds to the duration of a phenomenon. There are many units of time: century, decade, year, month, week, day, hour, minute, second…

To add or subtract hours, minutes and seconds, we must remember that:

1 minute (min) = 60 seconds (s)
1 hour (hr) = 60 minutes (min)

1. Write down the exact time right now. This is your ship’s departure time.
Example:
10:56 a.m.

2. In Brought to You by Ship, open the order book. Write down the journey length for the first six orders in the chart on the next page.

3. Calculate the length of each journey in seconds, then write your answers in the chart on the next page.

4. Determine the ship’s arrival time, then write your answers in the chart on the next page.
### Journey

*The answers are examples only.*

<table>
<thead>
<tr>
<th>Order</th>
<th>Journey length</th>
<th>Journey length in seconds</th>
<th>Ship’s arrival time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 min</td>
<td>600 s</td>
<td>11:06 a.m.</td>
</tr>
<tr>
<td>2</td>
<td>2 hrs</td>
<td>7200 s</td>
<td>12:56 p.m.</td>
</tr>
<tr>
<td>3</td>
<td>4h51 min</td>
<td>17 460 s</td>
<td>3:47 p.m.</td>
</tr>
<tr>
<td>4</td>
<td>4 min</td>
<td>240 s</td>
<td>11:00 a.m.</td>
</tr>
<tr>
<td>5</td>
<td>2 hrs 25 min</td>
<td>8700 s</td>
<td>1:21 p.m.</td>
</tr>
<tr>
<td>6</td>
<td>35 min</td>
<td>2100 s</td>
<td>11:31 a.m.</td>
</tr>
</tbody>
</table>

**Calculation space:**
Exchanging Polo$ and Talent$

Division

Talent$ are the official currency of the Game for Science virtual world. However, Brought to You by Ship has its own currency: the gold Polo$. This is the currency that allows you to manage your shipping company. Did you know that you can buy gold Polo$ with Talent$ to make your company get ahead faster? This activity gives you a chance to learn more about currency exchange.

Division is an operation that allows us to split an amount into a certain number of equal parts. The dividend is the number being divided. The divisor is the number used to divide, or the number of parts into which the dividend will be split. The quotient is the result of the division.

<table>
<thead>
<tr>
<th>Dividend</th>
<th>250</th>
<th>10</th>
<th>Divisor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quotient</td>
</tr>
</tbody>
</table>

1. In Brought to You by Ship, click on the number of gold Polo$ that you own. Write information about the purchase of gold Polo$ in the chart below.

<table>
<thead>
<tr>
<th>Purchase of gold Polo$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of gold Polo$</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>20 000</td>
</tr>
</tbody>
</table>
2. Calculate the unit cost of each gold Polo$, i.e. the number of Talent$ needed to buy a gold Polo$. Do the calculation for each row in the chart.

<table>
<thead>
<tr>
<th>Polo$</th>
<th>Talent$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculation space:

3. What did you notice?

_The more gold Polo$ you buy, the lower the unit cost is. So, it is more advantageous to buy large amounts of gold Polo$ than small amounts._
In playing *Brought to You by Ship*, you used the logistics associated with transporting goods by ship: purchasing and storing goods and fuel, hiring crew members, ensuring journey profitability, etc. In this activity, you will use these values in working on arithmetic means and rounding numbers.

The arithmetic mean is the sum of all the values observed, divided by the number of values.

\[
\text{Mean} = \frac{\text{Sum of all the values}}{\text{Number of values}}
\]

Rounding a number means replacing it by a value close to it. For example, to round a number to the nearest unit, we replace it by the nearest whole number:

- If the digit after the decimal point is lower than 5, we round down to the lower whole number;
- If the digit after the decimal point is higher than or equal to 5, we round up to the higher whole number.

1. In *Brought to You by Ship*, open the order book. For the first six orders, write the information below in the chart on the next page:
   - the number of gold Polo$ earned as a reward for successfully completing the delivery;
   - the number of litres of fuel needed for the journey.

2. Calculate the arithmetic mean of each column in the chart. If applicable, round to the nearest unit.
Order information

*The answers are examples only.*

<table>
<thead>
<tr>
<th>Order</th>
<th>Number of gold Polo$ earned as a reward</th>
<th>Number of litres of fuel needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2335</td>
<td>1900</td>
</tr>
<tr>
<td>2</td>
<td>1360</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>8000</td>
<td>1923</td>
</tr>
<tr>
<td>4</td>
<td>1965</td>
<td>950</td>
</tr>
<tr>
<td>5</td>
<td>4000</td>
<td>3000</td>
</tr>
<tr>
<td>6</td>
<td>1000</td>
<td>7692</td>
</tr>
<tr>
<td></td>
<td><strong>Arithmetic mean</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>3110</strong></td>
<td><strong>2744</strong></td>
</tr>
</tbody>
</table>
Fractions (representing and reducing)

The container ships travelling on the St. Lawrence may have different capacities, i.e. they can transport different numbers of containers. Furthermore, the type of goods stored in those containers can vary: cereals, fruits and vegetables, electronic devices, etc. In this activity, you will use fractions to represent these values.

A fraction is a number that represents part of a whole or a set divided into equal parts. It is represented like this:

\[
\frac{\text{Numerator}}{\text{Denominator}} \quad \text{Fraction bar}
\]

The numerator indicates the number of equal parts being considered. The denominator indicates the number of equal parts that constitute the whole.

\[
\frac{2}{3} \quad \text{of a whole} \quad \text{of a set}
\]

An irreducible fraction, i.e. a fraction reduced to lowest terms, is a fraction whose numerator and denominator can no longer be divided by the same divisor. The first fraction given as an example above is an irreducible fraction.

1. Log on to Brought to You by Ship and determine the total number of sets of containers that can be loaded on a ship.

15 sets of containers
2. Here are various orders for sets of containers to load on a ship. What fraction of the total number of containers that can be loaded does each represent?

a)

\[
\begin{align*}
\text{Fraction} & \quad \frac{2}{15} \\
\text{Number} & \quad 2 \quad 13
\end{align*}
\]

b)

\[
\begin{align*}
\text{Fraction} & \quad \frac{2}{15} \\
\text{Number} & \quad 2 \quad 3 \quad 10
\end{align*}
\]

2. Here are various orders for sets of containers to load on a ship. What fraction represents the number of sets of containers of electronic devices? Complete the representation of that fraction.

a)

\[
\begin{align*}
\text{Fraction} & \quad \frac{5}{15} \\
\text{Number} & \quad 5 \quad 10
\end{align*}
\]

b)

\[
\begin{align*}
\text{Fraction} & \quad \frac{7}{15} \\
\text{Number} & \quad 5 \quad 3 \quad 7
\end{align*}
\]
3. Here are various orders for sets of containers to load on a ship. What fraction represents the number of each set of containers? Where possible, reduce the fractions.

**a)**

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Reduced fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\frac{6}{15})</td>
<td>(\frac{2}{5})</td>
</tr>
<tr>
<td>(\frac{9}{15})</td>
<td>(\frac{3}{5})</td>
</tr>
</tbody>
</table>

**b)**

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Reduced fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\frac{3}{15})</td>
<td>(\frac{1}{5})</td>
</tr>
<tr>
<td>(\frac{9}{15})</td>
<td>(\frac{3}{5})</td>
</tr>
<tr>
<td>(\frac{3}{15})</td>
<td>(\frac{1}{5})</td>
</tr>
</tbody>
</table>
Adapted materials

Permeability and impermeability

When you played Brought to You by Ship, you used your container ship and bulk carrier to make a number of deliveries. The choice of materials that make up ships and port equipment is essential for the proper functioning of the marine industry.

Each material has its own specific characteristics or properties. The following are examples of properties:

- Density;
- Buoyancy;
- Solubility;
- Permeability;
- Impermeability;
- Etc.

1. Draw a line from each property to its definition.

2. In each circle, write P for permeable and I for impermeable.

- Sponge
- Umbrella
- Wool
- Metal
- Paper towel
- Glass
- Winter boot
- Plastic
- Raincoat
3. Do you think the hull of a ship like those found in *Brought to You by Ship* is permeable or impermeable? Explain your answer.

*The hull of a ship is impermeable. It’s made of metal (steel), which is an impermeable material. If the hull of a ship was permeable, it would fill with water and sink.*

______________________________________________________________________________

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4. The cargo containers in *Brought to You by Ship* are impermeable. What do you think would happen if they weren’t? Explain your answer.

*If the containers of goods weren’t impermeable, water could get inside them and damage the goods.*

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Solubility and buoyancy

The Brought to You by Ship port has three terminals containing bulk goods. Those goods have well-defined characteristics. Their transportation is provided by bulk carriers.

Each material has its own specific characteristics or properties. The following are examples of properties:

- Density;
- Buoyancy;
- Solubility;
- Permeability;
- Impermeability;
- Etc.

1. Draw a line from each property to its definition.

The buoyancy of a substance depends on its density, i.e. the mass of one cubic centimetre of the substance.

The density of water is 1 g/cm³. If a substance has a lower density than water, it will float on water. If a substance has a higher density than water, it will sink in water.
2. In *Brought to You by Ship*, locate the three bulk terminals and write down the goods that are stored in them.

![Images of three bulk terminals](Image)

- **Wood pellets**
- **Iron**
- **Road salt**

3. One of these three substances is soluble in water. Which one?

*Road salt is a water-soluble substance.*

______________________________________________________________________________
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4. Explain how you could verify your answer to Question 3.

*To verify my answer, I could take a sample of the substance, immerse it in a beaker of water, stir and observe whether the sample is still visible in the water.*

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5. The following boxes indicate the density of certain substances. Complete the two boxes with the names of two of the substances you wrote down for Question 2.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron</td>
</tr>
<tr>
<td></td>
<td>7.9 g/cm³</td>
</tr>
<tr>
<td>2</td>
<td>Cork</td>
</tr>
<tr>
<td></td>
<td>0.23 g/cm³</td>
</tr>
<tr>
<td>3</td>
<td>Olive oil</td>
</tr>
<tr>
<td></td>
<td>0.92 g/cm³</td>
</tr>
<tr>
<td>4</td>
<td>Wood pellet</td>
</tr>
<tr>
<td></td>
<td>1.1 g/cm³</td>
</tr>
</tbody>
</table>
6. In the pool of water below, indicate which substances from Question 5 will float and which will sink.

![Diagram with labels 1, 2, 3, 4]

7. Container ships and bulk carriers float on water. What can you conclude about the average density of those ships?

We can conclude that the average density of container ships and bulk carriers is lower than that of water (1 g/cm³).

Note: Ships are made of various materials. The density of most of these materials is higher than that of water. However, ships also contain a lot of air, whose density is very low. By combining the density of everything that makes up a ship, the result is lower than the density of water. That is why a ship floats.
Sources of energy

A ship can cover a distance of more than 300 kilometres on one litre of fuel to transport one ton of goods. This fuel consumption is very environment-friendly if we compare it to that of other means of transportation (train, truck).

People can use various sources of energy to meet their energy needs (transportation, heating, etc.). The following are some sources of energy:

- Sun (solar energy);
- Moving water (hydraulic energy);
- Wind (wind energy);
- Fossil fuels (fossil energy).

Energy sources can be renewable (they cannot be used up) or non-renewable (they can be used up).

1. In *Brought to You by Ship*, find the fuel symbol and draw it in the circle below.

2. What type of fuel do you think is used in container ships and bulk carriers?

   *Diesel, which is made from oil (petroleum).*
3. From what energy source is that fuel derived?

*Fossil energy.*

4. Explain how that fuel is formed.

*Step 1: Organic matter is deposited.*

*Over several millions of years, organic residues have accumulated at the bottom of oceans, where they have been covered by sand and rocks.*

*Step 2: Transformation into fossil fuel.*

*Pressure, heat and bacterial action transform the organic (fossil) residues into oil.*

5. Is it a renewable or non-renewable source of energy? Explain your answer.

*It is a non-renewable source of energy. Since it takes several million years for oil to form, there is a risk that the resource can be used up.*
Storm on the horizon!

Climate-related natural phenomena

In playing Brought to You by Ship, you probably noticed that ships can be forced to stop for various reasons, including climate-related natural phenomena. In this activity, you will learn more about these phenomena.

A number of natural phenomena are climate-related:

- Lightning: electrical discharge in a storm cloud (cumulonimbus), between two clouds or between a storm cloud and the ground.

- Tornado: vortex of violent and unpredictable winds, which occurs in warm, humid weather and which forms beneath a storm cloud.

- Hurricane: tropical storm (storm clouds in rotation with violent winds) that develops over warm seas.

1. Log on to Brought to You by Ship and make three deliveries to Gourmania Island. Write down the incidents that can force your ship to stop.

Several possible answers: thick fog, ice, wind creating big waves, etc.

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2. Of the incidents you wrote down in Question 1, circle those that are related to a natural phenomenon, if any.
3. Here are pictures of three natural phenomena. Name each phenomenon.

- [Image of a tornado]
- [Image of a hurricane]
- [Image of lightning]

3. Tornado    Hurricane    Lightning

4. What does the formation of these three climate-related natural phenomena have in common?

*In each case, their formation requires the presence of a storm cloud.*

______________________________________________________________________________
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5. Which of these phenomena do you think could force a ship to stop?

*A hurricane.*

______________________________________________________________________________
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5. Is Québec a suitable place for the development of hurricanes? Explain your answer.

*Québec is not a suitable place for the development of hurricanes, because they form over warm seas. Québec waters are too cold to create tropical storms.*

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**HIGH TIDE, LOW TIDE**

**Tides**

When a ship travels on a waterway or in a bay, or when it wants to dock in a port, it requires an adequate water level. In this activity, you will learn more about tides.

Tide is the phenomenon by which sea levels rise and fall, due to the gravitational attraction of the Moon and Sun.

The Moon and Sun attract the oceans. Since the Moon is closer to the Earth than the Sun, its attraction is stronger. But the Sun also plays a role in the phenomenon of tides. The position of the Moon, Earth and Sun determines if tides are high or not.

If the Moon, Earth and Sun are aligned:
- Combined attraction of the Moon and Sun;
- High tides;
- Name: spring tides.

If the Moon, Earth and Sun form a 90° angle:
- Uncombined attraction of the Moon and Sun;
- Low tides;
- Name: neap tides.

1. In the diagram below, indicate the positions of the Moon, Earth and Sun.
2. Does the diagram from Question 1 illustrate a spring tide or a neap tide? Explain your answer.

*The diagram illustrates a spring tide, because the Moon, Earth and Sun are aligned.*

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

3. Connect the diagrams to the type of tides to which they correspond.
4. A ship bound for the port of Gourmania consults the island’s tide table.

<table>
<thead>
<tr>
<th>Time</th>
<th>Water height (metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:14 a.m.</td>
<td>2.8</td>
</tr>
<tr>
<td>6:15 a.m.</td>
<td>0.8</td>
</tr>
<tr>
<td>12:29 p.m.</td>
<td>3.1</td>
</tr>
<tr>
<td>6:47 p.m.</td>
<td>0.7</td>
</tr>
</tbody>
</table>

a) At what times do low tides (lowest water level) occur?

*The low tides occur at 6:15 a.m. and 6:47 p.m.*

b) At what times do high tides (highest water level) occur?

*The high tides occur at 12:14 a.m. and 12:29 p.m.*

c) Is it better if the ship approaches the port of Gourmania at high tide or at low tide? Explain your answer.

*The ship must approach the port of Gourmania at high tide. When the water level is low, at low tide, navigation is more difficult. For example, the risk of the ship’s underside touching the bottom increases.*

Note: When a ship travels on a waterway or in a bay, it must take the tides and also its draught into consideration. The draught is the height of the submerged part of a ship. The draught is greater when the ship is loaded. To avoid an incident (for example, the ship going aground), many calculations must be done to determine the safest route.
Techniques specific to Geography

To travel from one location to another, ships must use well-established waterways or navigation channel. In *Brought to You by Ship*, several waterways connect the different Game for science islands. In Québec, the port network consists of about 20 ports, most of which are located on the St. Lawrence River (excluding the remote ports).

The map on the next page shows the St. Lawrence’s hydrographic system. The main ports in Québec are shown using white circles. They are (in alphabetical order):

<table>
<thead>
<tr>
<th>Baie-Comeau</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bécancour</td>
</tr>
<tr>
<td>Chandler</td>
</tr>
<tr>
<td>Gaspé</td>
</tr>
<tr>
<td>Gros-Cacouna</td>
</tr>
<tr>
<td>Havre-St-Pierre</td>
</tr>
<tr>
<td>Matane</td>
</tr>
<tr>
<td>Montréal</td>
</tr>
<tr>
<td>Pointe-au-Pic</td>
</tr>
<tr>
<td>Port-Alfred</td>
</tr>
<tr>
<td>Port-Cartier</td>
</tr>
<tr>
<td>Port-Saguenay</td>
</tr>
<tr>
<td>Québec City</td>
</tr>
<tr>
<td>Rimouski</td>
</tr>
<tr>
<td>Sept-Îles</td>
</tr>
<tr>
<td>Sorel-Tracy</td>
</tr>
<tr>
<td>Trois-Rivières</td>
</tr>
<tr>
<td>Valleyfield</td>
</tr>
</tbody>
</table>

1. Give the map a title.

2. Circle the map scale.

3. Cut out each strip, then paste it in the right place on the map.

4. Next to the white circles, write down the name of the ports you know.
The main ports in the St. Lawrence’s hydrographic system

North
- Sept-Îles
- Port-Cartier
- Baie-Comeau

St. Lawrence River
- Matane
- Rimouski
- Gros-Cacouna

West
- Port-Saguenay
- Port-Alfred
- Pointe-au-Pic
- Trois-Rivières
- Bécancour
- Sorel-Tracy
- Montréal
- Valleyfield

South

East

North
- Havre-St-Pierre

Gulf of St. Lawrence
- Gaspé
- Chandler

Québec City
- Pointe-au-Pic

Port-Sept-Îles
- Port-Cartier
Since the first French settlers arrived in North America, shipping has changed a lot, as you will see in doing this activity.

1. Connect each type of ship to one of the points on the time line.
2. Indicate if the following statements are true or false.

In New France, the St. Lawrence River was the key transportation route.  

Today, in Québec, the St. Lawrence River is the key transportation route.
The St. Lawrence River is Québec’s key transportation route. To facilitate trade, changes had to be made over time. This activity will allow you to learn more about this.

1. Complete the following time line by:

- identifying the century that each period corresponds to;
- completing the two boxes with the right solution;
- connecting each box to the right place on the time line.

**Need:** Facilitating trade between Upper Canada and Lower Canada via the St. Lawrence River.

**Problem:** 14-metre drop between Montréal and Lachine; presence of rapids.

**Solution:** Construction of the Lachine Canal.

**Composition:** 7 locks.

**Need:** Allowing ships to reach the Great Lakes.

**Problem:** To reach the Great Lakes, ships must use different lock systems, including some that are too narrow for the bigger ships.

**Solution:** St. Lawrence Seaway.

**Composition:** 15 locks in 5 short canals.
**Mathematics situational problem**

Marty, the superstore manager, has just placed an order for computers with one of his suppliers. For the delivery, he sees that various transport options are available: truck, train, ship or plane. He asks you for help to determine an eco-friendly delivery plan at the lowest possible cost.

These are the constraints to take into account in your delivery plan:
- The number of computers to be delivered is 330,000.
- Total fuel consumption must not exceed 100,000 liters.
- The maximum budget allocated for fuel is $80,000.00.
- The total amount of CO₂ (a pollutant responsible for global warming) must not exceed 5000 kg.

Here are the details for the different options:

<table>
<thead>
<tr>
<th></th>
<th>Truck</th>
<th>Train</th>
<th>Ship</th>
<th>Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip length:</td>
<td>653 km</td>
<td>436 km</td>
<td>798 km</td>
<td>358 km</td>
</tr>
<tr>
<td>Number of computers carried by one truck:</td>
<td>755</td>
<td>14,650</td>
<td>162,750</td>
<td>27,500</td>
</tr>
<tr>
<td>Fuel consumption:</td>
<td>35 L per 100 km</td>
<td>870 L per 100 km</td>
<td>5000 L per 100 km</td>
<td>2700 L per 100 km</td>
</tr>
<tr>
<td>Fuel cost:</td>
<td>$0.70/L</td>
<td>$0.70/L</td>
<td>$0.70/L</td>
<td>$0.70/L</td>
</tr>
<tr>
<td>CO₂ emissions:</td>
<td>0.11 kg/km</td>
<td>0.72 kg/km</td>
<td>0.87 kg/km</td>
<td>4.52 kg/km</td>
</tr>
</tbody>
</table>

**Brought to You by Ship**
Possible routes:

Which option would you suggest to Marty? Of the budget allocated, how much money will be left over?

1. Highlight all of the important information in the problem.

2. Re-state the problem in your own words.

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3. Use the calculation space below to show how you arrived at your solution.

Calculation space:
4. Complete the delivery plan.

**Delivery plan**

<table>
<thead>
<tr>
<th>Transportation mode chosen</th>
<th>Truck</th>
<th>Train</th>
<th>Ship</th>
<th>Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trucks, trains, ships or planes needed</td>
<td>438 trucks</td>
<td>23 trains</td>
<td>2 ships</td>
<td>12 planes</td>
</tr>
<tr>
<td>Total number of kilometers travelled by the vehicles as a whole</td>
<td>286 014 km</td>
<td>10 028 km</td>
<td>1596 km</td>
<td>4296 km</td>
</tr>
<tr>
<td>Total amount of fuel used by the vehicles as a whole</td>
<td>100 104.9 L</td>
<td>87 243.6 L</td>
<td>79 800 L</td>
<td>115 992 L</td>
</tr>
<tr>
<td>Total fuel cost</td>
<td>$70 073.43</td>
<td>$61 070.52</td>
<td>$55 860.00</td>
<td>$81 194.40</td>
</tr>
<tr>
<td>Total CO₂ emitted during the delivery</td>
<td>31 461.54 kg*</td>
<td>7220.16 kg*</td>
<td>1388.52 kg*</td>
<td>19 417.92 kg*</td>
</tr>
</tbody>
</table>

Note: The yellow highlighting indicates that the constraints have been exceeded.

* The numbers have been modified so that the exercise’s level of difficulty is appropriate for the students. Generally, 1 L of fuel releases 2.28 kg of CO₂. For further details, see [https://ec.gc.ca/ges-ghg/default.asp?lang=En&n=AC2B7641-1#section5](https://ec.gc.ca/ges-ghg/default.asp?lang=En&n=AC2B7641-1#section5)

Amount remaining in the budget allocated for fuel: ____________$24 140.00_______________

Explain why the solution you are proposing is eco-friendly. Several possible answers. Example: Using “Ship” as the transportation mode is the most eco-friendly of the four options since it consumes the least fuel and emits the least greenhouse gas for equivalent delivery.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Game questions

Questions to answer when a ship is stopped

Question 1:
About how many people work on a ship transporting goods on the St. Lawrence?

a) About 20 people
b) About 10 people
c) About 100 people

Professions related to marine transportation are numerous and are not uniquely limited to the crews that work on ships. In Québec, 36% of workers hold a navigational job (aboard a ship) and 64%, a non-navigational job (in ports, for instance).

Question 2:
Who do you think is the “boss” aboard ship?

a) The captain
b) The ship owner
c) The pilot

The captain is in charge of the marine expedition. He represents the ship owner and is responsible for the ship, its cargo and its passengers.

Question 3:
What is a ship owner?

a) He’s the owner.
b) He prepares tasty meals for the whole crew.
c) He maintains and repairs the ship's electrical circuits.

The ship owner equips one or more merchant ships. He outfits the ship, i.e. he provides a crew, equipment, supplies and everything that is necessary for the marine expedition.

Question 4:
On average, ships on the St. Lawrence carry 25 000 tons of cargo. How many trucks are needed to carry the same amount?

a) 870 trucks
b) 500 trucks
c) 300 trucks

While the transport sector (road, air, marine, rail, off-road) produces the most greenhouse gas (GHG) emissions in Québec, shipping generates only 4.3% of this total.
**Question 5:**
How many iPads do you think a container ship can transport?
- a) 182 million iPads
- b) 1 million iPads
- c) 182 000 iPads

The biggest container ship currently in service is longer than the Eiffel Tower and can transport 182 million iPads!

**Question 6:**
Up to how many containers do you think a container ship can carry?
- a) 18,000 containers
- b) 10,000 containers
- c) 5,000 containers

The biggest ships can carry up to 18 000 containers. However, these ships don't navigate the St. Lawrence River. On the St. Lawrence, ships carry a maximum of 4,500 containers, on average.

**Question 7:**
What percentage of the goods you use, and that come from outside the North American continent, is transported by ship?
- a) 90%
- b) 75%
- c) 50%

On average, around the world, 90% of the goods people use are transported by ship. Cereals, electronic devices, clothes... you use goods that have travelled on the St. Lawrence River. Without the St. Lawrence and without ships, your life would be very different.

**Question 8:**
During which seasons do you think ships travel on the St. Lawrence?
- a) Spring - summer - fall - winter
- b) Spring - summer
- c) Spring - summer - fall

Since 1960, ships have been able to travel up to Montréal in winter. They can navigate the St. Lawrence year-round thanks to the work of Canadian Coast Guard icebreakers.

**Question 9:**
When is a whistle or siren used on a ship?
- a) To indicate upcoming course change manoeuvres
- b) To let the sailors know that it’s mealtime
- c) To indicate that the ship must be evacuated

A ship’s course change and stopping manoeuvres are slow and can take several minutes. So, it’s important for a ship to warn other ships of its intentions. Coded light and sound signals allow it to indicate manoeuvres and speed changes.
Question 10:
On average, how many days does it take for a ship leaving a St. Lawrence port to reach Europe?
- a) About a week
- b) About three weeks
- c) About a month
It takes between seven and ten days for commercial ships to cross the Atlantic Ocean and make the trip from North America to Western Europe.

Question 11:
How many commercial ports are there in Québec?
- a) 20 ports
- b) 10 ports
- c) 5 ports
There is a network of 20 commercial ports throughout Quebec used to load and unload cargo. The main ones are Montréal, Québec City, Sept-Îles, Port-Cartier, Trois-Rivières, Saguenay and Sorel-Tracy.

Question 12:
Approximately how many ships travel on the St. Lawrence each year?
- a) 5,000 ships
- b) 1,000 ships
- c) 2,500 ships
About 5,000 ships travel on the St. Lawrence each year. They are mostly used to transport goods.

Question 13:
In the shipping world, what is a “flag”?
- a) A rectangular piece of cloth hoisted at the back of a ship
- b) The part of a ship where sailors can rest
- c) The captain’s summer house or cabin
A flag indicates the ship’s nationality, i.e. the country in which it is registered. For a ship registered in Canada, we say that it “flies the Canadian flag”.

Question 14:
What is this type of ship called?
- a) Container ship
- b) Bulk carrier
- c) Tugboat
Container ships transport finished manufactured products (electronic devices, furniture, etc.) and other refrigerated goods (fruits and vegetables, meat, etc.). These products are bundled and carried in metal boxes called containers.
**Question 15:**
What does the expression “merchant marine” refer to?

a) The marine transportation of goods or people  
   b) Military marine transportation  
   c) The sale of navy blue products

The merchant marine transports different types of goods. The products carried determine the type of ship used. Across the world's seas, we find specialized ships: bulk carriers, self-unloaders, tankers, tugboats and container ships.

**Questions to answer for paying port fees**

**Question 1:**
Once the cargo has been unloaded, how is it taken to its final destination?

a) By train and/or by truck  
   b) By plane  
   c) On horseback

Trains, trucks and shipping are complementary means used to bring cargo to its final destination.

**Question 2:**
The average load of the ships that navigate the St. Lawrence is 25,000 tonnes. How long does it take to unload it?

a) Between 25 and 35 hours  
   b) 1 week  
   c) 2 hours

Typical loading rates vary between 100 and 700 tonnes per hour, though some very advanced ports have rates of 6,000 tonnes/hour. After unloading, the ship’s holds are cleaned, particularly if the next cargo is of a different type. Loading can then begin.

**Question 3:**
What do we call people who work in a port and who load and unload the cargo?

a) Longshoreman  
   b) Captain  
   c) Elevator

A longshoreman loads or unloads the ship’s cargo. He is a port worker and does his work on shore.
**Question 4:**
What do you think a “docking pilot” is?

a) Person in charge of the docking and sailing operations  
b) Boat owner  
c) Employee in charge of washing dishes on a boat  

The docking pilot assists ships when they arrive, leave or move around in the port. He is a pilot aboard the ship who communicates with the different people concerned during the maneuvers.

**Question 5:**
In what year was the first lighthouse on the St. Lawrence built?

a) 1809  
b) 1608  
c) 1995  

Lighthouses are used as navigation aids to prevent disasters at sea. The St. Lawrence’s first lighthouse was built in 1809 on Île Verte.

**Question 6:**
Where does the road salt used as an abrasive on Québec roads in winter come from?

a) Magdalen Islands  
b) China  
c) India  

The road salt used in Québec in winter comes from the Magdalen Islands and is delivered by ship to the St. Lawrence ports.

**Question 7:**
What year did the St. Lawrence Seaway open?

a) 1959  
b) 1820  
c) 2000  

Officially inaugurated on June 26, 1959, the Seaway is jointly administered by Canada and the United States. This structure (15 locks, including 13 Canadian and 2 American ones) is recognized as one of the greatest technical achievements of the 20th century.

**Question 8:**
What does the word “ballast” mean?

a) Contents of a high-capacity water tank  
b) A dance  
c) A type of buoy  

Ballast is fresh water or salt water that is loaded into a compartment or tank in a ship’s hold to keep the ship stable. According to current Canadian laws and regulations, foreign ships can’t discharge their ballast water in the St. Lawrence.
Question 9:
How long does it take for a St. Lawrence Seaway lock to fill?

a) 10 minutes
b) 1 hour
c) 30 minutes

Each St. Lawrence Seaway lock contains about 91 million liters of water. The locks fill and empty through the force of gravity. To raise a ship, the upstream valves are opened. To lower it, the downstream ones are opened and the water comes out.

Question 10:
What is the “Automatic Identification System” (AIS)?

a) A ship positioning system
b) An identity screening tool for crew members
c) A constellation tracking method

The Automatic Identification System (AIS) is a tracking system that provides automatic updates to ship operators about ship position and other relevant trip-related data.

Question 11:
Which word below does not refer to a part of the ship?

a) Binding
b) Bow
c) Forecastle

The bow is the front part of the ship. The forecastle is the superstructure located on the forward part of an upper deck that extends across the ship. It contains the crew’s living quarters.

Question 12:
Which energy source is not used to power a ship?

a) Ethanol
b) Liquefied Natural Gas (LNG)
c) Diesel

The majority of ships navigating the St. Lawrence use diesel fuel. New hybrid ferries (diesel and liquefied natural gas) are currently being built and will begin operating in the coming months between Matane and Baie-Comeau/Godbout and Québec City and Levis.

Question 13:
What is a double-hulled ship?

a) A ship equipped with two hulls
b) A ship that transports eggs
c) A ship with two engines

All oil tankers navigating the St. Lawrence must be double-hulled in order to increase impact resistance. The space between the first and the second hull is so big that a person can stand in it.
Question 14:
What allows a ship to maintain buoyancy?

a) The hull
b) The propeller
c) The engine

The hull is the main component of a ship. It makes up the float: the part that ensures buoyancy and water-tightness. A ship can have a one hull (we then call it a single-hulled ship) or several (multi-hull).

Question 15:
Which of these lists includes ships that do not only transport cargo?

a) Tanker, bulk carrier, ferry
b) Barge, container ship, tugboat
c) Self-unloader, multi-purpose ship, roll-on/roll-off ship

The type of cargo carried determines the type of ship needed. There are four types of cargo: dry bulk (bulk carrier), liquid bulk (tanker), containerized and non-containerized cargo. A ferry is used to transport passengers.
Game interface

- Bulk terminals
- Bulk carrier
- World map to locate your ship
- Exit
- Container terminals
- Container ship
- Fuel supply tank
- Access activity cards
- My avatar
- My gold Polo$
- Order book
- Sailors’ home
- My points
- My level