junior tech challenge

The practical side of science and tech

MISSION: LAUNCH!

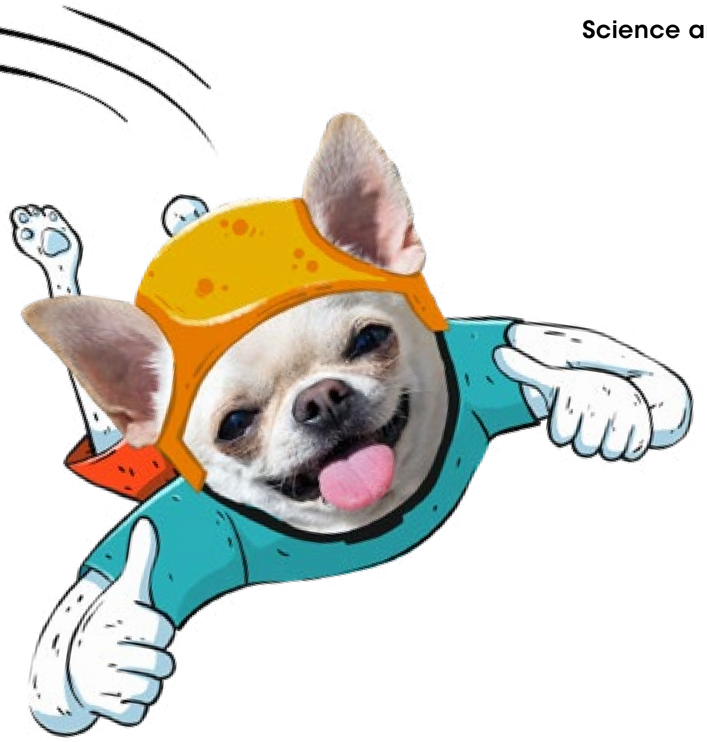
2022-2023 Edition

TEACHER'S GUIDE

Intended for:

Intensive ESL Project, Elementary Cycle 3

Science and Technology Program, Elementary Cycle 2 & 3



A program of

RÉSEAU TECHNOSCIENCE

Together for a new scientific generation

PRODUCTION TEAM

Provincial Coordinator of the Junior Tech Challenge

Sara Gosselin

Design of the challenge and the pedagogical tools

In collaboration with the pedagogical consultants of the regional networking group in Science and Technology, elementary of the Laval-Laurentides-Lanaudière region.

Layout

Fabien Dumas

English adaptation and translation

Elizabeth Alloul, ESL Consultant, LEARN

A program of

Réseau Technoscience — Together for a new scientific generation

In collaboration with

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INTRODUCTION

THE JUNIOR TECH CHALLENGE: A UNIQUE LEARNING SITUATION!

Every year in Quebec, the Junior Tech Challenge allows all elementary school students to learn about science and technology in a creative and fun way. The Junior Tech Challenge is an original and hands-on classroom project that is also a learning and evaluation situation (LES). Six challenges are presented cyclically, one per year. Educational tools are offered to meet the challenge of the current year. The pedagogical content can be adapted according to the intended pedagogical objectives. With each new edition, the rules and educational tools are improved upon to ensure that they best meet teachers' needs. This document is intended to support professionals who teach the Intensive ESL Project or the Science and Technology Program (Elementary), or anyone who wishes to experience the Junior Tech Challenge with their students in English.

AN ADAPTABLE CHALLENGE!

This year, we proudly present the new version of the 2016-2017 Junior Tech Challenge. Originally named *Sugar Power*, the new version *Mission: Launch*, can be carried out with a team at school, or individually at home. The challenge has also been adapted to meet the needs of students in all cycles.

FOR INTENSIVE ESL TEACHERS

The students will have the opportunity to:

1. **Develop Competency 1** (Interact orally in English) through challenging hands-on activities. The teacher will have various opportunities to observe the students' oral interactions during these activities.*
2. **Review and consolidate science knowledge** in an English-language context. The science, technology and mathematics concepts in this LES have already been taught in previous cycles. This LES gives students the opportunity to put these concepts into practical application and reach their end-of-cycle objectives (see Progression of Learning for Science and Technology and Mathematics on pages 7-10).
3. **Participate in an authentic learning situation**. The Junior Tech Challenge can be a class competition, a school-wide competition or a regional event where students from selected teams will have the opportunity to meet other selected teams at the Regional Finals.

** Evaluation tools and suggestions for activities can be found in Appendix 2.*

INTRODUCTION *(CONTINUED)*

TEACHING TOOLS AVAILABLE

All documents that have been translated into English can be accessed on the Réseau Technoscience website.

- Rules
- Teacher's Guide
- Student Handbook
- Slideshow (*Google Slides, PPT and PDF formats*)
- Junior Tech Certificate of Participation
- Carton de notation (*French only*)
- Tableau de pointage Excel (*French only*)
- Fiche de vérification des prototypes (*French only*)

PREPARATORY ACTIVITIES

The preparatory activities aim to help students acquire scientific concepts related to the challenge. They also help develop strategies that support students in the development of science-specific competencies.

Although the activities can be carried out independently, they can lose their meaning if they are not developed in a meaningful context where students can reinvest their knowledge in an authentic production. The activities suggested in this LES allow students to become familiar with the design process and to allow the teacher to collect traces of the following competencies in Science and Technology:

- Competency 1: To propose explanations for or solutions to scientific or technological problems.
- Competency 2: To make the most of scientific and technological tools, objects and procedures.
- Competency 3: To communicate in the languages used in science and technology.

All activities allow students to establish concrete links with scientific concepts anchored in the Progression of Learning Science and Technology and the Mathematics, Science and Technology program of Quebec.

FROM A LES FOR THE CLASSROOM TO THE REGIONAL FINALS

The **Junior Teach challenge** is an authentic learning opportunity in which students experience a science and technology design in the classroom. They are invited to compete in one of the many levels of competition - with the ultimate experience of participating at the Regional Finals!

Here are the different levels of finals:

Class Finals	These finals are organized in class to determine the most efficient prototypes.
School Finals	School Finals are organized per cycle to determine the representatives who will go to the school service center or school board finals. If there are no finals in the school service center or school board, they will go directly to the Regional Finals.
School Service Center Finals or School Board Finals	These finals are organized per cycle by the school service center or school board, or in collaboration with Réseau Technoscience. If the school service center or school board is planning on holding finals, students will have to register to these finals first.
Regional Finals	Regional Finals are organized per cycle and bring students together from their region. Réseau Technoscience organizes 11 regional finals which will take place in May, as part of l'Odyssée des sciences. Science fair projects from Expo-sciences and activities from the Débrouillards will also be presented. Consult the calendar for the date of your Regional Finals. To register teams, contact the Regional Coordinator of the Junior Tech Challenge. The contact information is available on the website.

Note: During the Regional Finals, the challenge can be presented in a different format to that presented in the school service center, or school board finals. The students will be required to change their strategy to adapt to this new format. No advanced preparation is needed, but extra time will be given to students to make the necessary changes.

PROGRESSION OF LEARNING FOR SCIENCE AND TECHNOLOGY

PROGRESSION OF LEARNING

The intention of this learning and evaluation situation is to help develop students' skills, particularly those associated with the technological design process. Many skills used during this process are described in the activities proposed in the Teacher's Guide. The details of the concepts targeted in each of the activities and the links with the Progression of Learning are presented below.

KNOWLEDGE ACTIVATED IN THE LES

This learning situation activates the following knowledge from the Progression of Learning Science and Technology and from the Progression of Learning Mathematics:

SCIENCE AND TECHNOLOGY

MATERIAL WORLD

		Elementary					
→	Student constructs knowledge with teacher guidance.						
*	Student applies knowledge by the end of the school year.						
	Student reinvests knowledge.	Cycle 1		Cycle 2		Cycle 3	
A.	**MATTER**	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
1.	Properties and characteristics of matter						
	a. Classifies objects according to their properties (*e.g. colour, shape, size, texture, smell*)	→	*				
	f. Distinguishes between the mass (*quantity of matter*) of an object and its weight (*gravitational force acting on the mass*)			→	*		
	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					→	*
B.	**ENERGY**	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
3.	Transformation of energy						
	d. Describes the transformations of energy from one form to another			→	*		
	e. Recognizes the transformations of energy from one form to another in various devices (*e.g. flashlight: chemical to light; electric kettle: electrical to heat*)					→	*

		Elementary					
→	Student constructs knowledge with teacher guidance.						
*	Student applies knowledge by the end of the school year.						
(blue)	Student reinvests knowledge.	Cycle 1		Cycle 2		Cycle 3	
C. FORCES AND MOTION		**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
3.	Gravitational attraction on an object						
	a. Describe the effect of gravitational attraction on an object (*e.g. free fall*)					→	*
5.	Characteristics of motion						
	c. Describes the characteristics of motion (*e.g. direction, speed*)			→	*	(blue)	(blue)
6.	Effects of a force on the direction of an object						
	a. Identifies situations involving the force of friction (*pushing on an object, sliding an object, rolling an object*)	→	*	(blue)	(blue)	(blue)	(blue)
	b. Identifies examples of a force (*e.g. pulling, pushing, throwing, squeezing, stretching*)			→	*	(blue)	(blue)
	c. Describes the effects of a force on an object (*e.g. Sets it in motion, changes its motion, stops it*)			→	*	(blue)	(blue)
	d. Describes the effects of a force on a material or structure			→	*	(blue)	(blue)
7.	Combined effects of several forces on an object						
	a. Predicts the combined effect of several forces on an object at rest or an object moving in a straight line (*e.g. reinforcement, opposition*)					→	*
D. SYSTEMS AND INTERACTION		**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
1.	Everyday technical objects						
	a. Describes the parts and mechanisms that make up an object	→	*	(blue)	(blue)	(blue)	(blue)
	b. Identifies the needs that an object was originally designed to meet	→	*	(blue)	(blue)	(blue)	(blue)
2.	Simple machines						
	a. Recognize simple machines (*lever, inclined plane, screw, pulley, winch, wheel*) used in an object (*e.g. lever in seesaw, inclined plane for an access ramp*)			→	*	(blue)	(blue)
	b. Describes the uses of certain simple machines (*to adjust the force required*)			→	*	(blue)	(blue)
3.	Other machines						
	a. Identifies the main function of some complex machines (*e.g. cart, waterwheel, wind turbine*)					→	*
4.	How manufactured objects work						
	b. Describes a simple sequence of mechanical parts in motion			→	→	→	*
	c. Describes a simple sequence of mechanical parts in motion			→	→	→	*

		Elementary					
→	Student constructs knowledge with teacher guidance.						
✱	Student applies knowledge by the end of the school year.						
(blue)	Student reinvests knowledge.	Cycle 1		Cycle 2		Cycle 3	

E. TECHNIQUES AND INSTRUMENTATION	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
2. Use of simple machines						
a. Appropriately uses simple machines (*lever, inclined plane, screw, pulley, winch, wheel*)			→	→	→	✱
3. Use of tools						
a. Appropriately and safely uses tools (*e.g. pliers, screwdriver, hammer, wrench, simple template*)			→	→	→	✱
5. Design and manufacture of instruments, tools, machines, structures (*e.g. bridges, towers*), devices (*e.g. water filtration device*), models (*e.g. glider*) and simple circuits						
a. Knows the symbols associated with types of motion, electrical components and mechanical parts			→	→	→	✱
b. Interprets a diagram or a plan containing symbols			→	→	→	✱
d. Draws and cuts parts out of various materials using appropriate tools			→	→	→	✱
e. Uses appropriate assembling methods (*e.g. screws, glue, nails, tacks, nuts*)			→	→	→	✱
f. Uses appropriate tools for proper finishing work			→	→	→	✱
g. Uses simple machines, mechanisms or electrical components to design or make an object			→	→	→	✱

F. APPROPRIATE LANGUAGE	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
1. Terminology related to an understanding of the material world						
a. Appropriately uses terminology related to the material world	→	→	→	→	→	✱
b. Distinguishes between the meaning of a term used in a scientific or technological context and its meaning in everyday language (*e.g. source, matter, body, energy, machine*)	→	→	→	→	→	✱
2. Conventions and types of representations specific to the concepts studied						
a. Communicates using appropriate types of representations that reflect the rules and conventions of science and technology (*e.g. symbols, graphs, tables, drawings, sketches, norms and standardization*)			→	→	→	✱

PROGRESSION OF LEARNING FOR SCIENCE AND TECHNOLOGY (CONTINUED)

MATHEMATICS

GEOMETRY

		Elementary					
→	Student constructs knowledge with teacher guidance.						
✱	Student applies knowledge by the end of the school year.						
	Student reinvests knowledge.	Cycle 1		Cycle 2		Cycle 3	
	B. SOLIDS	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
	1. Compares objects or parts of objects in the environment with solids (*e.g. spheres, cones, cubes, cylinders, prisms, pyramids*)	→	✱				
	2. Compares and constructs solids (*e.g. spheres, cones, cubes, cylinders, prisms, pyramids*)	→	✱				
	3. Identifies the main solids (*e.g. spheres, cones, cubes, cylinders, prisms, pyramids*)	→	✱				
	Vocabulary Solid, base of a solid, face, flat surface, curved surface Sphere, cone, cube, cylinder, prism, pyramid	→	✱				
	4. Identifies and represents the different faces of a prism or pyramid	→	✱				
	5. Describes prisms and pyramids in terms of faces, vertices and edges			→	✱		
	6. Classifies prisms and pyramids			→	✱		
	7. Constructs a net of a prism or pyramid			→	✱		
	Vocabulary Vertex, edge, net of a solid			→	✱		

OVERVIEW

<table>
<tr><th>DESCRIPTION</th><th>TIME</th><th>PEDAGOGICAL RESOURCES</th></tr>
<tr><td colspan="3">PREPARATION</td></tr>
<tr><td>Setting the Stage
The teacher presents the challenge to the students, but does not give them all the details. The rules will be presented at a later time.</td><td>15 minutes</td><td>• Student Handbook p. 2-3
• Slideshow
• Intensive ESL-Appendix 4: What Could We Do?</td></tr>
<tr><td>Activity 1: Machines that Launch!
In this task, students will explore machines that launch, and compare the different characteristics of the models presented (e.g. flexibility of the materials).</td><td>45 minutes</td><td>• Student Handbook p. 4-6
• Intensive ESL-Appendix 4: The Catapult</td></tr>
<tr><td>Activity 2: Launching from all Angles... Full Speed Ahead!
Part A - Varying the Launch Angle
Using an online simulator, students will experience how varying the launch angle can affect the trajectory of a projectile.

Part B - Varying the Speed of the Projectile
Using the same online simulator, the student can vary the launch speed of the projectile and observe how it affects the trajectory.</td><td>50 minutes</td><td>• Electronic device (Chromebook, computer or tablet)
• Student Handbook p. 7-10</td></tr>
<tr><td>Activity 3: Angle and Speed: A Perfect Team!*
Students will apply what was learned in the previous activity by varying the angle of the inclined plane and the speed of the projectile. Ultimately, they will find that for any given speed, the optimal angle to reach the greatest distance is 45°.</td><td>90 minutes</td><td>• Student Handbook p. 11-12</td></tr>
<tr><td>Activity 4 : Solid Structures
Students will build and then compare solids in order to determine the characteristics that make them strong.</td><td>75 minutes</td><td>• Student Handbook p. 13-14</td></tr>
<tr><td>Activity 5: The Effect of a Force on a Structure
Part A - Building a Springboard
Students will build a springboard and explore different applied forces on different structures.

Part B: A Flexible Structure
Students will explore how the flexibility of different structures require different applied forces.

Part C: The Launch
Students will test their hypotheses.</td><td>1+ period</td><td>• Student Handbook p. 15-20</td></tr>
</table>

** Activities 2 and 3 address similar concepts. If time and resources (computer, tablet, or Chromebook) are available, activities 2 and 3 are best done in class. If not, Activity 2 could be done online (asynchronous) and Activity 3 in class.*

EXEMPLE DE DÉROULEMENT (SUITE)

DESCRIPTION	TIME	PEDAGOGICAL RESOURCES
IMPLEMENTATION		
Preparing to Meet the Challenge & The Trials The teacher will present the rules of the competition to students. Students will experiment with different prototypes.	1+ periode	• Student Handbook p. 12-15 • Rules
The competition Students will execute the challenge.	2-3 periods	• Student Handbook p. 25 • Materials permitted for the construction of the prototype (*see Rules*).
REVIEW AND REFLECT		
The teacher and the students will review the design and the construction of the prototype, and the strategies that will be used to carry out the task.	20+ minutes	• Student Handbook p. 26

SETTING THE STAGE

Pedagogical Intentions

- Present the learning and evaluation situation and the challenge.
- Generate student interest.

Materials

- Slideshow
- Student Handbook p. 2-3

Procedure

Use the slideshow and the Student Handbook to present an overview of the challenge to the students.

1. Show slides 1-3. Ask students to think of the problem presented to them and brainstorm some possible solutions. After they present their suggestions, explain that a solution will be presented to them in the next slide.*
2. Present the rest of the slides.
3. Distribute the Student Handbook to generate interest.

**Intensive ESL see Appendix 2, Grammar Flash: What Could We Do?*

YOUR MISSION

The water level near your home is rising and you are worried about your friends who live on the islands nearby. How will you get them help if the roads between the city and the islands will soon be submerged?

To prevent the water from reaching your friends' homes, you will need to build a prototype that will allow you to propel sandbags onto the islands. Your friends will be able to receive them and install them to block the rising water from reaching their homes.

You will need to collect all the materials necessary to build your prototype. Your prototype will need to be able to launch projectiles as far as the farthest island.

THE CHALLENGE

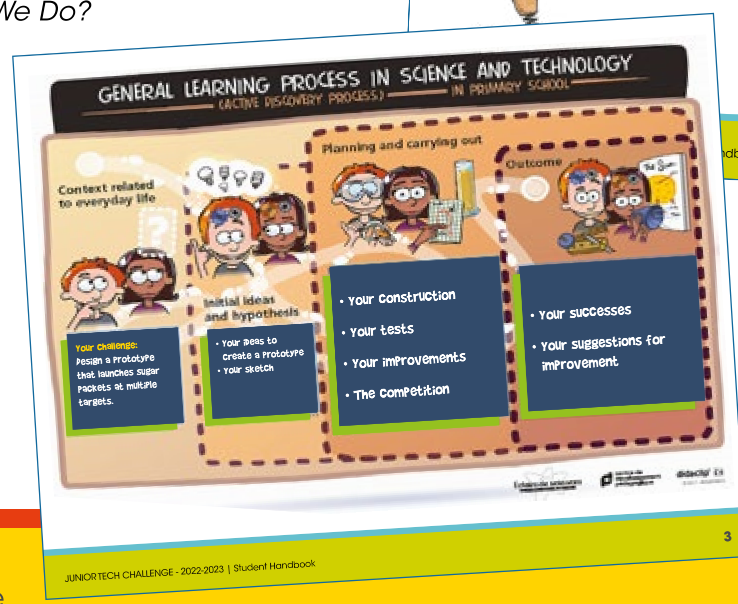
To build a prototype that launches sugar packets at multiple targets.

AN ADDITIONAL CHALLENGE FOR CYCLE 3!

For Cycle 3 students, the sugar packets must be launched by a **mechanical trigger**. This mechanical trigger must be something other than the participant's hand: a button, a pin, the cutting of a string, etc. The prototype must be able to remain armed before being triggered.

Although it is not necessary, you can decide to use a mechanical trigger even if you are in Cycle 1 or Cycle 2!

...dbook 2



ACTIVITY 1 – MACHINES THAT LAUNCH!

Pedagogical Intentions

- To analyse the mechanism behind machines that launch.
- To compare the characteristics of the different models (*e.g. flexibility of the different materials*).

Material

- Video
- Student Handbook p. 4-6

Procedure

Part A

1. Ask students to look at the images of the ballista and the catapult and identify their shared function.

Part B*

2. Show students the video and ask them to answer the questions explaining how the object works.
3. Ask students to describe the difference between a rigid object and a flexible one, circle their hypotheses and answer the questions.

Part C

4. Ask students to look at the additional images, circle their hypotheses and answer the question.

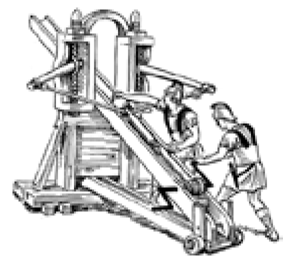
Part D

5. As the students complete Part D, point out that they will have the choice of using rigid or flexible materials in their design.

**Intensive ESL see Appendix 4, The Catapult before completing Part B.*

MACHINES THAT LAUNCH! ACTIVITY 1

A. Look at the two machines below and answer the following questions.



What is the function of these machines? What are they used for?

To throw a ball or other objects.

B. Watch the video and answer the following questions.

1. What is holding the ball in the catapult?

Sample answers: The ball is placed in a receptacle where the sides are high enough to keep it in place. / A receptacle is holding the ball in the catapult. Etc.

2. Explain how the catapult works.

Sample answers: The white rod must be pushed upwards. When the person's foot moves away, the white rod will rise and propel (throw) the ball. A rubber band can bring the arm up. Etc.

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Pour aller plus loin... (In French only)

Ce document est une ressource intéressante pour faire de l'analyse technologique avec les élèves: https://cdpsciencetechno.org/cdp/UserFiles/File/telechargement/analyse_primaire.pdf

ACTIVITY 1 – MACHINES THAT LAUNCH! (CONTINUED)

MACHINES THAT LAUNCH!

ACTIVITY 1 (CONT.)

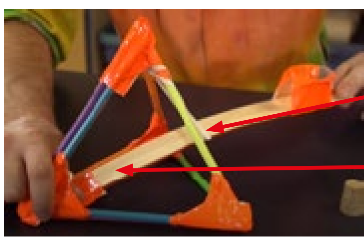
3. Are the following elements rigid or flexible? Circle your hypothesis.

4. What is the trigger of the catapult?

A pin attached to a rope holds the rod of the catapult. The pin is pulled out to activate the catapult and throw the ball.

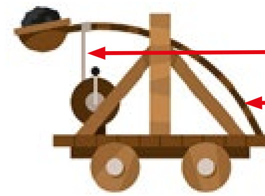
C. Look at other models of catapults and answer the following questions.

1. Are the following elements rigid or flexible? Circle your hypothesis.



MACHINES THAT LAUNCH!

ACTIVITY 1 (CONT.)



2. What do you observe about the materials?

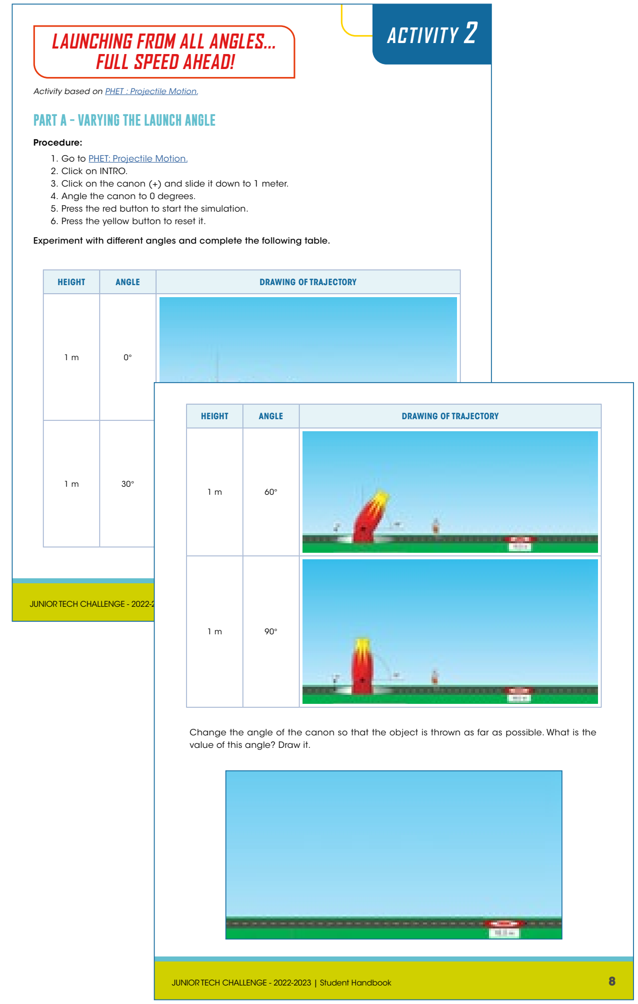
You can decide to use elastic or rigid materials for certain parts of the catapult. Some catapults have many elastic parts and others only one. The important thing is that there is at least one elastic part.

D. Which of the objects presented above inspires you most to build your catapult? Which characteristics do you think you can replicate? What will be your construction challenge?

Answers may vary.

ACTIVITY 2 – LAUNCHING FROM ALL ANGLES… FULL SPEED AHEAD!

PART A - VARYING THE LAUNCH ANGLE



Pedagogical Intentions

The student will recognize that:

- As the angle varies, the distance an object is projected varies.
- For any given speed and height, the optimal angle is 45°.

Materials

- Interactive Simulation PHET: Projectile Motion
- Chromebook, computer or tablet
- Student Handbook p. 7-8

Procedure

In teams of two:

1. Invite students to watch this tutorial video (in French only) or follow the procedure on page 7 of their Student Handbook.
2. Ask students to connect to the Interactive Simulation PHET: Projectile Motion (using a Chromebook, a computer or a tablet).
3. Ask students to complete the table in their Student Handbook by drawing the different trajectories of the projectiles when they are launched at these angles: 0°, 30°, 60° and 90°.
4. Challenge teams to find the angle at which the projectile will go the farthest.

With the whole class:

5. Compare the answers arrived at.
6. Lead students to conclude that the launch angle that will cover the greatest distance will always be 45°.

ACTIVITY 2 – LAUNCHING FROM ALL ANGLES… FULL SPEED AHEAD! (CONT.)

ACTIVITY 2

LAUNCHING FROM ALL ANGLES… FULL SPEED AHEAD!

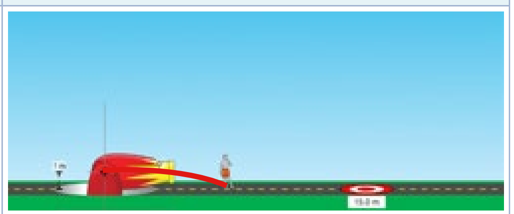
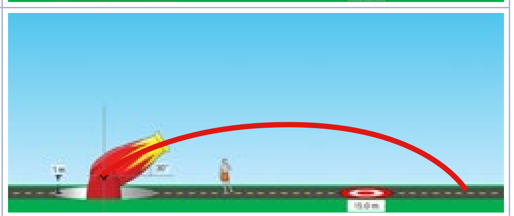
Activity based on PHET : Projectile Motion.

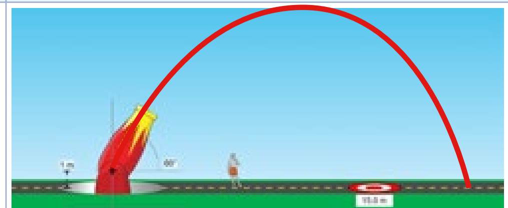
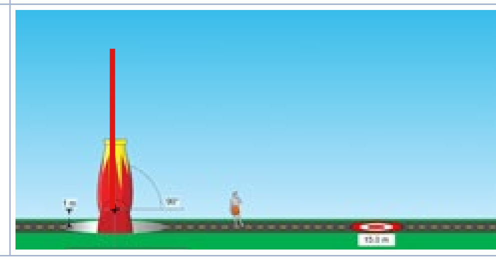
PART A – VARYING THE LAUNCH ANGLE

Procedure:

1. Go to PHET: Projectile Motion.
2. Click on INTRO.
3. Click on the canon (+) and slide it down to 1 meter.
4. Angle the canon to 0 degrees.
5. Press the red button to start the simulation.
6. Press the yellow button to reset it.

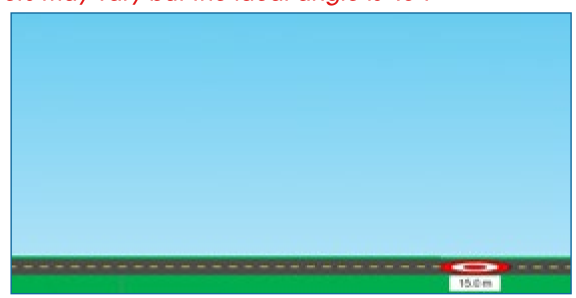
Experiment with different angles and complete the following table.

HEIGHT	ANGLE	DRAWING OF TRAJECTORY
1 m	0°	
1 m	30°	

HEIGHT	ANGLE	DRAWING OF TRAJECTORY
1 m	60°	
1 m	90°	

Change the angle of the canon so that the object is thrown as far as possible. What is the value of this angle? Draw it.

Answers may vary but the ideal angle is 45°.



ACTIVITY 2 – LAUNCHING FROM ALL ANGLES… FULL SPEED AHEAD! (CONT.)

PART B – VARYING THE SPEED OF THE PROJECTILE

Pedagogical Intentions

- Students will discover that varying the initial speed (launch speed) influences the distance traveled by the projectile.

Materials

- Interactive simulation [PHET: Projectile Motion]
- Chromebook, computer or tablet
- Student Handbook p. 9-10

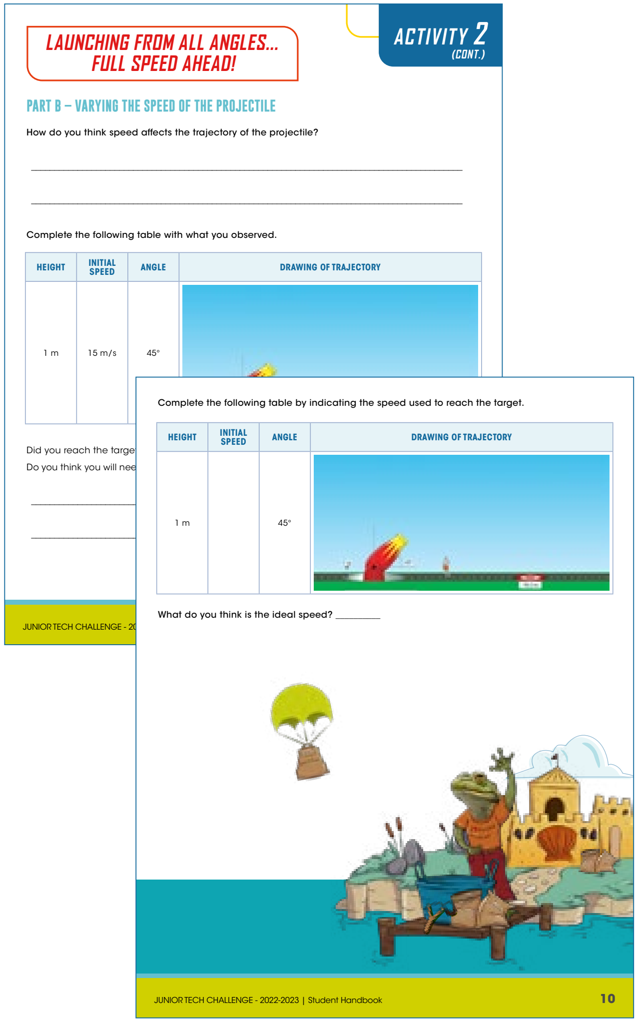
Procedure

In teams of two:

1. While using the simulator, students complete the table in their Student Handbook (p. 9).
2. Ask students whether or not they have reached the target.
3. Ask students to provide a hypothesis to predict whether to increase the initial speed or decrease it in order for the projectile to reach the target. Provide a tentative explanation.

With the whole class:

4. Compare the answers arrived at.
5. Ask students what think is the ideal speed.
6. Lead the students to conclude that the initial velocity is directly proportional to the distance traveled by the projectile.


LAUNCHING FROM ALL ANGLES… FULL SPEED AHEAD!

ACTIVITY 2 (CONT.)

PART B – VARYING THE SPEED OF THE PROJECTILE

How do you think speed affects the trajectory of the projectile?

Complete the following table with what you observed.

HEIGHT	INITIAL SPEED	ANGLE	DRAWING OF TRAJECTORY
1 m	15 m/s	45°	

Did you reach the targe

Do you think you will nee

JUNIOR TECH CHALLENGE - 20

Complete the following table by indicating the speed used to reach the target.

HEIGHT	INITIAL SPEED	ANGLE	DRAWING OF TRAJECTORY
1 m		45°	

What do you think is the ideal speed? ________

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ACTIVITY 2 – LAUNCHING FROM ALL ANGLES... FULL SPEED AHEAD! *(CONT.)*

LAUNCHING FROM ALL ANGLES... FULL SPEED AHEAD!

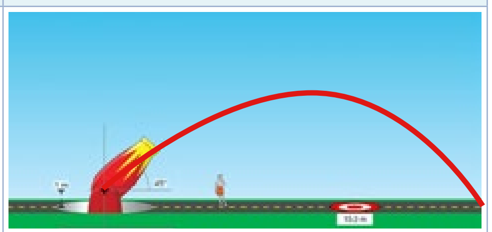
ACTIVITY 2 *(CONT.)*

PART B – VARYING THE SPEED OF THE PROJECTILE

How do you think speed affects the trajectory of the projectile?

Sample answer: I think that the greater the speed, the further the projectile will go.

Complete the following table with what you observed.

HEIGHT	INITIAL SPEED	ANGLE	DRAWING OF TRAJECTORY
1 m	15 m/s	45°	

Did you reach the target? No

Do you think you will need to increase the initial speed or decrease it to reach the target? Explain why.

Sample answer: I should reduce the speed because, if my hypothesis was correct, the projectile will not go as far.

Complete the following table by indicating the speed used to reach the target.

HEIGHT	INITIAL SPEED	ANGLE	DRAWING OF TRAJECTORY
1 m	12 m/s	45°	

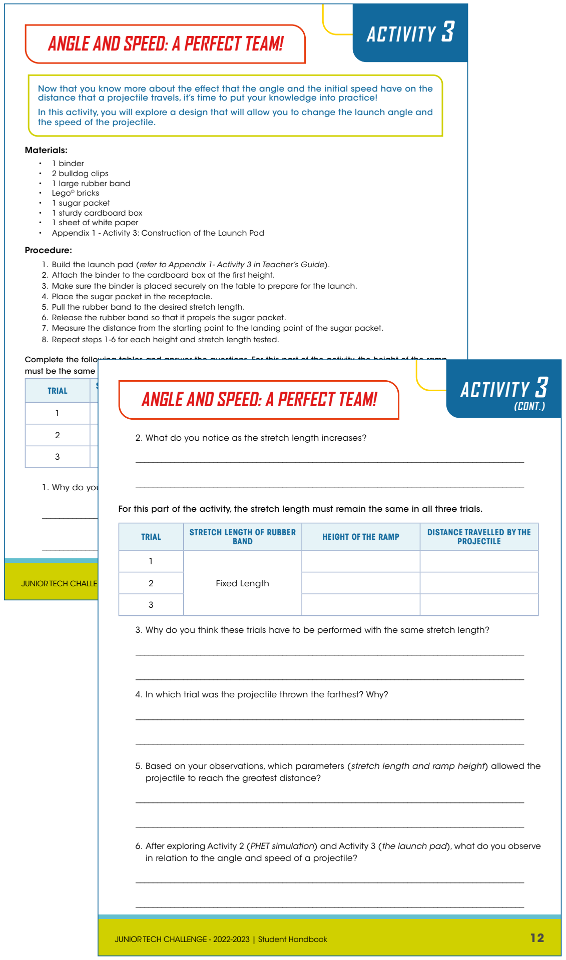
What do you think is the ideal speed? ________

The ideal speed is 12 because at 11 m/s the object does not reach the target, and at 13 m/s the object passes the target.

ACTIVITY 3 – ANGLE AND SPEED: A PERFECT TEAM!

Pedagogical Intentions

- Allow students to build on what they learned in the previous activity by varying the angle of the inclined plane and the speed at which the projectile is launched. Ultimately, they will find that for any given speed, the optimal angle to reach the greatest distance is 45°.



ANGLE AND SPEED: A PERFECT TEAM!

ACTIVITY 3

Now that you know more about the effect that the angle and the initial speed have on the distance that a projectile travels, it's time to put your knowledge into practice!

In this activity, you will explore a design that will allow you to change the launch angle and the speed of the projectile.

Materials:

- 1 binder
- 2 bulldog clips
- 1 large rubber band
- Lego© bricks
- 1 sugar packet
- 1 sturdy cardboard box
- 1 sheet of white paper
- Appendix 1 - Activity 3: Construction of the Launch Pad

Procedure:

1. Build the launch pad (*refer to Appendix 1- Activity 3 in Teacher's Guide*).
2. Attach the binder to the cardboard box at the first height.
3. Make sure the binder is placed securely on the table to prepare for the launch.
4. Place the sugar packet in the receptacle.
5. Pull the rubber band to the desired stretch length.
6. Release the rubber band so that it propels the sugar packet.
7. Measure the distance from the starting point to the landing point of the sugar packet.
8. Repeat steps 1-6 for each height and stretch length tested.

Complete the follo… must be the same …

TRIAL
1
2
3

1. Why do yo…

JUNIOR TECH CHALLE…

ANGLE AND SPEED: A PERFECT TEAM!

ACTIVITY 3 (CONT.)

2. What do you notice as the stretch length increases?

For this part of the activity, the stretch length must remain the same in all three trials.

TRIAL	STRETCH LENGTH OF RUBBER BAND	HEIGHT OF THE RAMP	DISTANCE TRAVELLED BY THE PROJECTILE
1	Fixed Length		
2			
3			

3. Why do you think these trials have to be performed with the same stretch length?
4. In which trial was the projectile thrown the farthest? Why?
5. Based on your observations, which parameters (*stretch length and ramp height*) allowed the projectile to reach the greatest distance?
6. After exploring Activity 2 (*PHET simulation*) and Activity 3 (*the launch pad*), what do you observe in relation to the angle and speed of a projectile?

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Materials

- 1 binder
- 1 large rubber band (this type)
- 1 sugar packet
- 1 sheet of white paper
- 2 Bulldog clips
- Lego© bricks
- 1 sturdy cardboard box
- Appendix 1 - Activity 3: Construction of the Launch Pad
  Note: Appendix 1 only appears in the Teacher's Guide. You may choose to project the document on the board or print it for your teams.
- Student Handbook p. 11-12

Procedure

In teams:

1. Attach the binder to the cardboard box at the first height.
2. Make sure the binder is firmly secured for the launch.
3. Place the sugar packet in the receptacle of the launch pad.
4. Pull the rubber band to the desired stretch length.
5. Release the rubber band to launch the sugar packet.
6. Measure the distance travelled between the starting position and the landing point of the sugar packet.
7. Repeat steps 1- 6 using different ramp heights and stretch lengths.

With the whole class:

8. Compare the answers arrived at.
9. Ask students what the relationship is between the stretch of the rubber band, the height of the ramp, and the distance traveled.

ACTIVITY 3 – ANGLE AND SPEED: A PERFECT TEAM! (CONT.)

ACTIVITY 3

ANGLE AND SPEED: A PERFECT TEAM!

Now that you know more about the effect that the angle and the initial speed have on the distance that a projectile travels, it's time to put your knowledge into practice!

In this activity, you will explore a design that will allow you to change the launch angle and the speed of the projectile.

Materials:

- 1 binder
- 2 bulldog clips
- 1 large rubber band
- Lego© bricks
- 1 sugar packet
- 1 sturdy cardboard box
- 1 sheet of white paper
- Appendix 1 - Activity 3: Construction of the Launch Pad

Procedure:

1. Build the launch pad (*refer to Appendix 1- Activity 3 in Teacher's Guide*).
2. Attach the binder to the cardboard box at the first height.
3. Make sure the binder is placed securely on the table to prepare for the launch.
4. Place the sugar packet in the receptacle.
5. Pull the rubber band to the desired stretch length.
6. Release the rubber band so that it propels the sugar packet.
7. Measure the distance from the starting point to the landing point of the sugar packet.
8. Repeat steps 1-6 for each height and stretch length tested.

Complete the following tables and answer the questions. For this part of the activity, the height of the ramp must be the same in all three trials.

TRIAL	STRETCH LENGTH OF RUBBER BAND	HEIGHT OF THE RAMP	DISTANCE TRAVELLED BY THE PROJECTILE
1	Answers		Answers
2	may vary.	Fixed Position	may vary.
3			

1. Why do you think these trials have to be performed with the ramp in a fixed position?

If the ramp height is constant, we can see a pattern on the effect of the velocity on the projectile.

ACTIVITY 3 (CONT.)

ANGLE AND SPEED: A PERFECT TEAM!

2. What do you notice as the stretch length increases?

The longer the stretch, the greater the speed and the further the projectile will go.

For this part of the activity, the stretch length must remain the same in all three trials.

TRIAL	STRETCH LENGTH OF RUBBER BAND	HEIGHT OF THE RAMP	DISTANCE TRAVELLED BY THE PROJECTILE
1		Answers	Answers
2	Fixed Length	may vary.	may vary.
3			

3. Why do you think these trials have to be performed with the same stretch length?

With the same stretch length (constant velocity), it is possible to see the effect that the height of the ramp will have on the distance covered by the projectile.

4. In which trial was the projectile thrown the farthest? Why?

Answers may vary.

5. Based on your observations, which parameters (*stretch length and ramp height*) allowed the projectile to reach the greatest distance?

For the projectile to reach the greatest distance, the stretch of the rubber band must be at its maximum and the angle must be close to 45 degrees (This is an average of the speed and the angle).

6. After exploring Activity 2 (*PHET simulation*) and Activity 3 (*the launch pad*), what do you observe in relation to the angle and speed of a projectile?

Sample answer: In both activities, it can be concluded that the greater the velocity of the projectile and the closer the angle is to 45o, the greater the distance the projectile will travel.

ACTIVITY 4 – SOLID STRUCTURES

Pedagogical Intention

- Students will build and then compare the structures of solids to determine which characteristics make them strong.

Material

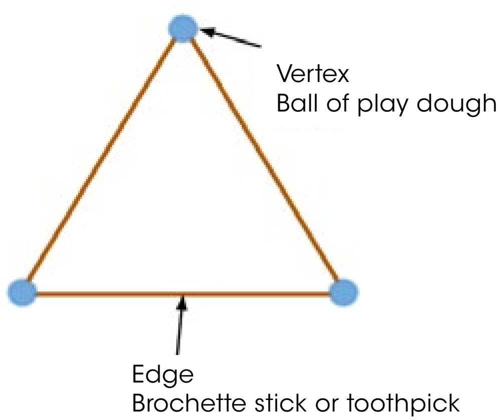
- 20 sticks of equal length per team (brochette sticks, toothpicks) to build the edges of the structure
  Note: We suggest that you prepare the sticks in advance by cutting the pointed ends off with a pair of scissors or shears.
- Modeling clay or adhesive putty to build the vertices of the solid
- Student Handbook p. 13-14

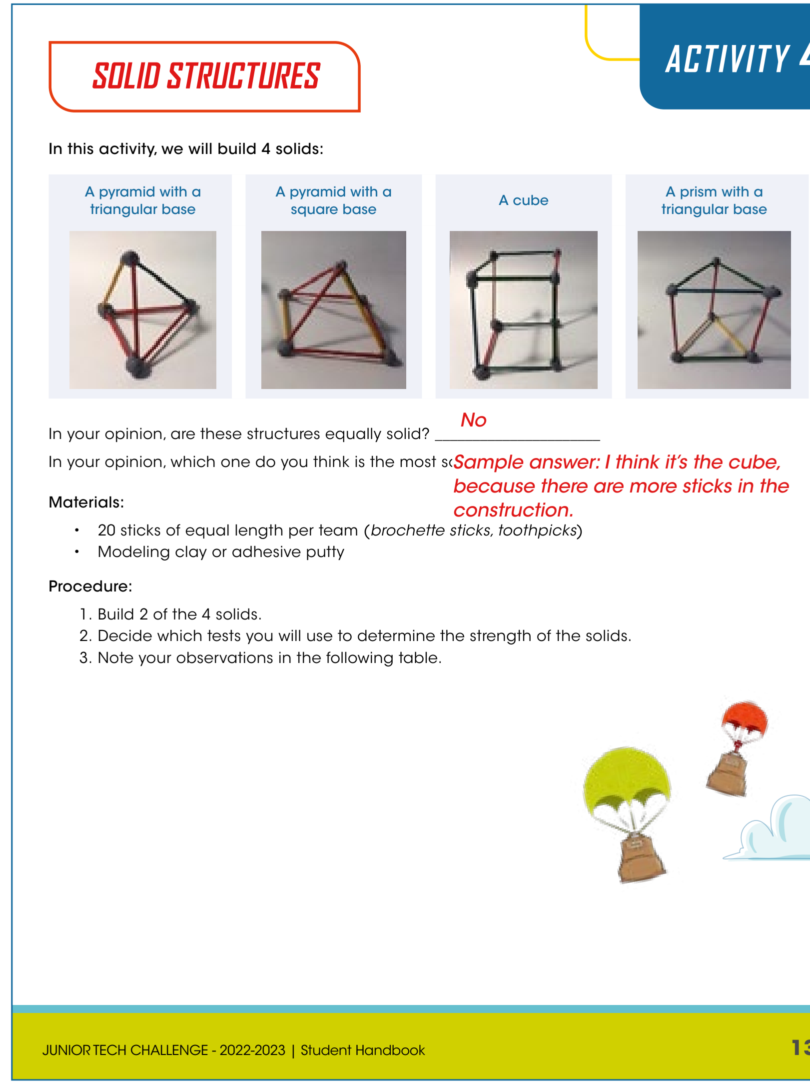
Procedure

With the whole class:

Introduce the activity to the students by referring to page 13 of the Student Handbook.

1. In teams of two, students will build 2 of the 4 solids:
   - Half the class will build a triangular prism, and a triangular pyramid.
   - The other half will build a cube and a square pyramid.
   - Explain the procedure for using the sticks and the play dough to build these solids by using the following diagram.





SOLID STRUCTURES

ACTIVITY 4

In this activity, we will build 4 solids:

A pyramid with a triangular base	A pyramid with a square base	A cube	A prism with a triangular base

In your opinion, are these structures equally solid? *No*

In your opinion, which one do you think is the most s*Sample answer: I think it's the cube, because there are more sticks in the construction.*

Materials:

- 20 sticks of equal length per team (*brochette sticks, toothpicks*)
- Modeling clay or adhesive putty

Procedure:

1. Build 2 of the 4 solids.
2. Decide which tests you will use to determine the strength of the solids.
3. Note your observations in the following table.

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ACTIVITY 4 – SOLID STRUCTURES (CONT.)

In teams of two:

2. Build 2 solids.

With the whole class:

3. Discuss the kinds of tests students can perform to test the strength of the solids. These may vary from team to team, but it is important to ensure that each team uses the same tests for both solids.

Suggestions:

- Press on the edges.
- Press on the vertices.
- Place an object on the solid.

4. Ask students to choose one or two of these suggestions to test the strength of the solids, and to complete the table in their Student Handbook (*p. 14*).

In teams of two :

5. Perform the strength tests.

6. Ask students to record their observations in the table on page 14 of their Student Handbook.

With the whole class:

7. Review the tests performed and reach a conclusion.

8. An additional challenge:

- Review the structures analyzed in Activity 1, and identify if triangle-shaped structures were used.
- Attempt to strengthen the solids with rectangular sides by adding sticks to it. Note that additional sticks of varying lengths will be needed.

ACTIVITY 4 (CONT.)

SOLID STRUCTURES

DESCRIPTION OF TESTS	*Sample answer: I placed my solid on my desk and pushed on the vertices.*			
SOLIDS TESTED	*Prism with a triangular base*	*Pyramid with a triangular base*		
MY OBSERVATIONS	*When I pressed the vertices at the top of my solid, my solid collapsed.*	*When I pressing on the vertices at the top of my solid, my solid kept its shape.*		
DRAW AN X ON THE STRONGEST SOLID.		*X*		

Which solid is the strongest? *The pyramids, especially the ones with a triangular base.*

Which geometric shape is found in the strongest solids? *The triangle*

Could you suggest a way to strengthen certain solids?

Where there are rectangular shapes in the structure, a stick could be added diagonally to create triangles. It could be attached to the inside of the solid, to one side or to the outside.

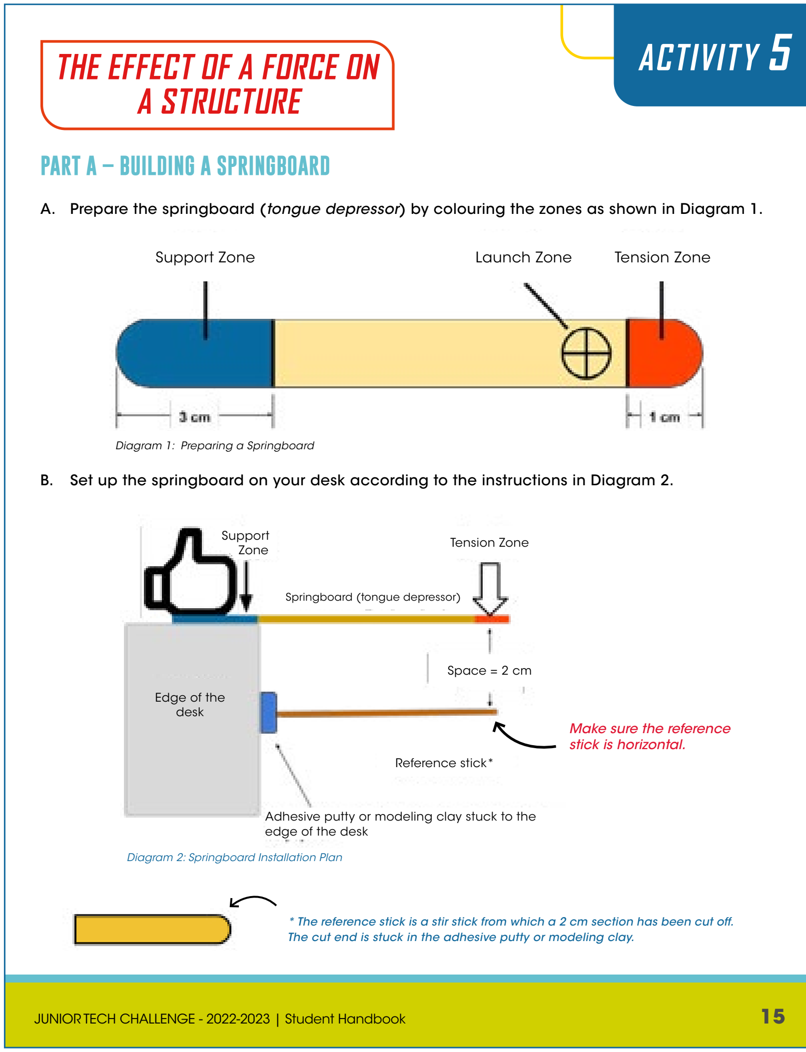
ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE

Pedagogical Intention

- Explore the conditions necessary for a springboard to build up enough energy to launch a ball of clay.

Materials for all three parts of this activity:

- 3 tongue depressors
  Tongue depressors are used instead of stir sticks because they are thin and flexible. The rigidity of stir sticks does not lead to the desired effects with respect to the concepts studied in these activities.
- 1 stir stick (from which a 2 cm section has been cut off)
  It can be cut ahead of time (see plan in the Student Handbook). A tongue depressor or plastic stir stick can also be used.
- 1 small ball of adhesive putty
  Modeling clay can also be used, but adhesive putty supports the stir stick better.
- A 15 or 30 cm ruler
- Red marker
- Blue marker
- Black marker
- A desk
- 2.5 cm diameter (approximately 15 g) ball of modeling clay
- Student Handbook p. 15-20


ACTIVITY 5

THE EFFECT OF A FORCE ON A STRUCTURE

PART A – BUILDING A SPRINGBOARD

A. Prepare the springboard (*tongue depressor*) by colouring the zones as shown in Diagram 1.

Diagram 1: Preparing a Springboard

B. Set up the springboard on your desk according to the instructions in Diagram 2.

Diagram 2: Springboard Installation Plan

** The reference stick is a stir stick from which a 2 cm section has been cut off. The cut end is stuck in the adhesive putty or modeling clay.*

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ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE (CONT.)

PART A – BUILDING A SPRINGBOARD

Pedagogical Intention:

- To build a springboard that will enable students to analyze the effects that different applied forces have on it.

Procedure

With the whole class:

1. Discuss the concept of a force applied on an object. Allow students to express their opinions.

   Sample questions:
   - What happens when I apply force to a ball of clay with my hand?
   - What happens when I apply force with my feet on the end of a diving board?
   - What happens when I apply force by pulling on the ends of a rubber band? When I release it?
   - What happens when I apply force to a pole while pole vaulting?
2. Explain task to students: To build a device (in this case, a springboard) that will allow students to observe the effects of a force applied to a structure.
3. Present Diagrams 1 and 2 on page 15 of the Student Handbook to guide students into building the simple catapult.
   a. Diagram 1: Preparing a Springboard
   b. Diagram 2: Springboard installation plan provides instructions on how to install the springboard to the edge of the desk.
   c. Students must follow the instructions illustrated in both diagrams.
4. Present and distribute the material that will be used by each team to build a springboard: 1 tongue depressor, 1 stir stick (or tongue depressor) and adhesive putty.

In teams of two:

5. Ask students to draw and colour the springboard zones on the tongue depressor while respecting the instructions in Diagram 1.
6. Ask the students to install the springboard on the edge of their desk as shown in Diagram 2. Adjustments may be necessary since the size of the desks may vary from one team to another or from one class to another.
   - It is important to respect the 2 cm space between the springboard and the reference stick (as much as possible).
   - The springboard must not be fixed to the desk. It must be manually held in place.

With the whole class:

7. Discuss the difficulties that were encountered, and the solutions found to solve the problems.
8. Inform students that the springboard they just built will be used in the next activities.

ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE (CONT.)

PART B – A FLEXIBLE STRUCTURE

Pedagogical Intention

- To determine the different amounts of force needed for different structures.

This task supports the development of the following strategies:

- Exploration strategies
  - Becoming aware of his or her previous representations.
  - Formulating questions.
  - Anticipating the results of his or her approach.
  - Using empirical approaches (*e.g. trial and error, analysis, exploration using one's senses*).
- Strategies for recording, using and interpreting information
  - Using a variety of observational techniques and tools.
  - Using different tools for recording information (*e.g. diagrams, notes, graphs, procedures, logbook*).
- Communication strategies
  - Exchanging information.

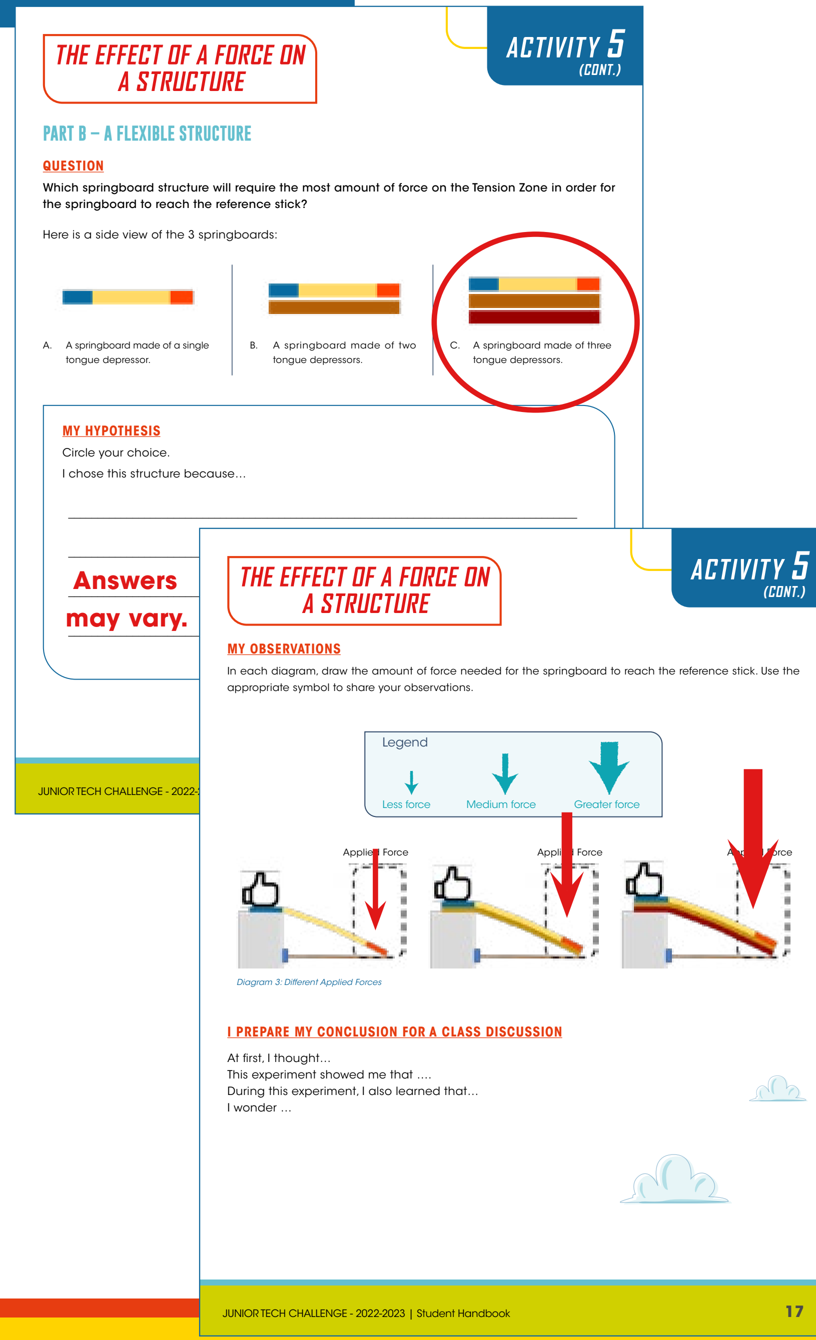
Research Question:

- Which structure will require the most amount of force on the Tension Zone in order for the springboard to reach the reference stick?

Procedure

With the whole class:

1. Present the activity to students and explain that they will make observations about the rigidness of the springboard.
2. Using multiple tongue depressors, present the side view of the three structures of springboards. Refer to the diagrams of the structures on page 16 of the Student Handbook. These tongue depressors show a side view of the thickness of the springboard. It may be necessary to present these views to the students by manipulating the tongue depressors in front of them.


THE EFFECT OF A FORCE ON A STRUCTURE

ACTIVITY 5 (CONT.)

PART B – A FLEXIBLE STRUCTURE

QUESTION

Which springboard structure will require the most amount of force on the Tension Zone in order for the springboard to reach the reference stick?

Here is a side view of the 3 springboards:

A. A springboard made of a single tongue depressor.

B. A springboard made of two tongue depressors.

C. A springboard made of three tongue depressors.

MY HYPOTHESIS

Circle your choice.

I chose this structure because…

Answers may vary.

JUNIOR TECH CHALLENGE - 2022-

THE EFFECT OF A FORCE ON A STRUCTURE

ACTIVITY 5 (CONT.)

MY OBSERVATIONS

In each diagram, draw the amount of force needed for the springboard to reach the reference stick. Use the appropriate symbol to share your observations.

Diagram 3: Different Applied Forces

I PREPARE MY CONCLUSION FOR A CLASS DISCUSSION

At first, I thought…
This experiment showed me that ….
During this experiment, I also learned that…
I wonder …

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ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE (CONT.)

3. Read the Research Question with the students while presenting each of the three springboards and the three hypotheses in the Student Handbook. Question students to ensure that they understand the Research Question.
4. Ask students to circle the image that represents their choice and to explain why they made this choice.
5. Ask a few students to share their hypothesis. Do not hesitate to question them to help them clarify their ideas and link them to observations, past experiences, etc.
6. Discuss the steps they will have to take to complete this experiment.
   Advise the students that when the springboard is made of many layers, the coloured tongue depressor must be on top.
   - One or two fingers should be used to push on the Tension Zone.
   - The student must bend each springboard until it reaches the reference stick (*2 cm*).

In teams of two:

7. Hand out 2 tongue depressors to each team.
8. Ask students to set up their springboard and reference stick if this was not already done (*see Part A*).
9. Ask students to carry out the experiment and to note down their results. They can use the legend on page 17 of their Student Handbook to identify the amount of force needed for each springboard to reach the reference stick.
10. Students may repeat the experiments many times to validate their observations.
11. Ask students to put their material away (*unless Part C is to be done immediately after Part B*).

With the whole class:

12. Reflect on the experiment using the questions in the Student Handbook. Remind students of their original hypothesis. Review the results of the experiment with them. Discuss what they learned. Lead them into creating a new question about their experience.

ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE (CONT.)

PART C – THE LAUNCH

Pedagogical Intention

- Determine which structure will project a ball of clay the highest when a force is applied it.

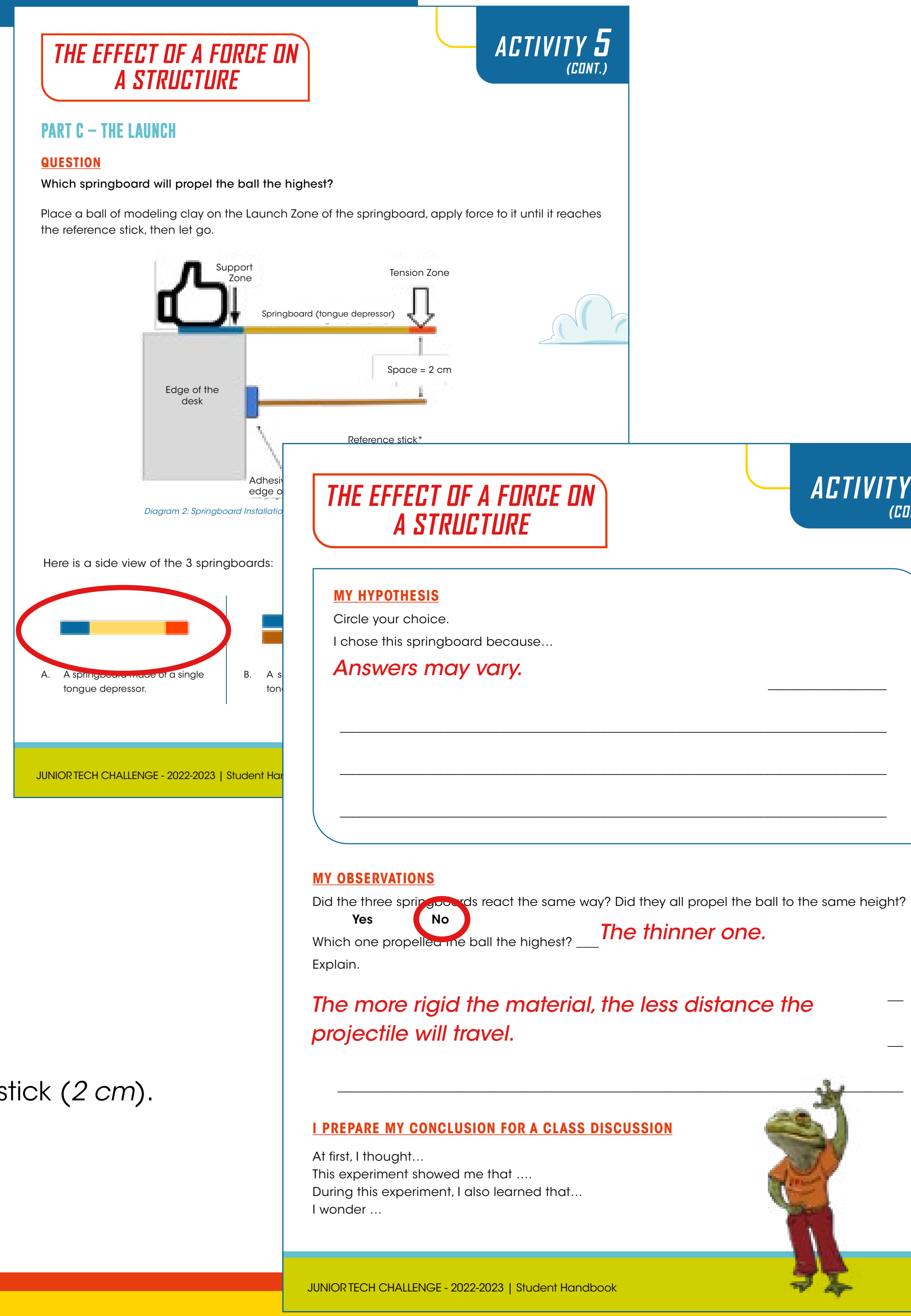
Research Question:

- When you place a ball of clay on the Launch Zone, and bend the springboard to reach the reference stick, which springboard will launch the ball the highest?

Procedure

With the whole class:

1. Present the activity to the students and explain that they will observe how a springboard propels an object.
2. Read the Research Question with the students while presenting each of the three springboards and the three hypotheses in the Student Handbook. Question students to ensure that they understand the Research Question.
3. Ask students to circle the image that represents their choice and to explain why they made that choice.
4. Ask a few students to share their hypothesis. Do not hesitate to question them so they can clarify their ideas and relate them to observations, past experiences, etc.
5. Tell students that when the springboard is made of multiple layers, the coloured tongue depressor must be on top.
   - One or two fingers should be used to push on the Tension Zone.
   - The student must bend each springboard until it reaches the reference stick (*2 cm*).



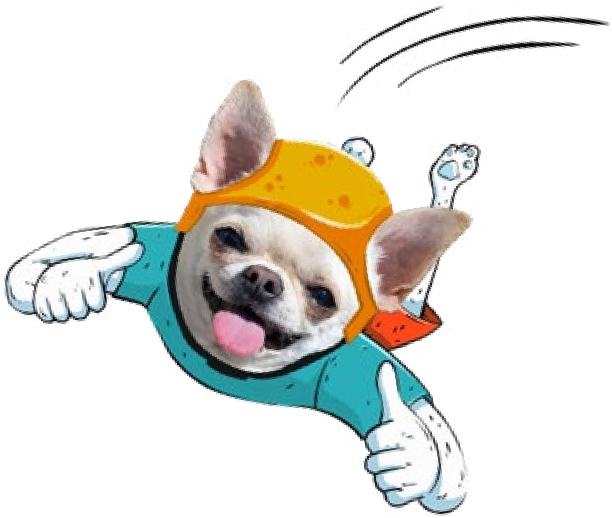
ACTIVITY 5 – THE EFFECT OF A FORCE ON A STRUCTURE (CONT.)

In teams of two:

6. Hand out one ball of clay per team.
7. Ask students to set up their springboard and reference stick if not already done (see Part A).
8. Ask students to carry out the experiment and to note their results in their Student Handbook.
9. Allow time to put the material away.

With the whole class:

10. Reflect on the experiment using the questions in the Student Handbook. Remind students of their original hypothesis. Review the results of the experiment with them. Discuss what they learned. Lead them into creating a new question about their experience.



PREPARING TO MEET THE CHALLENGE

Pedagogical Intention

- To consolidate the learning acquired during the process of designing a prototype.

Materials

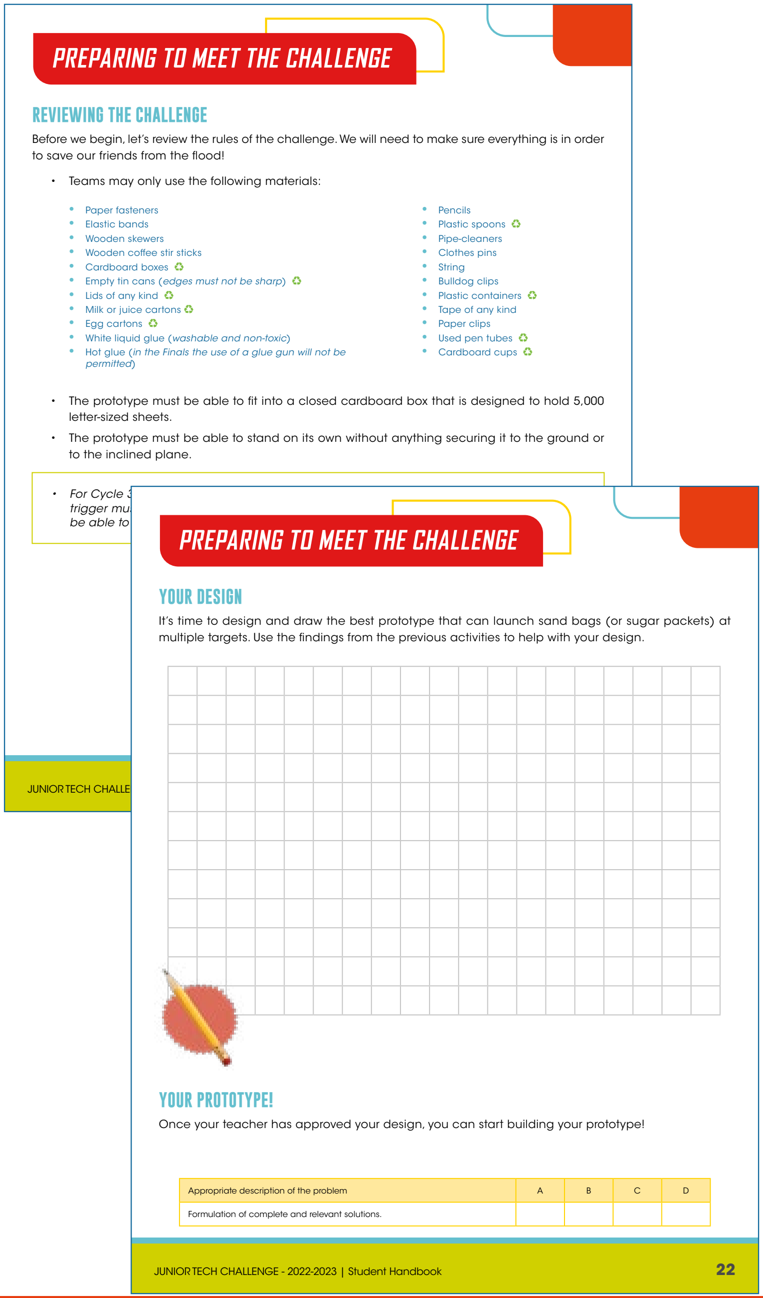
- Rules
- Slideshow
- Materials necessary to build the prototype
- 3 small aluminium trays (*about 19 cm x 14 cm x 5 cm*)
- 6 large aluminium trays (*about 22 cm x 16 cm x 6 cm*)
- Inclined Plane (*See Rules p. 10*)
- Student Handbook p. 21, 22

Setting the Scene

For the Finals of the Junior Tech Challenge, students will be asked to build a prototype that launches sugar packets at multiple targets.

Procedure

1. Use presentation slides to review the rules of the challenge.
2. Use Student Handbook to review the hypotheses discussed during the activities.
3. Ask the following questions to review and discuss what was learned from completing the activities:
   - How do you vary the launch angle?
   - Will you use materials that are flexible, rigid, or both? For which part(s) of your prototype?
   - How will you ensure that your prototype is strong enough to launch sugar packets?
4. Arrange students into teams of 1-3.
5. Before building their prototype, each team must:
   - Select the materials they will use.
   - Draw a sketch of their prototype on page 22 in their Student Handbook.


PREPARING TO MEET THE CHALLENGE

REVIEWING THE CHALLENGE

Before we begin, let's review the rules of the challenge. We will need to make sure everything is in order to save our friends from the flood!

- Teams may only use the following materials:
  - Paper fasteners
  - Elastic bands
  - Wooden skewers
  - Wooden coffee stir sticks
  - Cardboard boxes ♻
  - Empty tin cans (*edges must not be sharp*) ♻
  - Lids of any kind ♻
  - Milk or juice cartons ♻
  - Egg cartons ♻
  - White liquid glue (*washable and non-toxic*)
  - Hot glue (*in the Finals the use of a glue gun will not be permitted*)
  - Pencils
  - Plastic spoons ♻
  - Pipe-cleaners
  - Clothes pins
  - String
  - Bulldog clips
  - Plastic containers ♻
  - Tape of any kind
  - Paper clips
  - Used pen tubes ♻
  - Cardboard cups ♻
- The prototype must be able to fit into a closed cardboard box that is designed to hold 5,000 letter-sized sheets.
- The prototype must be able to stand on its own without anything securing it to the ground or to the inclined plane.

JUNIOR TECH CHALLE

PREPARING TO MEET THE CHALLENGE

YOUR DESIGN

It's time to design and draw the best prototype that can launch sand bags (or sugar packets) at multiple targets. Use the findings from the previous activities to help with your design.

YOUR PROTOTYPE!

Once your teacher has approved your design, you can start building your prototype!

Appropriate description of the problem	A	B	C	D
Formulation of complete and relevant solutions.				

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TESTING MY PROTOTYPE

Material

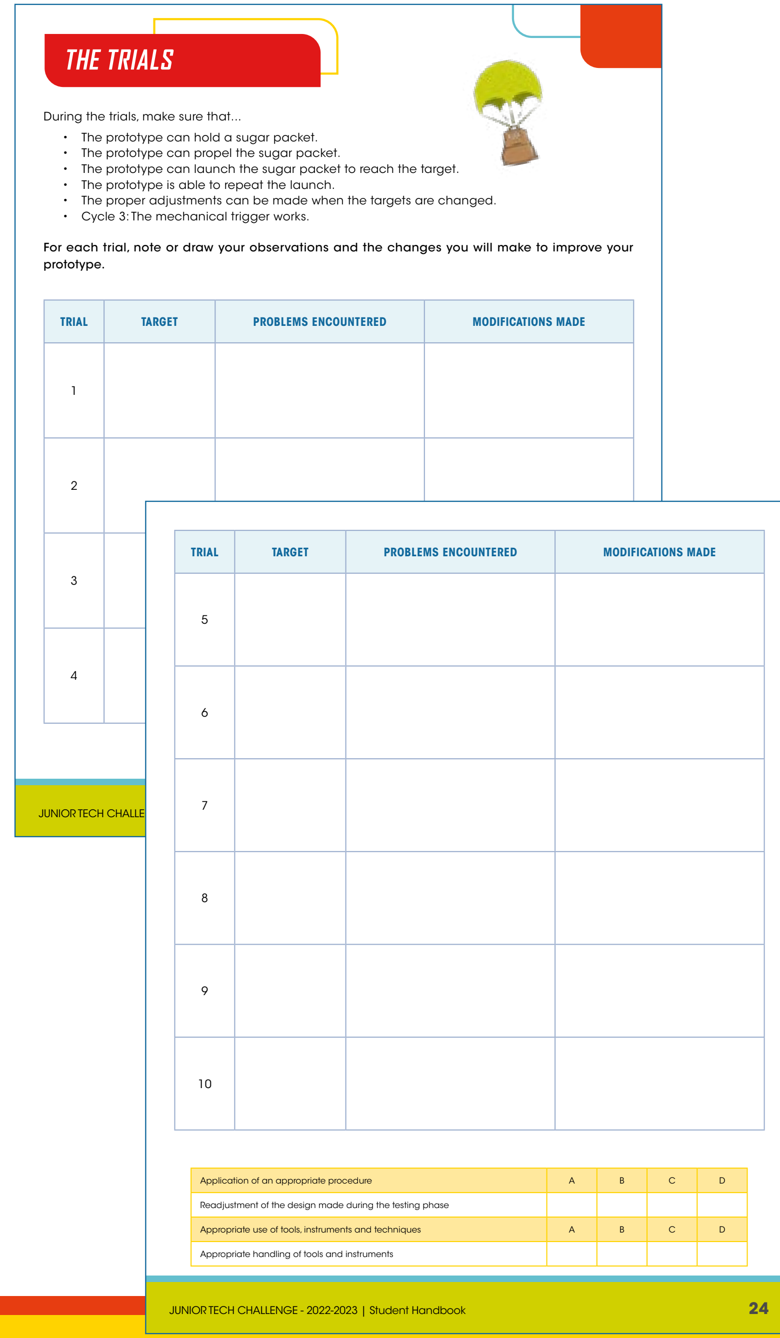
- Student Handbook p. 23, 24

Setting the Scene

For the finals of the Junior Tech Challenge, students will be asked to build a prototype that launches sugar packets at multiple targets.

Procedure

1. Each team designs their prototype to prepare for testing.
2. Before the trials, students must be reminded to verify that…
   - the prototype must be able to hold a sugar packet.
   - the prototype must be able to fit into a cardboard box designed to hold 5,000 letter-size sheets of paper, with the lid closed.
   - the prototype must be able to stand on the ground or on the inclined plane on its own.
   - in Cycle 3, the prototype must have a mechanical trigger.
   - there are several ways to vary the launch angle.
   - there are several ways to vary the launch speed.
3. Students note the performance of their prototype, the problems they encounter, and the modifications they make, in the table of their Student Handbook pages 23-24.
4. During the testing of the prototype, the teacher accompanies the students by questioning, encouraging and guiding them in their adjustments. The teacher also collects information on how students use the assembly techniques, and how they observe and solve problems.



THE TRIALS

During the trials, make sure that...

- The prototype can hold a sugar packet.
- The prototype can propel the sugar packet.
- The prototype can launch the sugar packet to reach the target.
- The prototype is able to repeat the launch.
- The proper adjustments can be made when the targets are changed.
- Cycle 3: The mechanical trigger works.

For each trial, note or draw your observations and the changes you will make to improve your prototype.

TRIAL	TARGET	PROBLEMS ENCOUNTERED	MODIFICATIONS MADE
1			
2			
3			
4			

JUNIOR TECH CHALLE

TRIAL	TARGET	PROBLEMS ENCOUNTERED	MODIFICATIONS MADE
5			
6			
7			
8			
9			
10			

Application of an appropriate procedure	A	B	C	D
Readjustment of the design made during the testing phase				
Appropriate use of tools, instruments and techniques	A	B	C	D
Appropriate handling of tools and instruments				

JUNIOR TECH CHALLENGE - 2022-2023 | Student Handbook 24

THE COMPETITION

Material

- Student Handbook p. 25

Procedure

You will find all the information on how to run the class competition on pages 4-8 in the Presentation and Rules. Here are some details to remember for the organization of the finals:

1. Ensure that all students of the same cycle complete the challenge under the same conditions.
2. Once the competition is over, ask students to record their scores on page 25 of their Student Handbook.

THE COMPETITION

Are you satisfied with your prototype? You are excited to show it to your friends who believed that your creativity could save them. You are now ready for the launch!

It's time to carry out the final test of your prototype.

The points will be calculated in this way:

Result of Round 1 *(Zones + Targets)* + Result of Round 2 *(Zones + Targets)* = Total points

During the competition, you must...

- Install your prototype on the ground or on the inclined plane at the start line.
- Wait for the signal to start.
- Activate the mechanism of your prototype.
- Launch 10 packets of sugar within a maximum of 2 minutes.
- Remember that your turn ends when you either run out of sugar packets, or time runs out.

NUMBER OF SUGAR PACKETS IN...			POINTS Cycle 1	POINTS Cycles 2 and 3	TOTAL POINTS
A	Zone		x 30 points	x 10 points	
	Left/right target		x 240 points	x 40 points	
	Center target		x 350 points	x 150 points	
B	Zone		x 20 points	x 20 points	
	Left/right target		x 140 points	x 140 points	
	Center target		x 250 points	x 250 points	
C	Zone		x 10 points	x 30 points	
	Left/right target		x 40 points	x 240 points	
	Center target		x 150 points	x 350 points	
			TOTAL		

JUNIOR TECH CHALLENGE - 2022-2023 | Student Handbook 25

REVIEW AND REFLECT

Pedagogical Intentions

- To consolidate learning.
- To review the design and construction of the prototype, as well as the strategies used to complete the challenge.

Material

- Student Handbook p. 26

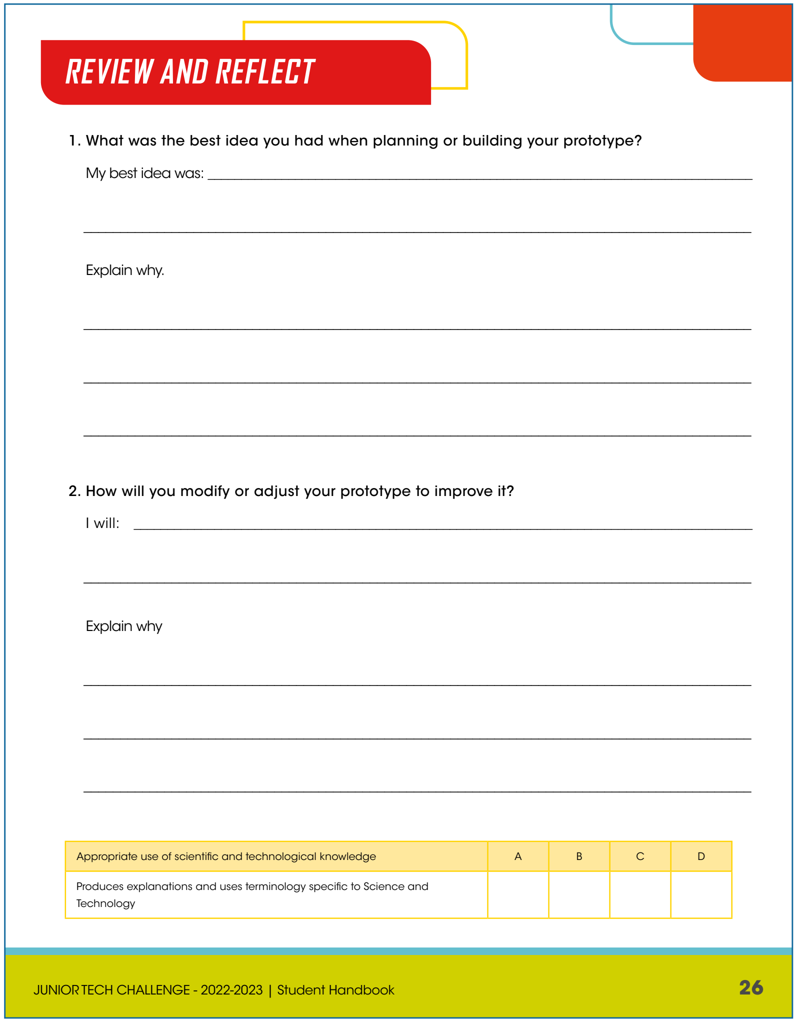
Procedure

Review and discuss the following questions as a group, then invite students to complete page 26 of their Student Handbook on their own.

1. Compare the different properties of the prototypes:
    - What made some prototypes more accurate and reliable?
    - Was the choice of materials appropriate?
2. Ask students about the strategies they used. Were some more effective than others?
3. Have students analyze their performance using the questions on page 26 of their Student Handbook.
4. Ask students to discuss what they learned from this project.

Frequently Asked Questions

The frequently asked questions are updated every week. Consult Foire aux questions regularly, and do not hesitate to send us your questions.


REVIEW AND REFLECT

1. What was the best idea you had when planning or building your prototype?

My best idea was: ______________________________

Explain why.

____

2. How will you modify or adjust your prototype to improve it?

I will: ______________________________

Explain why

____

Appropriate use of scientific and technological knowledge	A	B	C	D
Produces explanations and uses terminology specific to Science and Technology				

JUNIOR TECH CHALLENGE - 2022-2023 | Student Handbook 26

EVALUATION GRID-SCIENCE AND TECHNOLOGY

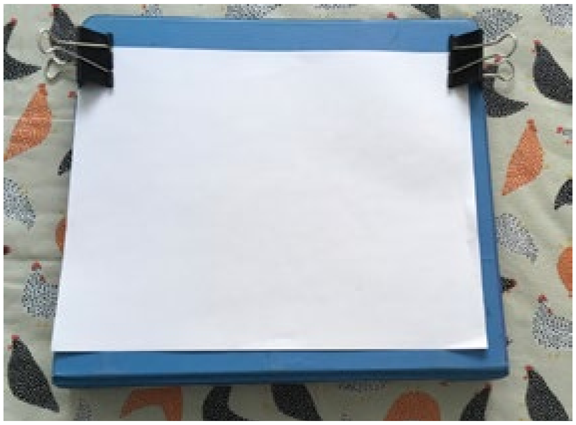
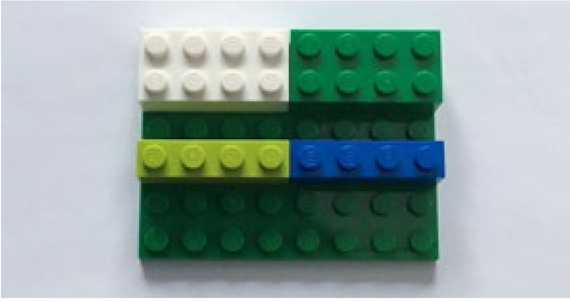
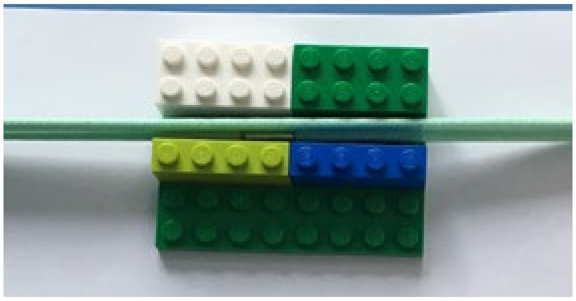
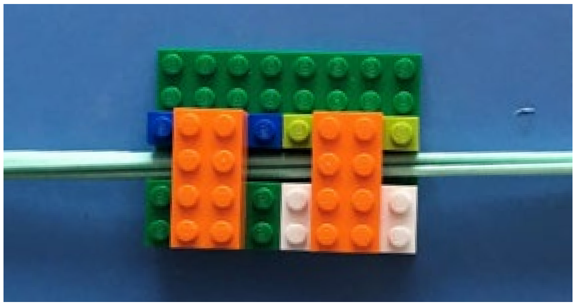
<table>
<tr><th>EVALUATION CRITERIA</th><th>A</th><th>B - C - D</th></tr>
<tr><td rowspan="3">Appropriate description of the problem</td><td rowspan="3">Formulation of complete and relevant solutions
(Student Handbook and observations made in class)
The student proposes relevant solutions of the design, orally or through the sketch drawn in the Student Handbook:
• The prototype has a receptacle to hold the sugar packet;
• The prototype has a place to launch the sugar packet;
• The prototype has a base that allows it to be placed on the ground or the inclined plane.
Note: We are not assessing the efficacy of the design. We want to check whether the student can identify the important elements of the design, and to propose possible solutions before its construction.</td><td>B : The student proposes a relevant solution, either orally or in writing, that addresses two of the three constraints mentioned in A.</td></tr>
<tr><td>C : The student proposes a relevant solution, either orally or in writing, that addresses only one of the constraints listed in A.</td></tr>
<tr><td>D : The student does not propose any relevant solutions either orally or in the Student Handbook.</td></tr>
<tr><td rowspan="3">Application of an appropriate procedure</td><td rowspan="3">Readjustment of the design made during the testing phase
(Student Handbook and observations made in class)
During the testing phase, the student identifies three problems encountered, and offers a number of relevant solutions for each, either orally or written.
Note: The solutions proposed do not necessarily have to be successful.
Some trials may be successful. Either way, evaluate trials where a problem and a modification have been described.</td><td>B : During the testing phase, the student identifies two problems encountered, and offers a number of relevant solutions for each, either orally or in writing.</td></tr>
<tr><td>C : During the testing phase, the student identifies one problem encountered, and offers a relevant solution, either orally or in writing.</td></tr>
<tr><td>D : During the testing phase, the student does not identify any problems.</td></tr>
<tr><td rowspan="2">Appropriate use of instruments, tools or techniques</td><td rowspan="2">Appropriate handling of tools and instruments
(Observations made in class and on the prototype.)
The student appropriately uses the techniques taught in class.</td><td>B-C : The student appropriately uses the techniques taught in class. Some difficulties are observed.</td></tr>
<tr><td>D : The student does not appropriately use the techniques taught in class.</td></tr>
<tr><td rowspan="3">Appropriate use of scientific and technological knowledge</td><td rowspan="3">Produces explanations and uses terminology specific to Science and Technology
(Student Handbook)
The student summarizes:
• by describing their best idea AND a modification;
• by using the terminology specific to Science and Technology.</td><td>B : The student summarizes by describing their best idea AND a modification. Some awkwardness is observed.</td></tr>
<tr><td>C : The student summarizes by describing their best idea OR its modification, and by using the terminology specific to Science and Technology.</td></tr>
<tr><td>D : The student simply presents their ideas without any explanation, or the explanation provided is not based on Science and Technology.</td></tr>
</table>

PEDAGOGICAL RESOURCES *(FRENCH ONLY)*

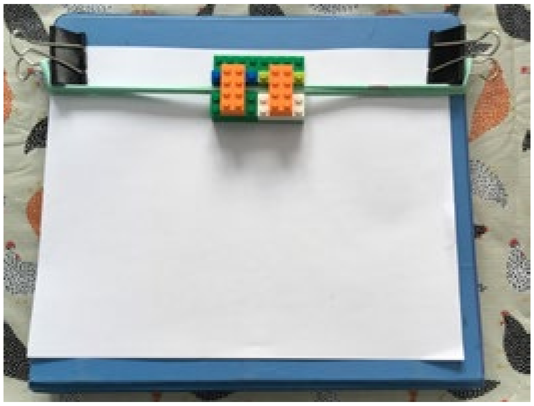
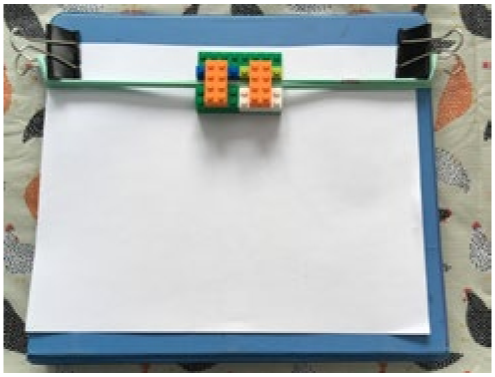
AUDIOVISUAL MATERIAL *(free)*	
Bricolage - la catapulte - Coopération – les bons côtés de la Suisse. *YouTube,* 1 min 34 s. https://www.youtube.com/watch?v=xyGHi8PfQhQ	
La catapulte à l'attaque! – Débrouillards. *YouTube,* 6 min 55 s. https://www.youtube.com/watch?v=QQuIsFp5fFw	
Tuto fabriquer une catapulte - Myah and co. *YouTube*, 3 min 08 sec. https://www.youtube.com/watch?v=esAWSCp7ASU&t=4s	
C'est pas sorcier, Le Châteaux Forts, segments de 10:14 à 12:00 et de 14:12 à 15:00 https://youtu.be/dybWx0kAYJE	
Déclencheurs pour s'inspirer - Comment fonctionnent-ils? https://sites.google.com/cslaval.qc.ca/declencheurs/accueil	
2 catapults out of popsicle sticks (English) https://www.youtube.com/watch?v=WpLFC_SOpXs	
DATA BASE *(paid subscription)*	
« Catapulte » - In Universalis Junior [en ligne]. *Encyclopædia Universalis.* http://junior.universalis-edu.com/encyclopedie/catapulte/	
« Principe du levier » - In eduMedia [en ligne]. *EduMedia.* https://junior.edumedia-sciences.com/fr/media/675-principe-du-levier *Chemin : Primaire / Technologies / Des machines simples pour nous aider / Principe du levier*	
« Leviers » - In BrainPop [en ligne]. *BrainPop.* https://fr.brainpop.com/technoingenierie/machinessimples/leviers/	
MAGAZINES	
À l'attaque! Catapulte-toi au Moyen Âge, *Les Débrouillards,* nº 380, avril 2018, p. 16 et 17 *Note : Si la bibliothèque de votre école n'a pas cette revue et si vous êtes membre de Bibliothèque et Archives nationales du Québec, vous pouvez obtenir un PDF de ces deux pages. Quand vous serez sur leur site : cliquez sur « BAnQ Numérique » et cherchez la base de données « Repère », l'article se cherche à cet endroit. Bonne chance!*	
BOOKS	
PUBLIC CIBLE	**NOM ET RÉFÉRENCE DU LIVRE**
3e cycle	**La démarche scientifique,** coll. « Les neurones atomiques explorent », Martin et Stéphane Brouillard, Éditions MultiMondes 2019, 23 p. ISBN : 978-2-8977-3118-2 *Note : On peut aussi se procurer ce livre en version numérique pour un versement dans la plateforme BIBLIUS.*

PUBLIC CIBLE	NOM ET RÉFÉRENCE DU LIVRE
3e cycle	**Les machines simples,** coll. « Les neurones atomiques explorent », Martin et Stéphane Brouillard, Éditions MultiMondes 2018, 23 p. ISBN : 978-2-8977-3102-1 *Note : On peut aussi se procurer ce livre en version numérique pour un versement dans la plateforme BIBLIUS.*
Dès le 1er cycle	**Moyen Âge,** coll. « Docu DYS », Coppin, Brigitte, Éditions Fleurus, 2019, 47 p. ISBN : 978-2-2151-3782-5 *Note : Suggestion pour le contexte de l'époque. La police de caractère facilite la lecture aux enfants dyslexiques.*
	Les machines de Léonard de Vinci : la catapulte et l'arbalète, coll. « Sassi science », Covolan, Chiara et Girolamo, Éditions Sassi Junior, 2018, 1 livre de 16 pages + 2 maquettes ISBN : 978-8-8686-0568-1 *Note : Obtenir ce livre jouet pourrait prendre plusieurs semaines à votre libraire.*
Dès le préscolaire	**Petit Poilu, t. 13. Au château de Crotte de Maille,** coll. « Puceron », Fraipont, Céline, Éditions Dupuis, 2013, 32 p. ISBN : 978-2-8001-5728-3 *Note : L'enseignant doit être prêt à assumer une aventure scatologique.*
Dès le préscolaire	**Super-héroïnes,** Hargreaves, Roger, Éditions Hachette jeunesse, 2020, 32 p. ISBN : 978-2-0121-0232-3 *Note : Fiction humoristique. Calamity Canaille dévaste la ville avec une catapulte de tartes à la crème.*
Dès le préscolaire	**Je fais des sciences,** Jugla, Cécile, Nathan, 2018, 93 p. ISBN : 978-2-0925-7941-1 *Note : Contient la question « Comment soulever des choses lourdes ? »*
Dès le préscolaire	**Les châteaux forts,** coll. « Le p'tit doc en format géant », Ledu, Stéphanie, Éditions Milan, 2021, 29 p. ISBN : 978-2-4080-3220-3 *Note : On y trouve le trébuchet plutôt que la catapulte.*
Dès le 2e cycle	**Le Moyen Âge**, coll. « L'histoire c'est pas sorcier ! », Mathivet, Éric, Éditions Deux coqs d'or, 2022, 31 p. ISBN : 978-2-0171-5671-0 *Note : Suggestion pour le contexte de l'époque. Contient les sujets des grandes invasions, une attaque au château fort et les guerres.*
Dès le 1er cycle	**Mon premier livre sur la science,** Oldham, Matthew, Usborne, 2020, 30 p. ISBN : 978-1-4749-8710-3 *Note : Il y a une double page titrée : déplacer des objets*
3e cycle	**Copain des sciences : le guide des scientifiques en herbe,** Pince, Robert, Milan, 2019, 254 p. ISBN : 978-2-4080-1449-0 *Note : Contient un chapitre titré : Énergies, forces et mouvements*
3e cycle	**Science,** Sparrow, Giles, Broquet, 2020, 127 p. ISBN : 978-2-8965-4646-6 *Note : Contient un chapitre titré : Forces et énergie.*
3e cycle	**Le guide des Castors juniors : aventures et découvertes,** Walt Disney Company, Éditions Glénat, 2018, 208 p. ISBN : 978-2-3440-2948-0 *Note : Six aventures où chaque récit est complété par trois pages documentaires. L'une de ces sections explique comment faire une catapulte.*

APPENDIX 1 - ACTIVITY 3: CONSTRUCTION OF THE LAUNCH PAD

STEP	PROCEDURE	ILLUSTRATED PROCEDURE
1	• Place a sheet of paper on the binder as illustrated. • Attach the bulldog clips to both sides of the binder.	
2	Build a receptacle for the sugar packet made out of Lego© (or cardboard).	
3	Place the rubber band through the receptacle.	
4	Cover the top of the receptacle.	

APPENDIX 1 - ACTIVITY 3: CONSTRUCTION OF THE LAUNCH PAD

STEP	PROCEDURE	ILLUSTRATED PROCEDURE
5	Attach the rubber band to the 2 bulldog clips using the bottom metal hook on each side to ensure a secure fit. *Students can use the paper to trace the position of the receptacle.*	
6	With a pencil, mark the cardboard box with the different heights that you will use in your experiments. Note that there will be 3 different heights used during the test: • Cycle 1 can estimate and measure height using non-conventional units (books, tissue boxes, etc.). • Cycle 2 can compare the angles using conventional units (a ruler). • Cycle 3 can estimate and measure the angles in degrees using the top of the binder and a protractor.	
7	At each tested height, drill holes in the box so that the clamp will hold securely in place.	
8	You should now have a finished launch pad!	

APPENDIX 2 - INTENSIVE ESL EXTRAS

You will find:

1. Suggestions
2. Functional Language
3. Grammar Flash: What Could We Do?
4. The Catapult
5. C1 - General Evaluation Tool
6. C3 - I Write Texts Checklist
7. C3 - Generic Evaluation Tool

1. SUGGESTIONS

Competency 1: To interact orally in English
Use the evaluation tool to observe students as they are planning their design and performing the various tasks.

Functional Language Posters: Ask students to brainstorm other possible phrases they will need while planning their prototype.

Competency 3: To Write Texts
Students can write a procedure (a step-by-step preparation) for the competition that will help them to succeed at the challenge. They can choose to present it as a poster, infographic, checklist, etc.

Suggested Tools:

- Graphic Organizers
- I Write Texts Checklist

Reflection Questions
It is important that students reflect on their experience at every step of the LES -before, during and after the challenge. The following are examples of a few reflection questions. Feel free to add more!

Before: Warm-Up Brainstorming Session
Before introducing the mission to students, present them with the situation and ask them if they had any ideas about how to solve it. See Grammar Flash: What Could We Do?

During
Consider these questions in a group discussion, just **after a new concept** has been presented and explored by the students:

- Give examples of where in your life you have seen the concept(s) presented in this activity.
- How does this concept connect to your life? to the world?
- What did you learn from this activity?

After

Consider these questions in a group discussion, at the end of the challenge:

- What was your favourite part of the challenge?
- What was the most difficult part of the challenge for you?
- How did you "fail forward" during the design and construction of the challenge?
- Name something you learned about teamwork while completing this challenge.

Journaling Ideas

- Ask students to record their daily experiences, in any form they choose (*collaborative platform, personal journal, video, audio...*) to reflect on their practices, and/or share with their classmates.
- Describe how knowledge of science concepts can be useful in everyday life.
- Give students the choice of answering ANY of the BEFORE, DURING or AFTER questions in their journal.

2. FUNCTIONAL LANGUAGE

BRAINSTORMING

- » We could...
- » Do you have any other ideas?

What do you think?

- » I think… because…
- » I don't think… because…

SUGGESTIONS

PRESENTING A HYPOTHESIS

- » I think that…
- » I predict that…
- » What do you think will happen?
- » What is your hypothesis?

Do you agree or do you disagree?

- » I agree because…
- » I disagree because...

SUGGESTIONS

PLANNING YOUR PROTOTYPE

- » Let's check if we have all the materials we need.
- » Do we have a...?
- » Where is the....?
- » Can you pass the... please?
- » I think we need ...

SUGGESTIONS

3. GRAMMAR FLASH: WHAT COULD WE DO?

To be presented BEFORE the mission is introduced, after slide 1.

WHAT COULD WE DO?
We use could to express possibility. Examples: *We could play baseball at recess.* *We could build a snowman in our backyard in winter.*
With your team, write 5 ideas that could help stop the flooding in your friends' homes.
1.
2.
3.
4.
5.

- ✂

WHAT COULD WE DO?
We use could to express possibility. Examples: *We could play baseball at recess.* *We could build a snowman in our backyard in winter.*
With your team, write 5 ideas that could help stop the flooding in your friends' homes.
1.
2.
3.
4.
5.

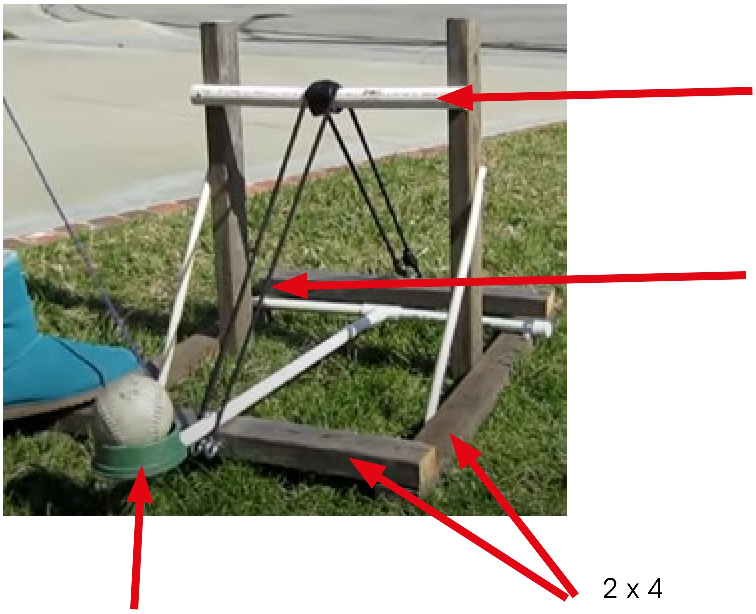
4. THE CATAPULT

BEFORE completing page 5 of the Student Handbook.

Part 1: Watch the video, display the words for the students to view and ask them to add the vocabulary to page 5 in their Student Handbook.

WORDS

- PVC pipes
- 2 by 4
- Bungee cords
- Drain to hold the ball (receptacle)



Part 2: Review the video by asking the questions below. Then answer the questions on page 5 of the Student Handbook.

Discussion Questions

1. What distance does the ball travel?
2. Why does the girl say to be careful?
3. What does she say at the end of the video?

5. C1 - GENERAL EVALUATION TOOL

C1 Rubric to be used while students are working in groups, designing and planning their prototype.

ELEMENTARY CYCLE THREE ESL GENERIC EVALUATION TOOL

Competency 1, *To interact orally in English*

Class : ____________________

Evaluation criteria	Criterion	Points	Descriptor	Student names		
Evaluation criteria : Participation in exchanges and Use of functional language	Participation in exchanges	**20**	Speaks throughout, contributing substantial content, AND uses techniques to create true interaction (e.g. asks partner questions, reacts to and builds on partner's ideas)			
		16	Speaks throughout, contributing substantial content.			
		12	Speaks throughout, contributing limited content.			
		8	Speaks sporadically.			
		4	Speaks rarely.			
	Use of vocabulary and useful expressions	**15**	Quickly accesses a variety of vocabulary and expressions.			
		12	Uses a variety of vocabulary and expressions.			
		9	Uses basic vocabulary and expressions.			
		5	Lacks vocabulary.			
	Comprehension of messages by an anglophone	**15**	Messages are easily understood despite errors, if any.			
		12	Messages are understood with **some** interpretation.			
		9	Messages are understood with **considerable** interpretation.			
		6	Some messages are not understood despite interpretation.			
		3	Messages are understood; however, they are brief, very simple and/or very few.			
			Total : /50			
			Challenges (see list below)			

Special cases :

- ❖ If a student does not participate or does not speak in English, allot 0/50.
- ❖ If most or all messages cannot be understood, allot 0/50.

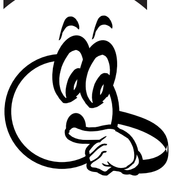
Challenges

1. Using English words
2. Pronouncing keywords clearly
3. Using a variety of words
4. Expressing more ideas
5. Elaborating on ideas (giving examples, details, etc.)
6. Expressing a personalized messages
7. Asking questions to maintain interaction, ask for details, ask for clarification, etc.
8. Building on what partner says
9. Reacting to what partner says
10. Initiating an exchange
11. Using vocabulary from available resources
12. Using a specific language convention : ____________________
13. Using the strategy : ____________________
14. ____________________

CHECKLIST

To write texts

I Write Texts



1. I prepare to write.

- I think of the instructions.
- I take out the resources I need (my books, my dictionary, my bank of expressions . . .)
- I look at the model.
- I write down ideas in English.
- I put them in order.

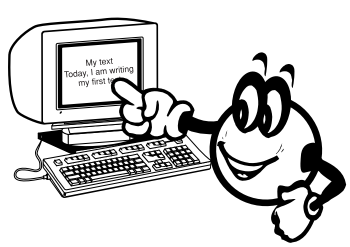
2. I write a draft.

- I look at the model again.
- I follow the instructions.
- I use my ideas.
- I write short sentences in English. (Subject / Verb / Object)
- I use the vocabulary and expressions I know.
- If I have a problem:
  - ➤ I ask for help, I use my bank of words . . .

3. I revise my text.

- Did I follow the instructions?
- Did I follow the model?
- Are my ideas original?
- I check the spelling, the word order and punctuation with the resources I have.
- I ask a friend to revise my text.
- I correct my text.

4. I write my final text.



- Is it OK?
- Is it neat?
- Is it easy to read?

Elementary Cycle Three Generic[1] Evaluation Tool for Competency 3, *To write texts*

Name of student: ______________________________ **Class:** __________

Evaluation criteria: Characteristics of the written text and Application of targeted language conventions

For marks and feedback purposes	For feedback purposes (+ = good job | – = to work on): Content	Form
› Comprehension of the text by an anglophone 10 The text is easily understood despite errors, if any. 8 The text is understood with **some** interpretation. 6 The text is understood with **considerable** interpretation. One or two sentences may not be understood. 4 Parts of the text are not understood despite interpretation.	+ – clarity + – detail + – flow + – paragraphing + – pertinence + – other: ____________	+ – articles + – capitalization and/or punctuation + – prepositions + – pronouns / possessive adjectives / possessive forms + – sentence structure (e.g. word order) + – singular/plural + – spelling + – verbs (e.g. tense, agreement) + – vocabulary + – other: ______________
› Introduction or introductory sentence 1 Effective 0 Ineffective 0 Missing	+ appropriate + catchy + original + useful + other: ____________	– does not make sense – inappropriate or not pertinent to the task or context – incomplete – unclear – other: ______________
› Body of the text 3 Effective 2 Mostly effective 1 Mostly ineffective 0 Ineffective	+ accurate + complete (all necessary information) + easy to follow + pertinent + well developed + well organized + other: ____________	– essential information missing – inaccuracies – insufficient detail or development – lack of logic – lack of organization – poor paragraphing – repetition – some content that does not make sense, is confusing or is not understood – some content that is inappropriate or not pertinent to the task – task requirements missing – other: ______________
› Conclusion or closing 1 Effective 0 Ineffective 0 Missing	+ appropriate + original + useful + other: ____________	– does not make sense – inappropriate or not pertinent to the task or context – incomplete – repetitive – unclear – other: ______________
› Adaptation of the text to purpose and audience (task) 5 Entirely 3 Mostly 1 Somewhat 0 Not at all	+ well-selected content + well-adapted content + well-selected language + other: ____________	– some inappropriate content – some poorly adapted content – some inappropriate language – other: ______________

Total mark for Competency 3	/20

Main challenges

Special cases

If you are unable to fairly evaluate the text using the tool, select one of the following descriptors and allot 6/20.

- Most or all of the text cannot be understood, despite interpretation.
- The text is incomplete or too short.
- The text is off task.

[1] If this evaluation tool is used along with a Competency 2 tool, do not evaluate “Body of the text” or “Adaptation of the text to purpose and audience,” in order to avoid an overlap in evaluation, as these two elements will be addressed in the Competency 2 tool.

Using the Evaluation Tool

This generic evaluation tool is suitable for most writing tasks. It may be used with Elementary 5 or 6 students. You may adjust the level of difficulty through task choice, design, requirements and expectations.

This tool was designed for two purposes:
1) to allow teachers to collect marks on students' writing skills for the report card
2) to help teachers support student learning by providing specific feedback

The left-hand column is used to assess the texts and provide marks. In the right-hand column, you may provide specific feedback that will allow students to have a better idea of what they are doing well (+ sign) and what they still need to work on (– sign), and enable you to base your assessment on observable elements.

For each section of the evaluation tool, first determine which descriptor best represents the student's text, and circle the corresponding mark. Next, in the right-hand column, circle the elements that were particularly strong and those that were the most problematic. The goal is to identify which elements stood out and which should be tended to, not to catch each mistake or weakness. Finally, add up the marks in the left-hand column to obtain the final result for the task.

Notes on the Descriptors

› *Comprehension of the text by an anglophone*

You must read the text in its entirety as if you were an anglophone with little or no knowledge of French or the task.

Easily understood – You do not have to infer to understand the text.

Despite errors, if any – Errors, if any, do not affect the comprehension of the text.

Some interpretation – You must infer to understand parts of the text but most of the text requires no interpretation.

Considerable interpretation – You must make a substantial effort to understand several parts, or a significant portion of, the text.

Parts of the text are not understood despite interpretation – Even though you try to infer meaning, part of the text remains unclear.

› *Introduction or introductory sentence*

Depending on the form of text that students are required to write, the introduction may simply consist of an introductory sentence (e.g. *I'm writing to propose a new activity for the school* or *Once upon a time there lived a little girl*).

Do not use this section (and adjust the total marks) if:
- the text does not call for any introduction or introductory sentence (e.g. poster)
- students merely reproduce an introduction from a model provided to them

› *Body of the text*

No matter what form of text students are required to write, the body of the text must meet certain requirements: the content must be relevant to the task and sufficiently developed; ideas must be clear and grouped in a logical manner so the reader can easily follow them; information must be accurate, etc. To determine the degree of effectiveness, refer to the task and the set requirements. Refer to the sidebar if the task involves Competency 2.

Note about integrated tasks

If the task that students carry out involves Competency 2, *To reinvest understanding of written and oral texts*, two sections of the tool will not be used in order to avoid an overlap in evaluation: "Body of the text" and "Purpose and audience." These sections will be addressed in the Competency 2 tool.

› *Conclusion or closing*

Depending on the form of text that students are required to write, the conclusion may simply consist of a brief sentence that appropriately brings the text to a close (e.g. *I hope this information will be useful* or *They lived happily ever after*).

Do not use this section (and adjust the total marks) if:

- the text does not call for any conclusion or closing (e.g. poster)
- students merely reproduce a conclusion or a closing from a model provided to them

› *Adaptation of the text to purpose and audience*

All texts are written for a purpose and a target audience. The purpose can be basic (e.g. to remind someone of an upcoming event) or more complex (e.g. to convince someone to do something). The target audience can be a single person, a group or the public at large.

You can determine whether or not a text was written in light of the purpose and audience by asking yourself a few questions. For example:

- Does the text accomplish what it was supposed to accomplish? For example, if the student was meant to explain a concept, was the concept explained well so that the reader will easily understand?
- Is the language used appropriate to the purpose and audience? For example, are words too technical for the target audience? Is slang used in a formal text?
- Is necessary background provided (if applicable)? For example, does the audience need to know certain facts about the topic to understand the text?
- Is there too much irrelevant or extraneous information, thus confusing the reader?
- Is information detailed enough for the audience to understand? For example, if a decision is presented in the text, is it explained? Are opinions supported?
- Is the information too specialized or technical for the reader, hindering his or her comprehension?
- Is the information organized in a way that the reader can easily follow and understand?

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