Resource Guide for Teachers

Strategies & resources to help you plan inclusive and engaging lessons for multilingual classrooms

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Resource Guide for Teachers: First Edition

This project was initiated by Emmanuelle Le Pichon and Jim Cummins at the University of Toronto and funded by MITACS and SSHRC.

Please visit:
https://escapeprojects.ca/ for additional resources and information.

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LANGUAGE FRIENDLY

The Language Friendly School prioritizes language as a valuable asset, embracing principles that celebrate linguistic diversity and rejecting exclusion based on languages, dialects, or accents.

LANGUAGE FRIENDLY SCHOOL

The pedagogy not only integrates students' home languages into the learning process but also highlights them in the classroom.

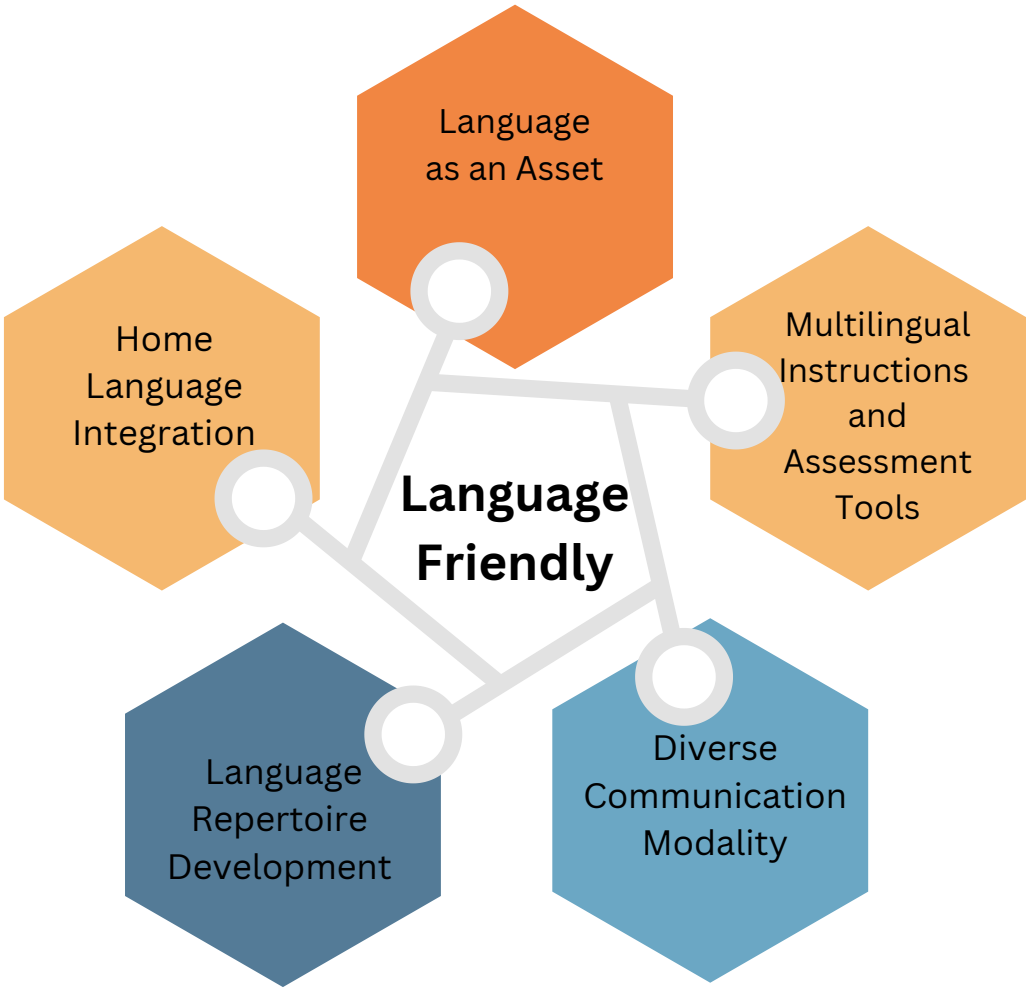
The school actively encourages students to express themselves in their own language. Parents are supported in maintaining their languages at home, recognizing the richness that diverse linguistic backgrounds bring to the learning environment.

The school's instruction is designed to cater to the various languages present, and communication is encouraged through diverse modes, such as written, oral, gestural, and graphic means.

The Language Friendly School is an initiative of the Rutu Foundation.

Accelerating the Learning Process

When students have the opportunity to use a language they are comfortable with, the learning of content is maximized and students are able to connect prior knowledge and experiences with new knowledge. This, in turn, allows teachers to assess students' understanding of science concepts more accurately as the language barrier is minimized.



Here are some key strategies to foster inclusivity in your classroom:

- Recognize linguistic diversity as a valuable asset.
- Promote using various languages in the classroom, integrating students' home languages into the learning process.
- Foster the development of students' language repertoires.
- Use multilingual instructional approaches that accommodate all languages present in the classroom.
- Promote diverse modes of communication.

COMPARING CURRICULA

"The more we as educators learn about our students, the more they are likely to learn from us." (Cummins, 2001)

What is Curriculum Comparison?

International curriculum comparison involves analyzing and understanding educational curricula from different countries.

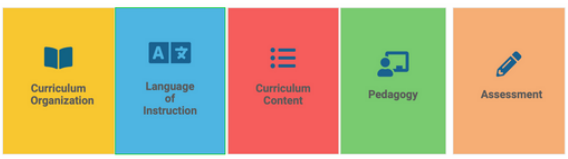
In conducting this, we examined curriculum organization, content, language of instruction, pedagogical approaches, and assessment methods.

Discover more about your students' prior learning & funds of knowledge!

Canada | Ontario | New Brunswick | Afghanistan | China | Egypt | India | Iraq | Iran | Jordan | South Korea | Lebanon | Pakistan | Syria | Türkiye | Poland | Nigeria

For more information on curricula of different countries, visit our website!
https://escapeprojects.ca/curricula-of-different-countries/

How Do Countries Compare?

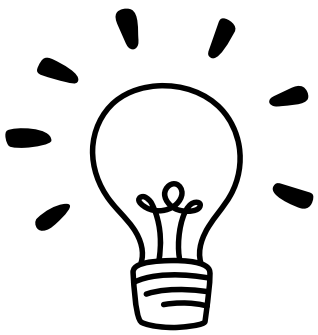


CURRICULUM COMPARISON: A WINDOW INTO STUDENTS' LINGUISTIC IDENTITIES AND CULTURAL BACKGROUNDS

How could teachers use this information?

Science and mathematics share universal principles and concepts that transcend cultural and linguistic boundaries; nevertheless, how they are taught, practiced, and applied can differ significantly based on cultural and linguistic contexts.

Teachers can leverage insights gained from curriculum comparison to tailor their teaching methods to accommodate for variations across countries and to provide their students with a more culturally responsive learning experience.



- You can incorporate intriguing examples found in this booklet to showcase how science and math can vary across cultures.
- You can use fun facts from different countries to test knowledge, engage students, and deepen their understanding of science and math.

INQUIRY BASED LESSON

An inquiry-based lesson plan is an instructional approach that encourages students to actively explore and investigate concepts, ask questions, and construct their own understanding of the topic.

3-Part Lesson

1. Minds On
2. Action
3. Consolidation

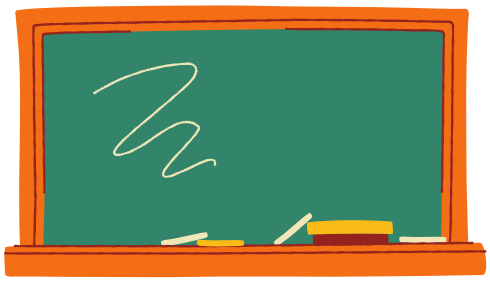
Student-Driven Learning

The teacher guides students through a series of questions, investigations, and discussions to help them discover knowledge independantly.

Promote a language friendly approach! Encourage students to use their full linguistic repertoires, offer multilingual resources, and foster collaborative learning.

12 SAMPLE LESSONS

This booklet introduces twelve lessons—six in science and six in math—that exemplify language friendly pedagogies. Each lesson is designed to foster a supportive learning environment, incorporating multilingual resources, diagnostic and formative assessments tailored for linguistic diversity, and a focus on connecting the home and school experience. Moreover, the lessons suggest ways to actively engage parents, recognizing their vital role in learning.



SCIENCE LESSONS

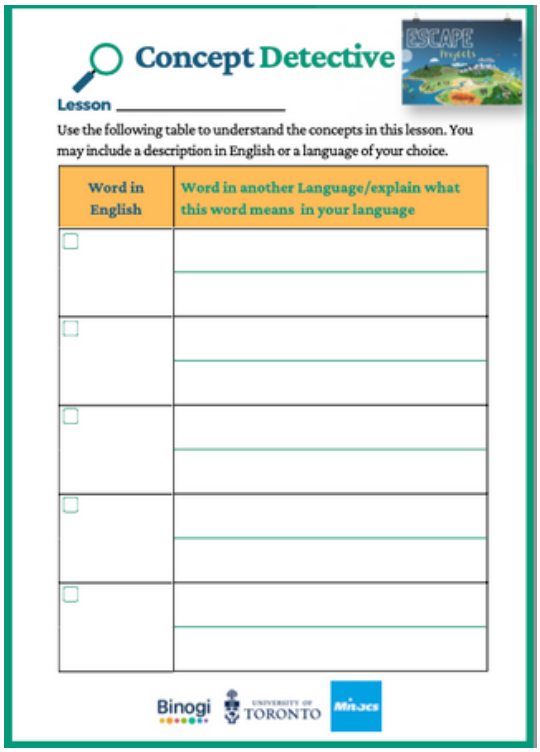
- **Cell**
- **Water Cycle**
- **Greenhouse Gases**
- **Electricity**
- **Pure Substances & Mixtures**
- **Stem Skills**

MATH LESSONS

- **Rational Number**
- **Order of Operation**
- **Linear & Non-Linear Relations**
- **Circumference**
- **Tessellations**
- **Simple Interest**

The lessons include engaging facts from various countries, adding a fun layer of global diversity and igniting curiosity. They also emphasize the importance of cultural relevance in planning science and math lessons to ensure every student gains knowledge and feels recognized, valued, and empowered. Through this approach, our goal is to assist educators in nurturing an inclusive and language friendly educational atmosphere that promotes student success.

Concept Detective: A Helpful Strategy for All Lessons


Concept Detective

Lesson _____

Use the following table to understand the concepts in this lesson. You may include a description in English or a language of your choice.

Word in English	Word in another Language/explain what this word means in your language

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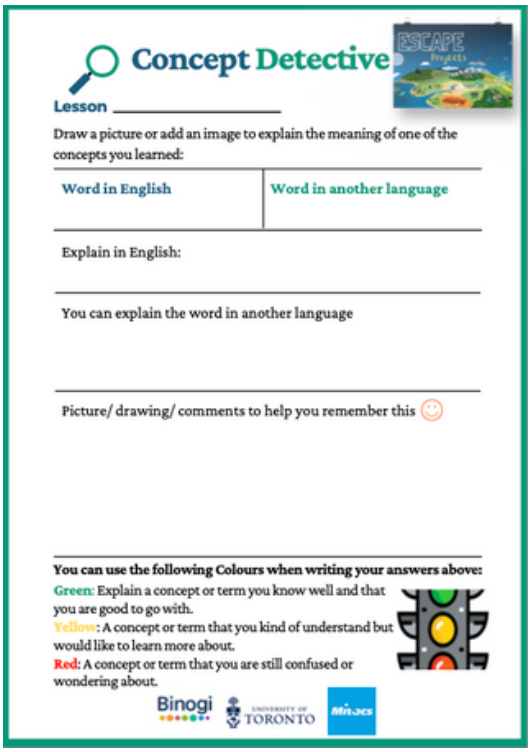

Concept Detective

Lesson _____

Draw a picture or add an image to explain the meaning of one of the concepts you learned:

Word in English	Word in another language

Explain in English:

You can explain the word in another language

Picture/ drawing/ comments to help you remember this

You can use the following Colours when writing your answers above:

Green: Explain a concept or term you know well and that you are good to go with.

Yellow: A concept or term that you kind of understand but would like to learn more about.

Red: A concept or term that you are still confused or wondering about.

Binogi · University of Toronto · MITACS

- Have students add new words to their Concept Detective. Print or share via class's online learning platform.
- Encourage students to use this document in each class to identify new words and write or find meanings with the help of peers, teachers and / or parents.

EXAMPLE

See examples on page 28 (Linear relations, Arabic) and page 33 (tessellation, Korean).

https://escapeprojects.ca/wp-content/uploads/2024/09/Concept-Detective-Poster-ENG.pdf

SCIENCE LESSONS

LESSON 1: CELL

Objective: Demonstrate an understanding of the basic structure and function of cells and cell processes.

Key Concepts: Plant cell, animal cell, organelles, nucleus, cell membrane, cell wall, cytoplasm, chloroplasts, vacuole, mitochondria, lysosomes, and photosynthesis.

Language Friendly Pedagogy
Invite students to use the Concept Detective tool to illustrate or write key terms related to the Cell (e.g., nucleus, DNA) in the language of their choice.

1

https://bit.ly/ConceptDetective

MINDS ON

Share the learning objective and co-create success criteria.
Diagnostic Questions: Start with 2 or 3 diagnostic questions to identify learners' prior knowledge and use the ESCAPE Projects' multilingual Concept Lists:

https://escapeprojects.ca/multilingual-concept-lists-posters/#Cells

2

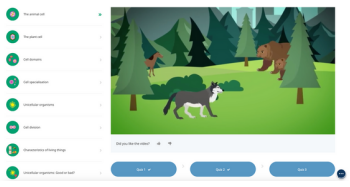
ACTION

Review cell structures and organelle functions, and divide the class into small groups. Create 3D cell models with play dough and toothpicks, using different colours for organelles (label organelles using index cards). Arrange models around the classroom, conduct a gallery walk, and discuss similarities and differences between models, emphasizing organelle functions. Ask students to write a short reflection on what they learned.

3

CONSOLIDATION

Assign students to watch a Binogi video and do at least 1 quiz about the Cell in their chosen language (and subtitles). Encourage students to watch and discuss the video with parents or family members. Example: https://app.binogi.ca/l/the-animal-cell



CONCEPT LIST

Concepts explained using various modalities

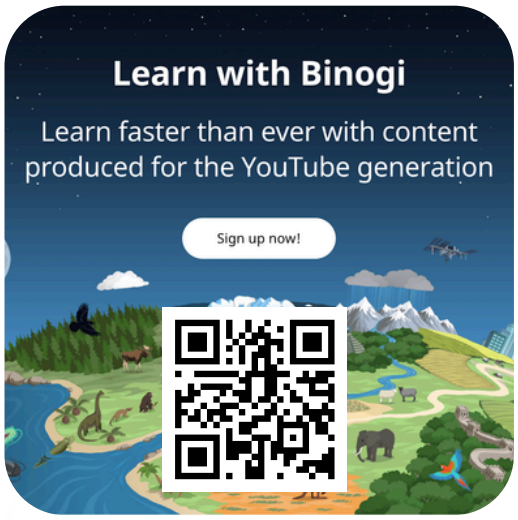
Accessed online, printed for students, or placed on classroom wall

Scaffolding – a comprehensive list of key concepts related to a given lesson

Binogi Video: The Plant Cell
English-Arabic Bilingual Concept List
The Escape Projects

Photosynthesis A process where mainly plants use sunlight, water and carbon dioxide to produce oxygen and sugars.	التركيب الضوئي عملية تستخدم فيها النباتات ضوء الشمس والماء وثاني أكسيد الكربون لإنتاج الأكسجين والسكريات.	
Glucose A simple sugar that can be broken down fast into energy by an organism. It exists naturally in plants.	جلوكوز هو نوع من أنواع السكريات البسيطة. يمكن للكائن الحي أن يحوله بسرعة إلى طاقة. يوجد بشكل طبيعي في النباتات.	
Cell The smallest unit of life that exists in all living creatures. The human body consists of several millions of cells and the simplest organisms consist of only one cell.	الخلية أصغر وحدة حياة، موجودة في جميع الكائنات الحية. يتكون جسم الإنسان من عدة ملايين من الخلايا وتتكون أبسط الكائنات الحية من خلية واحدة فقط.	
Protein A substance that plays an important role in the entire body. It is needed to build up the body's organs, hormones, and transport of nutrients. Protein is found in beans and meat.	بروتين مادة تلعب دوراً مهماً في الجسم كله. فهو ضروري لبناء أعضاء الجسم والهرمونات ونقل العناصر الغذائية. يوجد البروتين في الفواكه واللحوم.	
Algae Groups of organisms that live in water and can perform photosynthesis.	الطحالب مجموعات من الكائنات الحية التي تعيش في الماء ويمكنها القيام بعملية التركيب الضوئي.	
Cell Nucleus The center part of the cell where the cell's development and functions are controlled.	نواة الخلية مركز السيطرة والتحكم بالعمليات الحيوية في الخلية.	
Chloroplast The part in a plant cell where photosynthesis occurs and contains a substance called chlorophyll.	الصانعات الخضر عضيات خلوية موجودة في الخلية النباتية وحيث تحدث عملية التركيب الضوئي، تحتوي على مادة تسمى الكلوروفيل.	
Chlorophyll A substance that gives the plants their green color and captures the light in photosynthesis.	الكلوروفيل (اليخضور) مادة تعطي النباتات لونها الأخضر وتلتقط الضوء في عملية التركيب الضوئي.	
Organelle Parts inside the cell that constitute specific functions.	العضية مراكز خاصة (عضيات) داخل الخلية لإنتاج مواد مختلفة وأداء وظائف حيوية مختلفة.	

BINOGI: MULTILINGUAL VIDEOS & QUIZZES

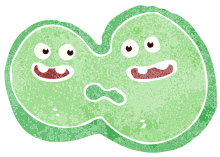


Binogi Video: The Animal Cell

Binogi Video: The Plant Cell

Binogi Video: Cell Domains

Binogi Video: Bacteria



Did You Know?

The word "cell" has interesting linguistic connections across languages. For example, in English, the term can refer to either the smallest building block within an organism or a confined space where a prisoner is locked up. Meanwhile, in Arabic, the term "خَلِيّة" (khalia), used for a biological cell, encompasses various meanings such as a bee-hive and a small unit within a party or movement.

Appreciating these linguistic nuances adds cultural richness to the understanding of the fundamental units of life.

LESSON 2: WATER CYCLE

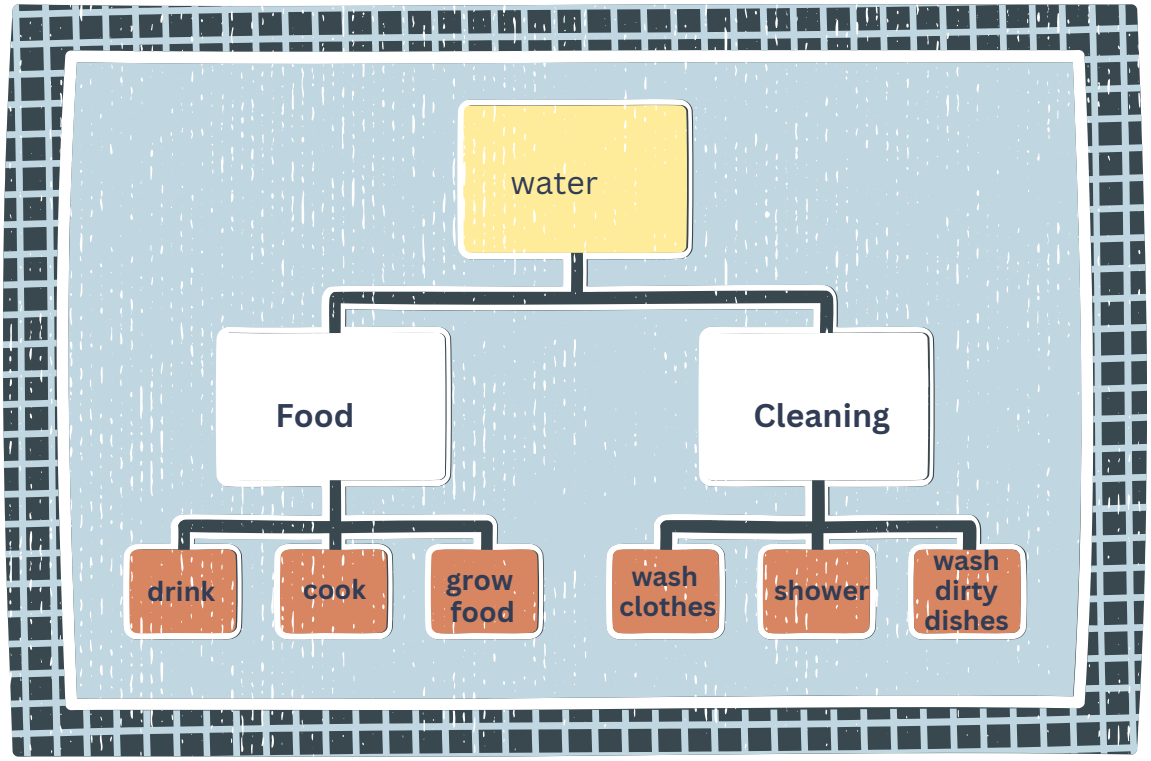
Objective: Understanding factors that change the size of glaciers and ice caps and how it affects the water systems.

Key Concepts: glacier, ice cap, global warming, climate change, glacier melting
Check out our **Multilingual Concept List** here Or scan the QR code.

Minds-On:
1. Teacher writes “Glaciers and Ice Caps” on the board and also shows some relevant images either from online or text sources.

2. Have a ‘Popcorn style’ discussion, where students shout out words that are related to the prompt “Glaciers and Ice Caps”. Teacher writes them on the board.
OR
Students use sticky notes, where they can draw and use their home language to respond to the prompt “Glaciers and Ice Caps”. Students stick their notes on the board. Once all are done, teacher reads out the sticky notes, identifies commonly used terms and asks questions regarding drawings/descriptions if needed.

Alternate Minds-On: Start with having students brainstorm what we use water for.



Language Friendly Tip: Invite students to share their experiences and thoughts on glaciers and ice caps.
Do these terms exist in their home languages?
Is there an awareness among students about glacier melting?

Action: The class watches the Binogi video: **Climate Change - the Biology Perspective**; the teacher pauses the video and asks questions:

Have your students watch the videos in the language of their choice.

Pause at 0:43: Why do you think the temperature has increased drastically in the past 100 years? What term is used to describe this phenomenon?

Pause at 2:31: Ask the class, "Have you experienced or witnessed any consequences of global warming? Explain."

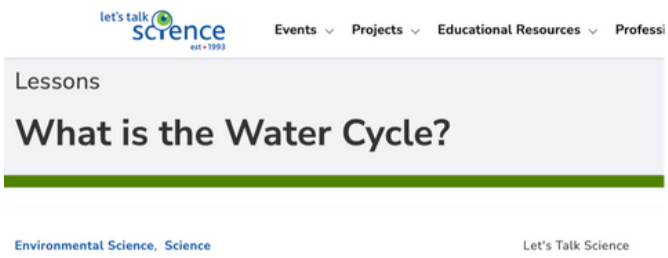
https://app.binogi.ca/l/climate-change-the-biology-perspective

Consolidation: Gallery Walk -
Students get into small groups and discuss the following questions: (on a chart paper)
1. Check out the following news about iconic World Heritage glaciers: https://bit.ly/worldglaciers
   - What are your initial thoughts and feelings?
   - Who/what is going to be affected by glacier melt and how?
2. How does global warming affect your home country? In this activity, investigate and pinpoint the specific impacts of climate change on your country of origin.
3. What can we do to stop global warming at a local, national, and global level?

HELPFUL TIPS

Let every student mark on the globe where they have family and measure the direct impact of global warming on the country in question.

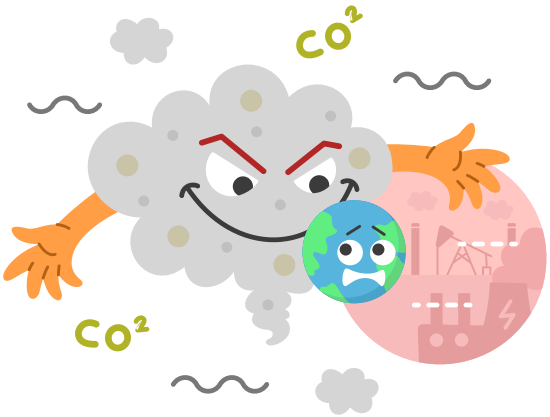
Check out more Water Cycle Resources at the Let's Talk Science Website.



https://letstalkscience.ca/educational-resources/lessons/what-water-cycle

LESSON 3: GREENHOUSE GASES

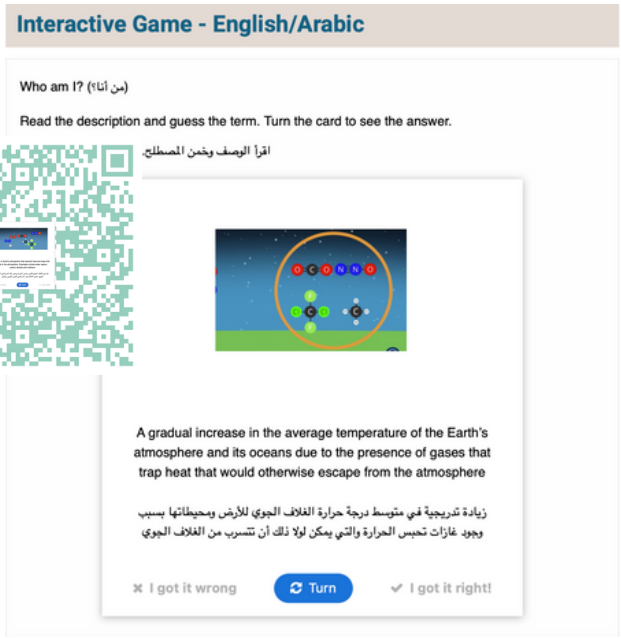
Objective: Understanding the effects of heat on the Earth. For example, the greenhouse effect and global warming.
Big Idea: “How I can be aware of and reduce greenhouse gases and my carbon footprint.”



Key Concepts: Greenhouse effect, greenhouse gasses, carbon dioxide, methane, chlorofluorocarbons, acid rain, particle theory, fossil fuels, carbon footprint.

LANGUAGE FRIENDLY

Binogi Video: Greenhouse Gases



Minds On

Prepare the class by creating a set of multiple-choice questions related to greenhouse gases. Engage students by including colourful visuals and utilizing online platforms (for instance, Kahoot).

Action

Have students guess what “carbon footprint” means, then explain. Each student calculates their own carbon footprint via QR code (available in different languages).
Have students take notes of their results.

Consolidation

Have a discussion based on the students’ Carbon Footprint activity results:
1. Why do you think your results lead you to have more than one Earth?
2. What is your worst “habit”?
3. What is your best “habit”?
4. What do you think you can do (immediately and long-term) to change your results?

BINOGI AT HOME

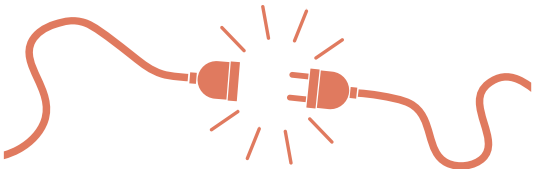
At home, students and their parents watch a Binogi video together, sharing insights and responding to any questions the child may have.

Did you know that deforestation (clearing of trees) for purposes like logging or urban development raises carbon dioxide levels in the atmosphere? This, in turn, contributes to climate change and global warming, as trees are essential for absorbing carbon dioxide through photosynthesis.

LESSON 4: ELECTRICITY

Objective: Understand the impact of the use and generation of electrical energy on society and the environment. Recognize ways to use electrical energy responsibly.

Key Concepts: Current, battery, circuit, electrical energy, heat energy, mechanical energy, generator, renewable energy, non-renewable energy, turbines.



1

Minds-On: Introduce the Concept Detective activity by informing students that they will be "energy source detectives." Instruct them to explore and compare the generation of electricity using fossil fuels versus nuclear power. Encourage students to use the provided worksheet to record keywords by writing or illustrating them in the school language or their home language.

2

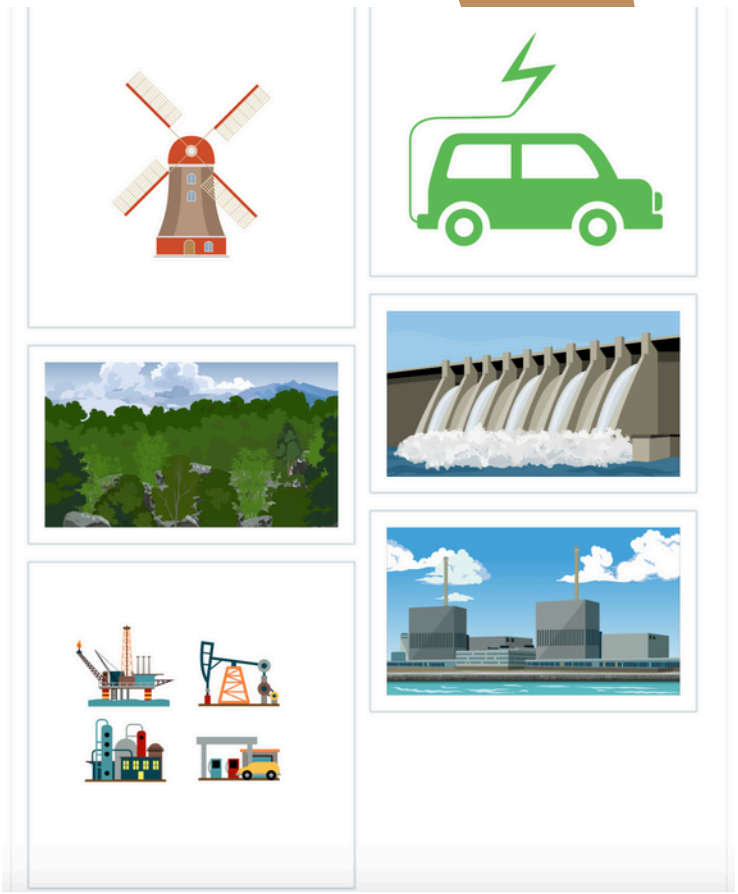
Action: Students identify images associated with renewable energy sources (solar, wind, hydro, geothermal, and biomass). They write or illustrate their responses on concept detective worksheets in their preferred language, followed by a discussion on the significance of each renewable energy source.

3

Consolidation: Lead a class discussion on the environmental impact of different energy sources. Have students journal their thoughts on the importance of making informed energy choices for a sustainable future.

Image Identification Activity

Identify all the images associated with renewable energy sources.



https://escapeprojects.ca/resource/interactive-lesson-plans-grade-6-electricity/

Language Friendly Pedagogy

1 Binogi

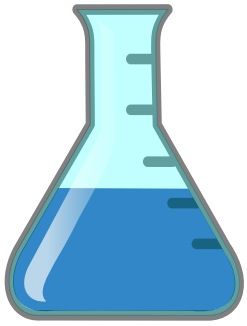
You can assign students to watch Binogi's video (multilingual) on Renewable Energy Sources.

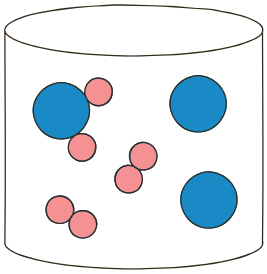
2 Integrate discussions on unequal access to energy into a language-friendly pedagogical approach, empowering students to explore diverse perspectives on global energy inequalities. Encourage them to express themselves in their home languages, fostering a connection to their home countries and enhancing cultural awareness through dialogue.

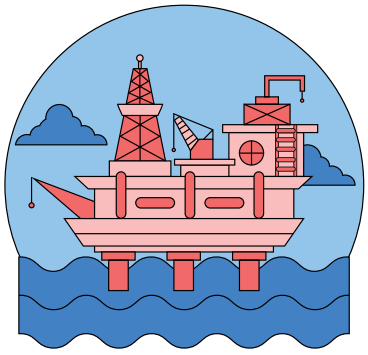
3 **Concept List Posters:**
You can download/print posters in many languages or print "add a language" posters.....Great for in-class activities or to send home with your students.
https://escapeprojects.ca/multilingual-concept-lists-posters/

LESSON 5: PURE SUBSTANCES & MIXTURES

Learning Objective: Understand the properties of pure substances and mixtures, and their environmental impact.







Key Vocabulary: Dissolve, Soluble, Insoluble, Dispersant, Oil Spill (presented in multiple languages).

Minds On: Encourage students to record key scientific terms and their translations in their "Concept Detective" worksheet:

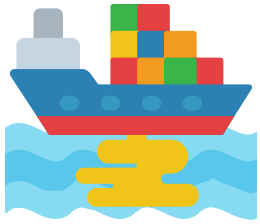
https://escapeprojects.ca/wp-content/uploads/2022/09/Concept-Detective-Poster.pdf

Action: Oil Spill Simulation - A hands-on experiment to understand the impact of oil spills and dispersants on the environment.

Consolidation:

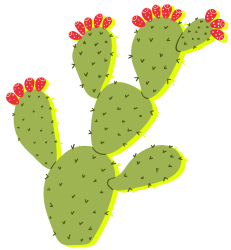
1. Debrief the results of the experiment.
2. Discuss the following questions as a class:
   a. Did any method completely remove the oil?
   b. Do you think all toxins or chemicals behave the same way? Why or why not?
   c. Who/what are affected by oil spill? How?
   d. Is an oil spill more difficult to cleanup in freshwater or saltwater? Why?
   e. Why might oil refineries be located away from populated areas?
   f. Despite the danger of oil spills and its irreversible consequences, why do you think oil is transported on ship?

Extension Activity: Research global water pollution issues, highlighting different countries' approaches to water treatment and oil spill management.
For information on oil spills, scan the QR code.



Fun Facts:

- In Mexico, researchers are developing substances extracted from cactus plants (mucilage) as a natural and effective method to clean oil spills.
- Japan has a history of using innovative approaches, including the development of oil-eating bacteria and advanced non-toxic dispersants.
- Saudi Arabia, a major oil producer, has developed capabilities for dealing with oil spills, particularly in the Persian Gulf, using containment, recovery, and chemical dispersants.



Encourage students to research emerging techniques for cleaning oil spills in a country of their choice.

Language-Friendly Strategy: Invite students to share their multilingual entries from the "Concept Detective" worksheets to contribute to a collective class word wall

LESSON 6: STEM SKILLS

Objective: Employ scientific investigation to explore and understand the properties and environmental impacts of sustainable materials. Engage in thoughtful discussions with your students, encouraging the use of critical thinking and communication skills to recognize and express the varied cultural influences on sustainable practices in science and technology.

Minds-on

Discuss what makes materials eco-friendly, focusing on sustainability, low environmental impact, and recyclability. Discuss three key materials:

Bamboo: Rapidly renewable, strong, used for flooring and roofing.

Reclaimed Wood: Sourced from old structures, applied in flooring and paneling.

Recycled Plastic: Reduces landfill, utilized in decking and insulation.

Introduce the "Concept Detective" worksheet for students to record terms in their language(s) of choice.

Action

Set up three stations for bamboo, recycled plastic, and reclaimed wood. Each station should have information cards, samples (if available), and QR codes for multilingual resources. Students will rotate among these stations to explore and discuss the materials. They'll use the "Concept Detective" worksheet to note important terms.

Example Resources:

Recycled Plastic (Chinese)

Reclaimed Wood (Polish)

Consolidation

- Students briefly share their findings about each material.
- Discuss the sustainability and practical applications of these materials.

Homework Assignment

- Students discuss with family/friends about eco-friendly materials known to them (types, uses, and cultural significance of these materials). Then, they create a poster in language(s) they choose, that includes the terms they put in concept detective as well as information they learned from their conversations

MATH LESSONS

LESSON 7: RATIONAL NUMBERS

Learning Objectives: To understand the value of each digit of whole numbers up to and including a hundred million

Required Prior Knowledge:

- Read and represent whole numbers up to and including 100, 000
- Names of the place values

Key Concepts:

- whole number
- place value
- million
- digit
- base 10

DID YOU KNOW?!

💡 In Yoruba and other cultures in Nigeria, numbers are important in the tribal marks system that was originally practiced for beautification, identification and for signifying one's ancestral links. For instance, three horizontal incisions on each cheeks may indicate royalty.

💡 In Korea, there are 2 number systems: native Korean and Sino-Korean. Native Korean number system only goes up to 99 and is mainly used to count smaller quantities and express time. On the other hand, Sino-Korean numbers are based on Chinese numerals and they are primarily used for counting extensive quantities, measurements, phone numbers, and monetary amounts.

Minds On

1. Write '85' on the board.
2. Students write the number in words in their school language and in other language(s) with their meanings. They then share their work in a small group and identify any patterns while examining the meanings of the number words.
3. Students share their findings with the class. Teacher writes the findings on the board and discuss the differences and similarities between English number system (base 10) and number systems of other languages. See Examples below.

Language	Word	Meaning
English	*eighty-five*	80-5
French	*quatre-vingt-cinq*	4-20-5
Yoruba	*márúndínlaadọ́run*	5 from 90 (90 in Yoruba means 10 from 100)

Action

1. Name the place values of the digits in a number, using a place value chart. Students who speak other languages to write the names of each place value in those languages. Share with the class and compare the words and how they are grouped. Examples below.

English	hundred millions	ten millions	millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones
Korean	억 (eok)	천만 (cheon-man)	백만 (beck-man)	십만 (sip-man)	만 (man)	천 (cheon)	백 (beck)	십 (sip)	일 (il)
Urdu	دس کروڑ (das crore)	کروڑ (crore)	دس لاکھ (das laakh)	لاکھ (laakh)	دس ہزار (das hazar)	ہزار (hazar)	سو (sau)	دس (das	ایک (ek)

2. Discuss with the class that each place value has a value is ten times greater than the one to its right. For example, in the number 333, the '3' in tens' place value is worth 10 times more than the '3' in ones' place value. The '3' in hundreds' place value is worth 100 times more than '3' in ones' place value.

3. Write numbers on the place value chart, then identify the value that corresponds to a specific digit in English and student's home language. Examples below.

English	hundred millions	ten millions	millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones	Value of digit '5'
Korean	억 (eok)	천만 (cheon-man)	백만 (beck-man)	십만 (sip-man)	만 (man)	천 (cheon)	백 (beck)	십 (sip)	일 (il)	
85 390					8	5	3	9	0	5 thousand / 5 *cheon*
5 092 183			5	0	9	2	1	8	3	5 million / 5 *beck-man*

Consolidation

Is the value of the digit '9' in 29,038 greater or smaller than the digit '3' in 391,002? By how much?

LESSON 8: ORDER OF OPERATIONS

LEARNING OBJECTIVES

- To use the order of operations to solve multi-step math expressions.

REQUIRED PRIOR KNOWLEDGE

- How to add, subtract, multiply, and divide
- Use of exponents

KEY CONCEPTS

- addition, subtraction, multiplication, division, exponent, bracket

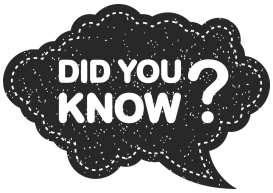
MINDS ON

1. Each student is given a paper featuring either a mathematical term, symbol, or its definition, all related to the order of operations. The students must then identify others whose papers correspond to the same mathematical concept as theirs. To view the complete list of these mathematical terms, symbols, and definitions, scan the QR code provided below.

- Example: Student 1 has '+'. Then, this student has to find classmates who have a paper with "plus", "addition", "sum", "together", "The operation that represents the sum of two or more numbers", "Opposite/inverse of subtraction"

2. After students form groups based on matching mathematical concepts, those who speak other languages teach their group members the specific terms and symbols related to that concept in those languages.
3. Create a word wall with students' work.

Resource: http://holi-frysk.nl/lesmateriaal/06_HF_LES_Meertalige_rekentaal_EN.pdf



Order of Operations around the world:

- BEDMAS (**B**racket, **E**xponent, **D**ivision, **M**ultiplication, **A**ddition, **S**ubtraction) in Canada
- **P**EDMAS in USA, where P stands for parenthesis
- In Brazil, many students memorize the order through songs rather than having such an acronym
- 加减乘除 (加 Addition, 减 Subtraction, 乘 Multiplication, 除 Division) in China

ACTION

1. Watch a Binogi video on Order of Operations as a class.
The teacher selects language and subtitle options as needed.

- Pause the video after each BEDMAS question, discuss and answer the questions from the video as a class.
- After the video, the teacher uses a chart paper and writes "BEDMAS". Then, the class identifies what each letter represents in words and symbols.

B	BRACKET	( )
E	EXPONENTS	X^2
D	DIVISION	÷
M	MULTIPLICATION	×
A	ADDITION	+
S	SUBTRACTION	−

2. Students uses sticky notes to share other ways of representing BEDMAS on the same chart paper (check "Did you know" on pg. 23).

3. In pairs, students work on the following question:

- Find out which statement is true. Show your work.
  - $(22 - 19)^3 + 5 \times 2 - 4^2 = 12$
  - $(22 - 19)^3 + 5 \times 2 - 4^2 = 48$
  - $(22 - 19)^3 + 5 \times 2 - 4^2 = 21$
  - None of the above. The correct answer is _____ (students fill out their response).

4. Once all pairs are done, the teacher uses the BEDMAS poster to solve the problem above with the class. Pairs check their work and ask questions if needed.

CONSOLIDATION

1. The teacher identifies "My Favourite 'No's" - *watch the YouTube video for instruction.*

- Go over some of the wrong responses to correct misconceptions.

LESSON 9: ALGEBRA LINEAR RELATIONS

Learning Objectives

- To solve linear algebra problems using various representations of linear relations

Required Prior Knowledge

- Interpret and construct graphs and tables of values
- Graph linear growing and shrinking patterns on the basis of their constant rates and initial values

Key Concepts

- rate of change
- slope
- y-intercept
- linear relations

Binogi

Watch Binogi videos before the lesson to understand linear equations:

1. The slope of a line
2. Linear equations

Did you know?

- In English, "slope" emphasizes the ratio of the vertical change to the horizontal change.
- In Portuguese, "slope" is called "coeficiente angular", meaning "angular coefficient ." This highlights the angular aspect of this concept, focusing on the angle that the line forms with the horizontal axis. Hence, the greater the slope, the larger the angle.

1

Concept Detective:

- Students fill out the Concept Detective form using the following mathematical terms (sample work on pg. 25):
  - linear relation, non-linear relation, rate of change

** allow students to use translating devices and dictionaries if needed **

2

Minds On:

1. Share the following sentences on the board and have the students determine whether each situation describes a linear relation or not:
   - A taxi charges a fixed rate for every kilometre traveled.
   - The total cost of apples in a grocery store increases as more apples are purchased.
   - The market value of a new car decreases as the years go by.
   - The area of a circle changes as the length of the circle's radius increases.
2. For each scenario, invite the students to explain their decision.

3

Action & Consolidation:

1. Math Jigsaw.
   - Students will work in small groups of 4 or 5.
   - Use the QR Code for the activity instruction.

Concept Detective

Lesson linear relation (Arabic and English)

Use the following table to understand the concepts in this lesson. You may include a description in English or a language of your choice.

Word in English	Word in another Language/explain what this word means in your language
☐ linear relation	علاقة من الدرجة الأولى أو العلاقة الخطية $y = 5x + 2$
☐ non-linear relation	علاقة غير خطية $y = x^2 - 2$
☐ rate of change	$y = 3x + 1$. معدل التغيير هو 3.
☐	
☐	

LESSON 10

Measurement: In Circumference π

Learning Objectives 29

: To understand the relationship between diameter, pi (π), and circumference

Required Prior Knowledge

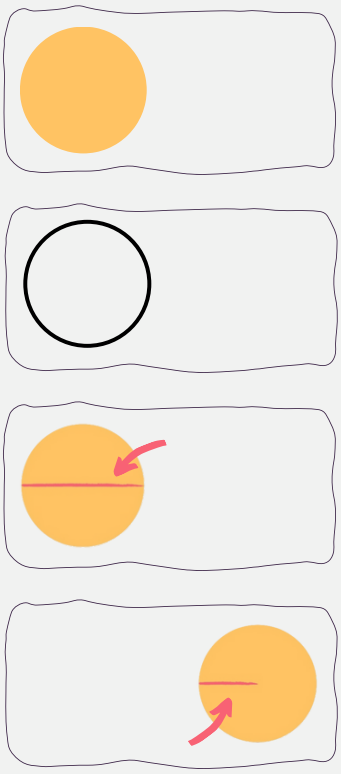
: Difference between radius and diameter

: Perimeter

Key Concepts

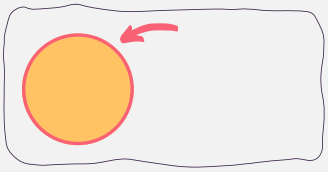
: diameter, pi (π), circumference

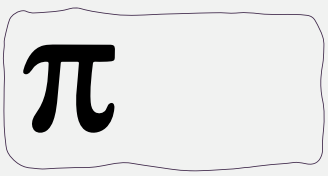
In Polish, "***koło***" refers to the whole circle including its interior, while "***okrąg***" specifically denotes the circle's boundary or perimeter.



Minds On:

1. The teacher posts 6 posters with drawings around the class. *See sample posters on the left and below.*
2. Students get into groups of 4. Then, they go around as a group, each student with sticky notes.
3. At each poster, students write down what they think the drawings are with explanations in any language they wish to use and/or read what previous groups have written and build on it. Then, share with their group members.
3. When all the groups have visited all the posters, the teacher goes over the posters and reveal key terms for each of them: circle, diameter, radius, circumference, pi (π).





Action:

1. Students work in small groups of 2 or 3.

2. Each group receives the following items and fills out the chart below. They measure the items using a string and a ruler.

items	diameter	circumference	ratio between circumference and diameter
coin 			
bracelet 			
hula hoop 			

** Please note these items can be replaced by other items. You can have more items and have different groups to measure different items.*
*** The teacher has the table on a chart paper.*

3. The teacher puts up the chart on the board and writes the groups' findings.

4. The teacher asks the class, "What do you notice about the ratios of the items?"
a. Anticipated response: "They are all similar (~3.14)."

5. Inform the class that this number (~3.14) is called pi (π) and that this ratio represents a constant relationship between diameter and circumference regardless of the size of a circle.

6. Think-pair-share: "Use the 3 numbers (diameter, circumference, pi) to create a formula."

pi x diameter = circumference (πd = C)

OR

2 x pi x radius = circumference (2πr = C)

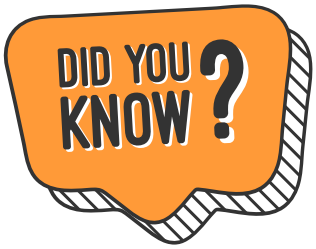
Consolidation:

1 Watch The Circumference of a Circle video on Binogi.
2. Exit Ticket: "*Would the longer radius result in the bigger circumference? Explain.*"

LESSON 11: GEOMETRY - TESSELLATION

LEARNING OBJECTIVES

To identify geometric properties of tessellating shapes and identify the transformations that occur in the tessellations



TESSELLATIONS ORIGINATED AROUND 4000 BCE WITH THE SUMERIANS, WHO DECORATED THEIR HOMES AND TEMPLES USING CLAY TILES.

KEY CONCEPTS

- tessellation
- transformation

REQUIRED PRIOR KNOWLEDGE

- regular polygons
- transformations which include translations, reflections, rotations, and dilations

MINDS ON

1. Sorting: The teacher displays photos (access via QR code) on the board. With the class, identify polygons and categorize them into polygon and non-polygon groups.

Binogi

Check out "Patterns" Binogi video to learn more about tessellation!

ACTION

1. The teacher presents tessellations to the class through photographs showcasing tessellations found in nature, art, and architecture. (honeycomb, snake skin, Islamic arts, tile work at Alhambra in Granada, The Oval in London, Bergeron Centre in Toronto, MC Escher's art work such as *Horseman, Lizard*). ** *Use any art work or architecture from students' home countries if possible.*
3. As a class, identify the common features and/or geometric properties of the tessellation photos.
4. Together, create a checklist for a tessellation:
    a. Tiles cover an area without any gaps or overlaps.
    b. 1 or multiple shapes are in a repeating pattern.
    c. Shapes can be arranged using rotation, reflection, and translation.

CONSOLIDATION

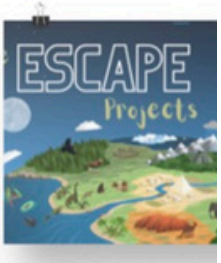
Fill out the Concept Detective (*refer to page 33 for a sample*). Encourage students refer to the Tessellation Checklist they co-constructed.

CHECK IT OUT

Cross-curricular Math-Arts Project

Collaborate with Art teacher to create various types of tessellations such as regular, non-regular, Escher-type, and Girih tessellations.

Concept Detective



Lesson tessellation (Korean and English)

Draw a picture or add an image to explain the meaning of one of the concepts you learned:

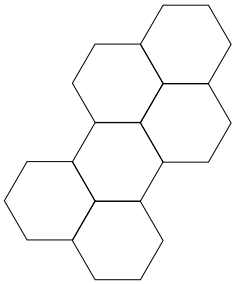
Word in English	Word in another language
tessellation	테셀레이션

Explain in English: repeating shapes. no space. not on top of each other.

You can explain the word in another language

도형들을 빈틈없이, 또 겹치지 않게 공간을 채우는 것. 도형들은 패턴으로 나열되여있어야하며 평행 이동, 대칭 이동, 회전 이동일 수 있다

Picture/ drawing/ comments to help you remember this



Korean traditional window

You can use the following Colours when writing your answers abov

Green: Explain a concept or term you know well and that you are good to go with.

Yellow: A concept or term that you kind of understand but would like to learn more about.

Red: A concept or term that you are still confused or wondering about.

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LESSON 12: SIMPLE INTEREST

Learning Objectives

To calculate simple interest to solve problems.

Required Prior Knowledge

Understanding that simple interest helps people make financial decisions when saving and budgeting for big expenses.

Key Concepts

- Simple Interest
- Saving
- Interest
- Borrowing
- Interest Rate

FUN FACTS

Islamic financial systems, based on the principles of Sharia law, prohibit charging or paying interest. This means that in certain Islamic countries, such as Saudi Arabia and the UAE, charging interest is more regulated.

Different Discount Systems
In China, 20% off is described as 8折, and people will multiply the original price by 80% automatically.

8折 VS. 20%

LANGUAGE FRIENDLY PEDAGOGY

Start the lesson by having students add key terms or any new words to the concept detective

Concept Detective

MINDS ON

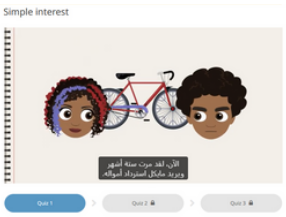
Let's have the students think about:

"What's a better deal? 20$ off or 20% off?"

And explain why

ACTION

Watch Simple Interest on Binogi



Pause at 2:20

CONSOLIDATION

The new smartphone costs $999

With which option will the phone cost me the least?

1. 4 instalments with 1.5% interest
2. 6 instalments with 1.75% interest
3. Upfront payment of $999 + 13% tax

Introduce the formula:
$C = p(1 + R \times T)$
and how it can be used to calculate interest

C: total amount (final value)
p: the initial principal amount invested or borrowed
R: the annual interest rate
T: the number of years the moeny is invested or borrowed

Extension Activity

Ask your students to

"Compare and contrast savings accounts from"

TD CIBC RBC BMO

Choose an account that suits them

And explain why

How can you alter this activity to make it relevant to your context

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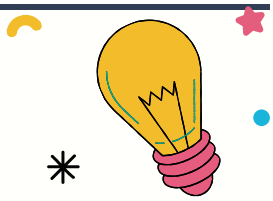
APPENDIX: ADDITIONAL RESOURCES



ESCAPE Website
https://escapeprojects.ca

Open an account (Free)!

Cross-Curricular Activity

Pure Substances and Mixtures

INTRODUCTION

SUMINAGASHI, THE JAPANESE ART OF PAPER MARBLING, OFFERS A FANTASTIC OPPORTUNITY TO INFUSE CREATIVITY INTO YOUR LESSON ON SUBSTANCES AND MIXTURES. THIS ENGAGING ACTIVITY NOT ONLY ALIGNS WITH SCIENTIFIC CONCEPTS BUT ALSO INTRODUCES STUDENTS TO CULTURAL PRACTICES.

MATERIALS

- Shallow trays filled with water
- Droppers
- Ink or liquid watercolors in various colors
- Absorbent paper (like rice paper or watercolor paper)
- Newspapers to protect surfaces

Discuss the scientific principles behind Suminagashi. Emphasize how the ink, when dropped on water, creates a mixture of colors due to surface tension and cohesion.
Connect this to the broader idea of mixtures and how substances interact.

HANDS-ON ACTIVITY

Demonstrate how to drop ink onto the water's surface and create patterns. Encourage students to experiment with different colors and observe how they mix and blend. After the activity, gather students to reflect on the patterns they created. Discuss how the colors interacted and blended, drawing parallels to the concepts.

LANGUAGE-FRIENDLY PEDAGOGY

- Explain that Suminagashi in Japanese comes from "Sumi" for ink and "Nagashi" for floating. Share examples of words in other languages explaining phenomena (e.g. in Chinese, the term for gravity, "引力" (Yīnlì) combines "引" (Yǐn) for attraction and "力" (lì) for force, encapsulating the force that pulls objects toward each other.

SCIENCE POSTER

Concepts in Different Languages

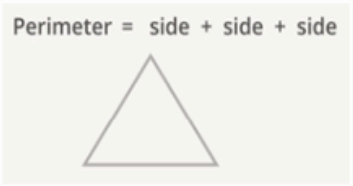
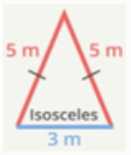
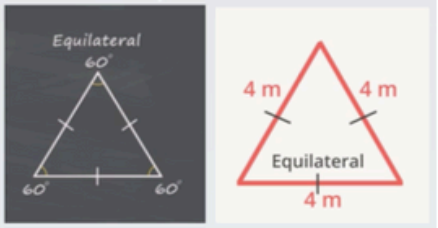
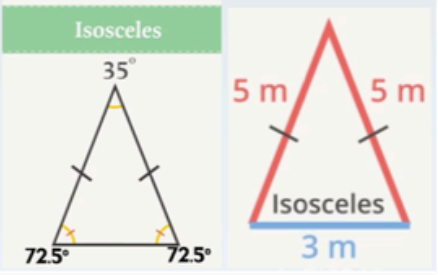
Students can find/explore the concept in their home language.

CHECK OUT additional multilingual Binogi posters at https://escapeprojects.ca/binogi-science-posters/!

MATH CONCEPT DETECTIVE

Binogi Video: The perimeter of a triangle

Bilingual Concept List

Mathematical Terms	Draw or add in your language	Examples
Perimeter: The distance all the way around the edges of a shape or geometrical figure.		 **Examples:**  **Perimeter = 4m + 4m + 4m = 12m**  **Perimeter = 5m + 5m + 3m = 13m**
Equilateral Triangle A triangle with three sides of the same length.		
Isosceles Triangle A triangle with two equal sides and two equal angles.		

Merci
French

Danke
German

ありがとう
Arigato
Japanese

Takk
Icelandic

감사합니다
kamsahamnida
Korean

Gracias
Spanish

Thank you

Spasiba
Russian

Grazie
Italian

Salamat
Tagalog

Terima Kasih
Indonesian

谢谢
Xie xie
Mandarin

ขอขอบคุณ
khob khun
Thai

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