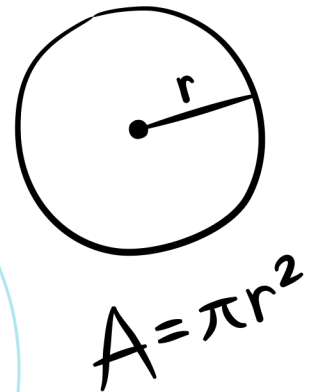
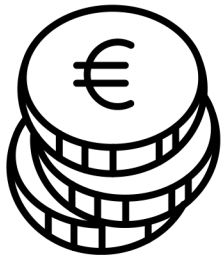




UNIVERSITY OF TORONTO
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FOR STUDIES IN EDUCATION



Teaching for Student Engagement: Science, Technology, Engineering, Math (STEM) in a Globalizing World



Teaching for Student Engagement: Science, Technology, Engineering, Math (STEM) in a Globalizing World: First Edition

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The ESCAPE Projects were initiated by Emmanuelle Le Pichon and Jim Cummins at the University of Toronto and funded by MITACS and SSHRC. “ESCAPE” comes from the French “Enseigner les sciences aux élèves plurilingues” - Teaching Science to plurilingual students.

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Please visit:

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for additional resources and information.



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Overview

Welcome!

This guide aims to support you in implementing Language Friendly approach for all learners, promoting linguistically and culturally inclusive practices for all students.

Our guide is intended to help you try a new way that makes educational practices inclusive for all students. You can find resources for leveraging and celebrating students' language skills in your classroom. You can use this guide as a roadmap to make learning meaningful and accessible for all.

This guide is structured around the following questions:

How can I, as an educator, create an environment that recognizes my students' languages as crucial for achieving their learning objectives?

How can I adopt practices that foster their complete identity and broaden their understanding of the world?

A Language Friendly Approach



In the following chapters, we will delve into the following key aspects:

- **Inclusion of all languages of the school community**

Including all languages of the community means valuing not only the languages of students but also those of the teachers, staff, and families. Everyone contributes to shaping the educational world of the student. Therefore, we must recognize this rich diversity to enrich our educational environments. The way we embrace these languages will have a significant impact on our students' education, learning experiences and ultimately, identity development.

- **Inclusive instructional strategies & Language Friendly resources**

The goal is to ask yourself daily: How do language and culture influence my teaching? How can I use this understanding to tailor my instruction so that each student can contribute their unique perspective?

In recent years, we have become aware of the importance of technology in providing equitable learning resources, tailored to the needs of each individual. How can we promote access to knowledge? How can we support students in their academic journey without causing a delay due to the need to learn the school language?

- **Family and community engagement**

School takes up a lot of our students' time, but we are not the only ones involved: families, neighbors, and many organizations (library, sport club, religion centre, heritage language schools...) are part of it. How can we collaborate to support students as best as possible? How can we develop a productive partnership that promotes an inclusive educational environment?

- **Cultural sensitivity and respect**

Languages reflect and carry culture. Creating an inclusive environment in a school setting means not only respecting but also embracing these languages, as well as the values, norms, ways of thinking, and knowledge base they are associated with. How can we, as educators, create classroom experiences that are mindful of diverse cultural perspectives and effectively integrate them into our teaching practices?

- See [The Language Friendly School](#) for more information!

1. Planning

Find **concrete strategies** and **resources** that will help you plan lessons with your multilingual students in mind.

This section consists of four parts:

1.1 Planning Tips and Tricks

1.2 **Who? Know your students:** understand your students' diverse backgrounds and discover their language skills and cultural experiences; make language a central focus; raise awareness.

1.3 **What? Discover the tools:** Check out the language friendly resources created for this purpose!

1.4 **How? Plan your lessons:** Lesson plans provide a solid plan to lean on or modify for your classroom

1.1 Planning Tips & Tricks

SCAFFOLD

Plan for scaffolding based on your students' needs.

Check out Section 2.1 for more details & examples.

MAKE SPACE FOR RECIPROCAL LEARNING

Learn from your students! Be aware of cultural & linguistic contexts that impact how concepts are taught, practiced, and applied. Check out the [Fun Knowledge page](#) to learn something new.

EMBRACE FUNDS OF KNOWLEDGE

Consider what your students already know when planning a lesson. Check out our [International Curriculum Comparison](#).

BE LANGUAGE FRIENDLY

Plan opportunities for students to share their ideas with each other in their own language.

Create spaces where languages are valued. Teach your students to make the most of their languages and world experiences!

BE FLEXIBLE

Appreciate students' diverse ways in expressing how they understand and apply concepts.

ALLOW FOR MORE TIME

Plan for extra time for students who need to adapt to the new system.

1.2 Know Your Students

1. Recognize the linguistic and cultural diversity of your students - Learn about the languages of your students

- Conduct a survey or have an informal conversation with each student to learn about their cultural background, languages spoken at home, and any specific cultural practices they may want to share with you.
- Display posters or create a bulletin board showcasing the diverse cultures and languages represented in the classroom.
- Encourage students to share STEM-related materials or resources in their home languages, creating an atmosphere of reciprocal learning.

2. Make language itself a central part of the learning process

- Create a positive and supportive learning environment, where students can use all their languages for their learning goals.
- Integrate language friendly learning resources such as books, videos, and online content into the curriculum that helps enrich students' understanding.
- Implement a language buddy system where students pair up to exchange their ideas in their shared language(s).



Understanding your students is key to effective teaching. It helps tailor instruction, foster inclusion, gauge language proficiency, and enhance engagement for better learning outcomes.

Know Your Students

3. Highlight different languages spoken by students in your class.

- Share interesting facts, common phrases, or cultural aspects related to that language to foster appreciation.
- Create a bulletin board in your classroom displaying key phrases or words in various languages spoken by your students. Encourage students to contribute and share information about their languages.
- Encourage students to create projects, essays, or presentations in their home languages. This not only values their linguistic diversity but also allows them to share their culture with classmates.

4. Learn about and leverage your students' educational experiences

- Encourage students to create timelines or presentations illustrating their educational journey, including details of their previous schools, subjects studied, and memorable experiences.
- Build on students' knowledge and skills that they bring to your classroom. For more information, check out: [Funds of Knowledge](#) and [Good Practice Examples](#)
- Involve students in STEM-related activities that can draw on their community's expertise and knowledge, such as environmental projects or engineering challenges.

Tips:

- When planning Math or Science lessons, involve students by using examples from their backgrounds.
- Use open-ended questions to encourage personal interpretations, allowing them to connect their interests and cultures with the subject for better understanding.

Planning - Language goals in STEM

In STEM instruction, language is crucial for students to grasp and express scientific and mathematical ideas. Set clear language goals to promote students' language development alongside content knowledge acquisition.

1. Offer personalized language support to students

- This can include targeted language exercises, bilingual glossaries, or language-specific tutorials to facilitate STEM comprehension.

The screenshot shows a video player interface for 'The ESCAPE Projects' by Binogi. The video title is 'The angles of a triangle'. Below the video player is a 'Bilingual Concept List' table with three columns: 'Mathematical Term/Concept & Definition (English)', 'Add Your Own Language!', and 'Image / Examples'.

| Mathematical Term/Concept & Definition (English) | Add Your Own Language! | Image / Examples |
|---|------------------------|------------------|
| <p>Euclidean geometry A mathematical system for studying geometry that is based on the work of the mathematician Euclid. Sometimes called school geometry.</p> | | |
| <p>equilateral triangle A triangle with three sides of the same length.</p> | | |

Source: escapeprojects.ca

Language goals in STEM


2. Identify the core language goals and objectives in the subjects you teach.

- For instance, in mathematics, it may involve understanding mathematical symbols, precision in articulating explanations, and interpreting word problems.

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.

Check out this example from our 12-lesson booklet.

[Click here](#) or scan below to check it out!




3. Identify specific language objectives related to listening, speaking, reading, and writing skills in your content area context.

- For example, in science, it could involve using precise vocabulary, presenting data, or explaining complex concepts. List these language objectives and consider how they can be addressed during instruction.

This screenshot is from the Electricity lesson in our 12-lesson booklet. It addresses language goals by introducing the Concept Detective to students in a Minds-On activity.

[Click here](#) to check it out!

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



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.

Language goals in STEM

4. Recognize language skills that can be reinforced across different STEM subjects.

- For example, scientific discourse and argumentation skills may be relevant in multiple disciplines.

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.

This screenshot is from the Measurement: Circumference lesson in our 12-lesson booklet.

This action activity includes filling out a chart - which is an essential skill transferable to other subjects!

[Click here](#) to check it out!

5. Focus on task-level language goals.

- Identify language demands for specific tasks within a lesson, such as reading and interpreting a scientific article or explaining a problem-solving process. Develop strategies to support students' language needs while they engage in the task.

Figure 3.2 Content and Language Objectives Example

| Content Objective | Language Objectives |
|---|---|
| Classify the three main types of rocks and explain the formation of each. | <p>Vocabulary: igneous, sedimentary, metamorphic, molten, lava, magma, sediment, intrusive, extrusive, particles, compressed, conglomerate, minerals, temperature, pressure</p> <p>Language features: "timeless" present tense and passives</p> <p>Type of text: Explanation</p> <p>Language skills: Read short scientific text and provide an oral explanation of content.</p> |

(Cummins and Early, 2015, p. 36)

1.3 Discover the Tools

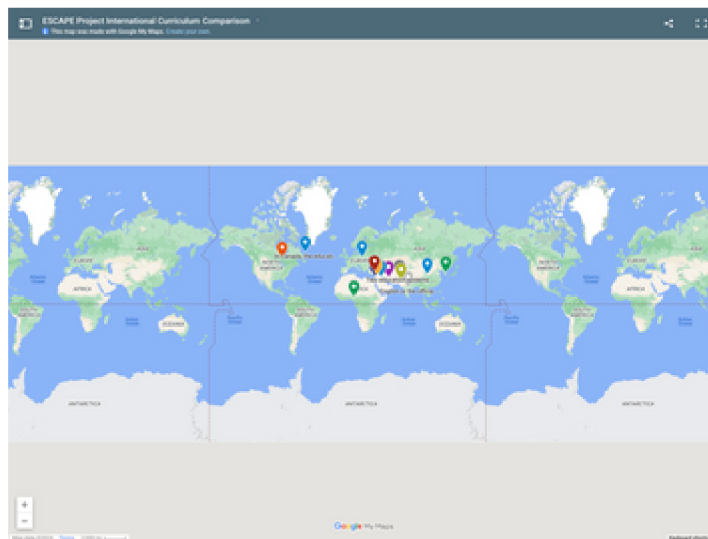
BINO GI

Binogi is a multilingual, digital learning platform for students in grades 6-9. The platform consists of animated lessons and interactive quizzes. Students are able to study math and science in a language of their choosing. Audio tracks and subtitles are easily switched between languages.

This guide refers to Binogi at times, but it is optional when working with ESCAPE Projects resources.

CURRICULUM COMPARISON

On escapeprojects.ca, you can find resources for exploring Ontario curriculum and comparing it to those of different countries. [Curriculum – ESCAPE Projects](#)



CONCEPT LISTS

Concept lists are a language-friendly tool that your students can use to leverage their home languages in STEM subjects. It allows for adaptation and modification to meet the needs of diverse student populations, classroom settings, and individualized learning.

PRINTABLE POSTERS

Printable posters are **downloadable** visual aids that are designed to facilitate learning of the STEM concepts and support the learning needs of multilingual students.

BINO GI

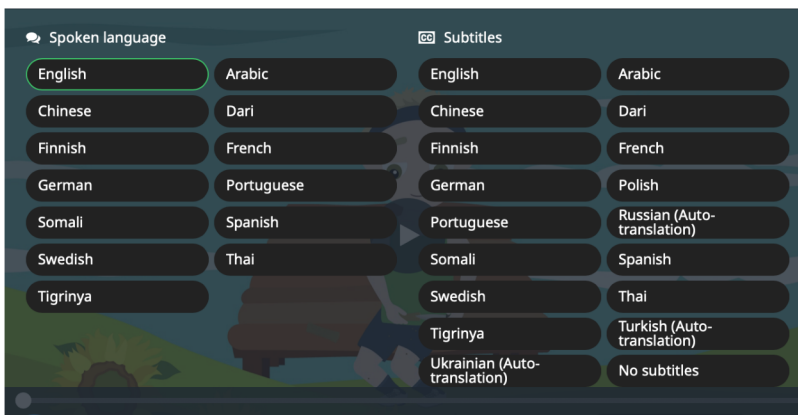
Binogi is a multilingual, digital learning platform for students in grades 6-9. The platform consists of animated lessons and interactive quizzes. Students are able to study math and science in a language of their choosing. Students are able to study in more than 12 languages, including French, Swedish, Arabic, Tigrinya, Dari, Somali, Finnish, and German. The platform is always adding new languages. Students can listen to the spoken lesson and read the subtitles in any combination of these languages (e.g., listen in Arabic and read subtitles in English).

Binogi supports the Sustainable Development Goals(SDGs) by implementing Education for Sustainable Development(ESD) related content. Binogi helps to foster the development of students as global citizens.



Scan to
check out Binogi

Below: A screenshot of the Binogi website, with available languages.

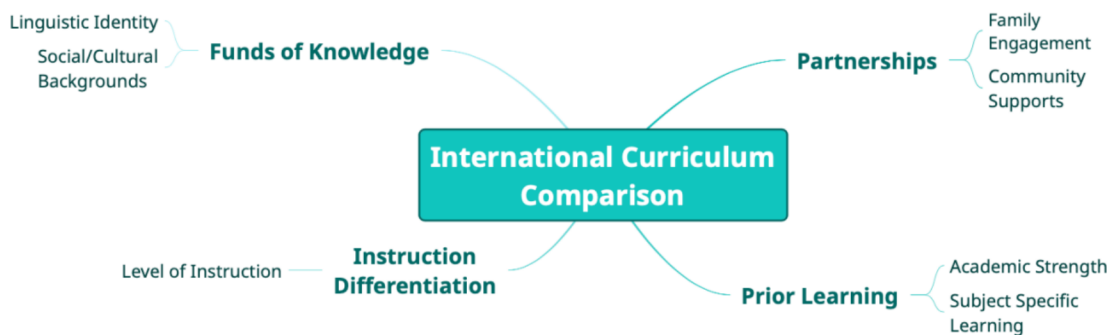


Above: The Binogi mobile app

CURRICULUM COMPARISON

An international curriculum comparison supports teachers in familiarizing themselves with their students' prior learning (i.e.: academic strengths and subject-specific learning) as well as with their funds of knowledge (i.e.: linguistic identity, social and cultural backgrounds). This information is important in providing instruction differentiation needed to support students in achieving different curriculum expectations. It also provides an opportunity for teachers to partner with different communities, and support/engage families in their children's learning.

By comparing different curricula, Escape Projects provides educators access to curriculum organization and content, language of instruction, pedagogical approaches and types of assessment from around the world. This information can be coupled with translanguaging strategies to differentiate instruction and to support students in building on their prior learning and funds of knowledge. Additionally, it promotes the creation of learning communities where the students become active participants in a reciprocal sharing of knowledge.



The table below shows questions ('What,' 'How,' and 'Why') that guided our research and that educators can ask themselves to understand their students better and support them in achieving different learning goals.




| What | How | Why |
|--|---|---|
| <ul style="list-style-type: none"> • What prior academic strength/knowledge do students have in STEM subjects? • What type of assessment have they been exposed to? • What social/cultural format have they been taught? • In which language have they been taught? • What community resources are available to support students? | <ul style="list-style-type: none"> • How can we build on what our students have learned in the country of provenance? • How have they been taught? • How to engage parents and family in the learning process? | <ul style="list-style-type: none"> • Why do a comparative analysis of the curriculum from the home and host country? • Why integrate students' prior knowledge? • Why engage parents and family in the learning process? |

CONCEPT LISTS

Binogi Video: [Renewable Energy Sources](#)

English-Arabic Bilingual Concept List

The Escape Projects

| | | |
|---|---|--|
| <p>Kinetic Energy The energy an object or particle has when it is moving. The heavier an object is or the faster it moves, the higher the kinetic energy of that object.</p> | <p>الطاقة الحركية الطاقة التي يمتلكها الجسم أو الجسم عندما يتحرك. كلما كان الجسم أثقل أو كلما تحرك بشكل أسرع، كلما ازدادت الطاقة الحركية لذلك الجسم.</p> |  |
| <p>Turbine A machine that is made up of a series of blades that are spun by pressure from water, steam or air, in order to generate power.</p> | <p>العنفقة (التوربين) آلة تتكون من سلسلة من الشفرات التي تدور نتيجة الضغط من الماء أو البخار أو الهواء، من أجل توليد الطاقة.</p> |  |
| <p>Generator A machine that generates electricity by converting kinetic energy into electrical energy.</p> | <p>مولد آلة تولد الكهرباء عن طريق تحويل الطاقة الحركية إلى طاقة كهربائية.</p> |  |

Above: Screenshot of Concept List in English and Arabic.

On escapeprojects.ca, you can find concept lists in math and science in many different languages! (French, Mandarin, Arabic, Urdu, Persian, Korean, Dari, Pashto)

Find Science lists here: <https://escapeprojects.ca/multilingual-concept-lists-posters/>

Find Math lists here: <https://escapeprojects.ca/concept-lists-posters/>

PRINTABLE POSTERS

We have created posters on “Signing up your students on Binogi” and “Science and Math: From the Classroom to Home” These posters can be shared digitally or printed and shared with students and their families.

FOR TEACHERS AND STUDENTS



SIGNING UP YOUR STUDENTS ON BINOGI



ESCAPE PROJECTS

<https://escapeprojects.ca>

Want to watch a tutorial video?

<https://tinyurl.com/createbinogiaccount>

GO TO BINOGI.CA

1. Click Sign up
2. Choose 'Google,' 'Microsoft,' or manual entry.
3. Type in First and Last name, email address, and create a password.
4. Click Next
5. Click 'student'
6. Start typing in school name, and click it.
7. Click Next
8. Type in your age (if you are under 13, you need parent permission. Click this box if you have their permission.
9. Click to accept the Privacy Policy and User Agreement.
10. Click 'Sign up'

1

Login

Sign up

4

Next

Already a member? [Log in](#)**5**

Are you a student or a teacher?



Student



Teacher

8

How old are you?

12

Ask your parent or guardian if you can use this service

I am under 13 years of age, but I have my parent/guardians' consent to use this service.

9

I accept the Privacy Policy and User Agreement.

Sign up

FOR STUDENTS & THEIR FAMILIES AND COMMUNITIES



SCIENCE & MATH: FROM CLASSROOM TO HOME

Expanding Web-based
Educational Opportunities
for Students in STEM

Binogi

ESCAPE
PROJECTS

<https://escapeprojects.ca>

MULTILINGUAL
DIGITAL LEARNING
PLATFORM

ACCESS
BINOGI AT
HOME

An opportunity for parents to access curriculum-related content and support their children in the following areas:

- learning and practicing science and math during and outside of school hours
- engage with science and math lessons in the form of short videos and quizzes, available in many languages, and be able to get involved as a family
- watch the videos and add subtitles in the language of their choice.

1. Go to www.binogi.ca and click on "Login."
2. Enter the student's e-mail and password used to create the account at school.
3. Type the name of the Binogi video you wish to watch.
4. Together, students and parents/guardians can watch the Binogi video in the language of their choice.
5. You can provide help/support with the quizzes.
6. For more information, watch the [Binogi at Home](#) video at:
<https://www.loom.com/share/ecb249b2943b46159346a73ee5598492>

1.4 How? Lesson Plans

Sample lesson plans to guide you.

We have a whole collection of lesson plans on our website, including our downloadable **Resource Guide for Teachers**. In the Resource Guide, there are 12 lesson examples for you to reference. The lessons all follow a 3-part lesson plan, including a minds-on activity, an action activity, and a consolidation activity. They are language-friendly and culturally responsive plans for you to modify and use with your class!

The graphic features a large yellow dollar sign icon to the left of the title 'LESSON 12: SIMPLE INTEREST'. To the right is an illustration of a teal cash register with a purple calculator on top. The number '34' is displayed on the calculator's screen. Below the title, there are three main sections: 'Learning Objectives' with a checkmark icon, 'Required Prior Knowledge' with a lightbulb icon, and 'Key Concepts' with puzzle piece icons. The 'Key Concepts' section includes terms like 'Simple Interest', 'Interest Rate', 'Saving', 'Borrowing', and 'Interest', each accompanied by a coin icon.

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
- Interest Rate
- Saving
- Borrowing
- Interest

Above: Screenshot from 12-lesson booklet. [Click here to access](#)

Teaching

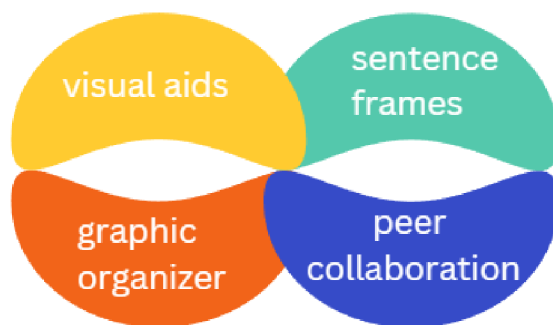
2.1 Scaffolding

Scaffolds are essential for helping our students. They provide the structure and support needed to understand content, develop language skills, engage actively, and demonstrate mastery.

"extensive use of visual cues, manipulatives, pictures, diagrams, graphic organizers; attention to the clarity of instructions; modelling of preferred ways of working in mathematics; previewing of textbooks; pre-teaching of key specialized vocabulary; encouragement of peer tutoring and class discussion; strategic use of students' first languages" (Cummins and Early, 2015, p. 68)

Plan scaffolds

- Create a toolbox of scaffolding strategies that you can use in your lessons to support your students. Include techniques like visual aids, sentence frames, graphic organizers, and peer collaboration.



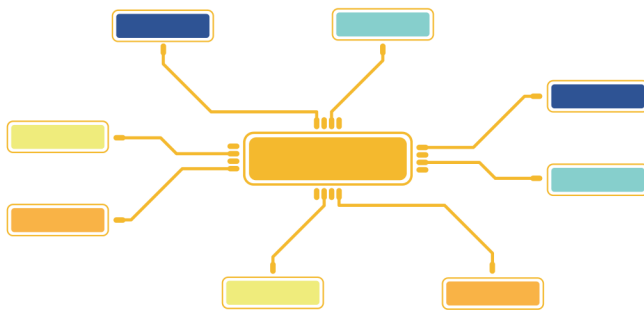
- Match specific scaffolds to different language objectives and tasks in your lesson plans.

Types of Scaffolds

1. Graphic Organizers

Graphic organizers in STEM instruction are visual tools that aid in understanding complex concepts without relying heavily on language. They provide a clear, non-linguistic way to organize information, making STEM subjects more accessible and supporting effective learning.

Example: In a biology lesson on the human digestive system, provide students with a graphic organizer that has labeled diagrams of the digestive organs. Students can write or draw explanations in their preferred language to describe each organ's function.



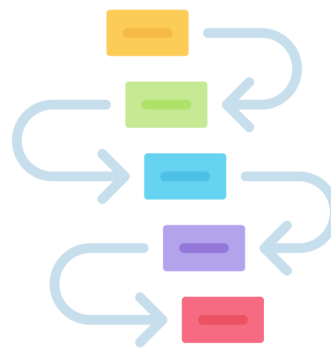
Mind Maps



Venn Diagrams



Pyramid Diagrams



Sequence Charts

Types of Scaffolds

2. Sentence Stems

Sentence stems are prompts or starters that help guide students in constructing complete sentences. They provide a structured way to express thoughts and ideas, making it easier to communicate effectively and improve writing and language skills.



Expressing Opinions:

- English: "I believe that..."
- Mandarin: "我认为..." (Wǒ rènwéi...)
- Arabic: "أعتقد أن..." (A'taqid anna...)

Showing Cause and Effect:

- English: "As a result..."
- Chinese: "因此..." (Yīncǐ...)
- Swahili: "Kwa matokeo..."

Introducing Evidence:

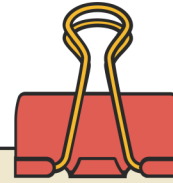
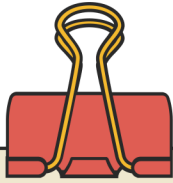
- English: "According to..."
- Spanish: "Según..."
- Arabic: "وفقاً ل..." (Wafqan li...)

Contrasting Ideas:

- English: "On the other hand..."
- Italian: "D'altra parte..."
- Polish: "Z drugiej strony..."

● **Develop visual aids such as anchor charts that reflect the variety of home languages spoken by the students.**

● **Encourage students to actively participate in translating these sentence stems into their languages and practice using them in both oral and written forms.**

**Offering Examples:**

- English: "For instance..."
- Korean: "예를 들면..." (Yereul deulmyeon...)
- Turkish: "Örneğin..."

Making Comparisons:

- English: "Similar to this..."
- Portuguese: "Semelhante a isso..."
- Ukrainian: "Схоже на це..." (Skhozhe na tse...)

Asking for Clarification:

- English: "Could you explain..."
- French: "Pourriez-vous expliquer..."
- Hindi: "क्या आप समझा सकते हैं..." (Kyā āp samajhā sakte hain...)

Providing Reasons:

- English: "This is important because..."
- German: "Das ist wichtig, weil..."
- Hindi: "यह महत्वपूर्ण है क्योंकि..." (Yah mahatvapūrṇa hai kyonki...)

Making Predictions:

- English: "I expect that..."
- Portuguese: "Eu espero que..."
- Ukrainian: "Я очікую, що..." (Ya ochikuyu, shcho...)

Summarizing Points:

- English: "In conclusion..."
- Dutch: "Tot slot..."
- Swahili: "Hitimisho..."

Types of Scaffolds

3. Visual Aids

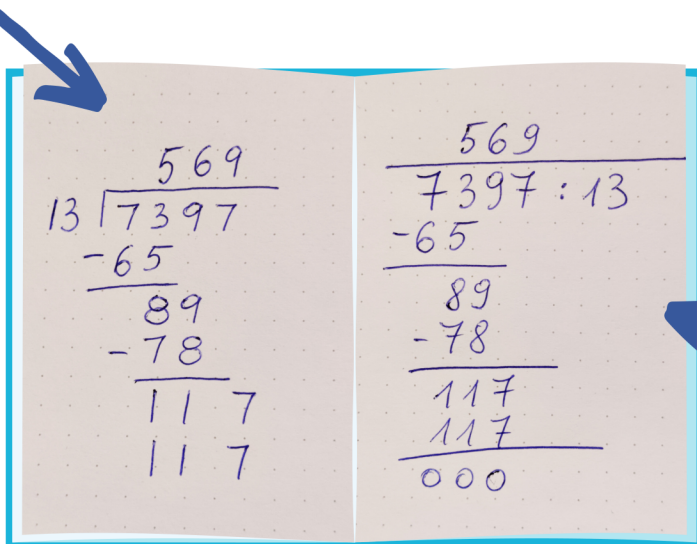
Using visual aids, such as **images**, **videos**, and **graphical representations**, serves as crucial scaffolds, enhancing understanding and engagement by **simplifying complex ideas**.

Incorporating a language-friendly approach in STEM education means you **recognize and value the diverse linguistic backgrounds and representation systems** students bring to the classroom.



To foster inclusivity and accessibility, you should explore **various ways of representing numbers, formulas, and mathematical operations**, acknowledging that students may be familiar with different methods, such as long division styles, symbols, and numerical systems from their home countries.

Long division as taught in Canada



Long division as taught in Poland



Understanding different registers of representations, such as the everyday, school, and technical registers is important for learning. Developing translation skills between these registers not only aids comprehension but also enriches students' mathematical language proficiency.

| | Everyday Register | School Register | Technical Register | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------|---|--|---|---------------------|-------------|----|---------------------------|----------------------|----|-------|-------|----|-------|-------|----|-------|------|----|-------|-----|--|-----------------|----------------------|-------------|----|------|-------|----|-------|-------|----|-------|-------|----|-------|------|----|-------|-----|----|-------|-------|
| Words | My grade collected \$350 from a bake sale for a field trip to the science museum. There are 47 of us in total. The museum admission fee is \$10 per student, and they are giving a \$20 discount for every 10 students. Do we have enough to cover all the students' tickets? If not, how much more do we need, or how much will we have left over? | 47 Grade 8 students raised \$350 for a field trip. The bus can carry 50 students, with entry at \$10 each. The museum offers a \$20 discount for every 10 students. a) Is \$350 enough to cover all the students' admissions? b) If so, how much will be left? c) If not, how much more do they need? | The cost per unit is \$10 and a reduction of \$20 applies for each set of 10 units, with a total of 47 units and \$350 in possession. 1) Determine if \$350 is sufficient to cover the cost of 47 units. 2) If sufficient, calculate the surplus amount post-transaction. 3) If insufficient, determine the additional amount required to meet all 47 units. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Graphic | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Symbolic-numerical | <p>The total cost without discount: 47 students x \$10 per student = \$470</p> <p>The total discount: 4 x \$20 = \$80</p> <p>The total cost with discount: \$470 - \$80 = \$390</p> <p>The amount we need: \$390 - \$350 = \$40</p> | <table border="1"> <thead> <tr> <th>Number of students</th> <th>Total with discount</th> <th>Amount left</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>(10 x \$10) - \$20 = \$80</td> <td>\$350 - \$80 = \$270</td> </tr> <tr> <td>20</td> <td>\$190</td> <td>\$150</td> </tr> <tr> <td>30</td> <td>\$240</td> <td>\$110</td> </tr> <tr> <td>40</td> <td>\$320</td> <td>\$30</td> </tr> <tr> <td>43</td> <td>\$350</td> <td>\$0</td> </tr> </tbody> </table> <p>Need admissions for 4 more students: 4 x \$10 = \$40</p> | Number of students | Total with discount | Amount left | 10 | (10 x \$10) - \$20 = \$80 | \$350 - \$80 = \$270 | 20 | \$190 | \$150 | 30 | \$240 | \$110 | 40 | \$320 | \$30 | 43 | \$350 | \$0 | <table border="1"> <thead> <tr> <th>Number of Units</th> <th>Total with reduction</th> <th>Amount left</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>\$80</td> <td>\$270</td> </tr> <tr> <td>20</td> <td>\$150</td> <td>\$150</td> </tr> <tr> <td>30</td> <td>\$240</td> <td>\$110</td> </tr> <tr> <td>40</td> <td>\$320</td> <td>\$30</td> </tr> <tr> <td>43</td> <td>\$350</td> <td>\$0</td> </tr> <tr> <td>47</td> <td>\$390</td> <td>-\$40</td> </tr> </tbody> </table> | Number of Units | Total with reduction | Amount left | 10 | \$80 | \$270 | 20 | \$150 | \$150 | 30 | \$240 | \$110 | 40 | \$320 | \$30 | 43 | \$350 | \$0 | 47 | \$390 | -\$40 |
| Number of students | Total with discount | Amount left | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | (10 x \$10) - \$20 = \$80 | \$350 - \$80 = \$270 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | \$190 | \$150 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | \$240 | \$110 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 40 | \$320 | \$30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 43 | \$350 | \$0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Units | Total with reduction | Amount left | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | \$80 | \$270 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | \$150 | \$150 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | \$240 | \$110 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 40 | \$320 | \$30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 43 | \$350 | \$0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47 | \$390 | -\$40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Symbolic-algebraic | --- | <p>R = amount raise for the trip (\$350) n = number of students (47) c = cost per student (\$10) d = discount for every 10 students (\$20) x = amount left over or needed m = number of students apply for discount (40)</p> <p>The total cost before discount = $c \times n$ The total discount = $(m/10) \times d$ The total cost after discount = $(c \times n) - (m/10) \times d$ The amount need = $[(c \times n) - (m/10) \times d] - R$ = $[(\\$10 \times 47) - (40/10 \times \\$20)] - \\$350$ = \$40</p> | $10x - \{20 \times (x/10)\} \leq 350$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cultural relevance | Raising a fund for a field trip may be an unfamiliar concept for newcomer students. | Raising a fund for a field trip may be an unfamiliar concept for newcomer students. | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Adapted from "Linguistic registers and their representations," by Prediger, S., Clarkson, P., & Bose, A. (2015). Purposefully relating multilingual registers: Building theory and teaching strategies for bilingual learners based on an integration of three traditions. In Barwell, R., Clarkson, P., Halai, A., Kazima, M., Moschkovich, J., Planas, N., Phakeng, M., Valero, P., & Ubillús, M (Eds.), *Mathematics education and language diversity: The 21st ICMI study*, (pp. 206). Springer.

You can facilitate the development of translation skills by designing activities that encourage students to move between registers they encounter in daily life and those used in the classroom.

This can include translating between chosen or assigned registers, identifying suitable ones, assessing their fit for specific situations, explaining the discovery of mathematical relationships within a particular register, and analyzing various expressions within it. (Prediger and Wessel, 2013)



Ask an AI Chatbot to support you!

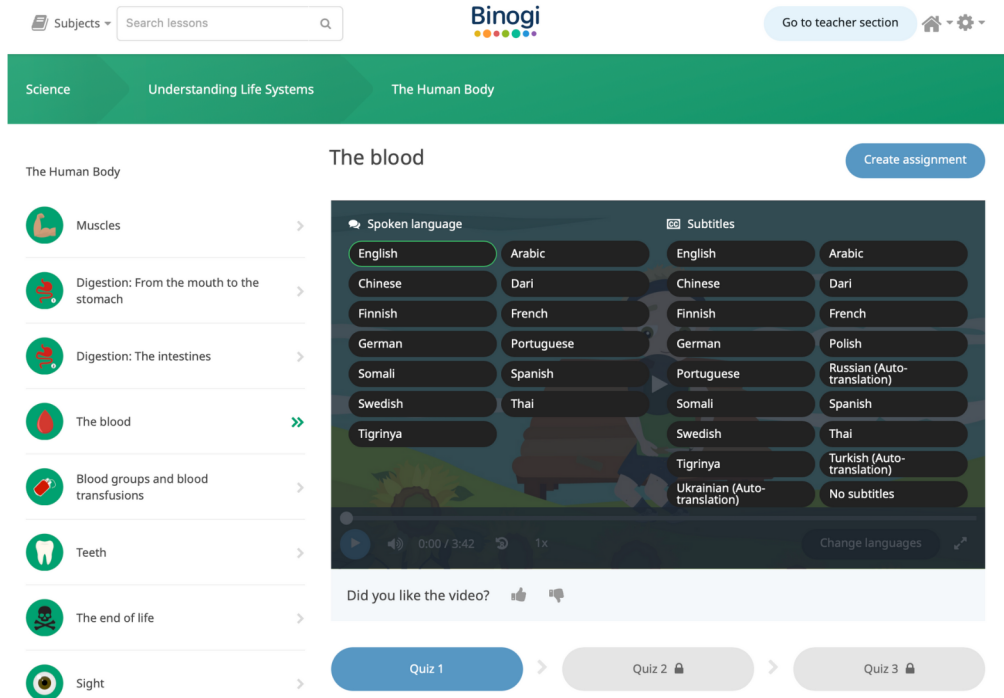
This collection of prompts can be entered into an AI chatbot interface or any educational platform that supports AI interactions. Doing so generates responses in various mathematical registers, allowing you to discuss and analyze these with your students in class.

| | |
|--|---|
| Convert Everyday Language to Mathematical Register | "Translate this everyday statement into a mathematical expression: 'If you buy 5 apples and each costs 3 dollars, how much do you spend in total?'" |
| Explain Technical Terms in Everyday Language | "I have a technical description: 'The sum of two integers is 15.' Can you rephrase that in everyday language a young student might understand?" |
| Identify Suitable Register for a Scenario | "Which register would be most appropriate for explaining the concept of multiplication to a third-grade student, and why?" |
| Translate Between School and Technical Registers | "How would you explain the school-level concept of 'solving for x' in a more technical, algebraic register?" |
| Assess Fit of a Register | "Given this explanation of fractions in a technical register, assess whether it would be suitable for a fifth-grade classroom. If not, how could it be adjusted?" |

| | |
|---|--|
| <p>Create a Dialogue Using Different Registers</p> | <p>"Can you create a short dialogue where a teacher explains a scientific concept in both a technical register and then in an everyday register?"</p> |
| <p>Analyze Expressions in Different Registers</p> | <p>"Analyze the expression 'The derivative of a function at a point gives the slope of the tangent line at that point' in both a technical and an everyday register."</p> |
| <p>Translate Visual Representations into Verbal Expressions</p> | <p>"Here's a graph showing a linear relationship. Can you describe what this graph represents in both school-level and everyday registers?"</p> |
| <p>Explain Mathematical Relationships in Different Registers</p> | <p>"Explain the relationship between the circumference and diameter of a circle in both a technical register and an everyday register"</p> |
| <p>Compare Registers for Different Audiences</p> | <p>"How would you explain the concept of exponential growth to a high school student versus a college student? Use the appropriate register for each."</p> |

Types of Scaffolds

4. Strategic Use of Students' Home Languages



Left: The Binogi platform includes spoken and subtitled languages for all of their video content.

You can use students' home languages at different moments in instruction to enhance comprehension and inclusivity while promoting effective learning. Here are several key strategies for doing so:

| | |
|-----------------------------|--|
| Clarifying complex concepts | Use students' home languages to explain intricate scientific or mathematical concepts, especially when introducing a new topic. |
| Vocabulary Building | Support language acquisition by providing translations or definitions in students' home languages for essential scientific vocabulary. |
| Instructional Transitions | When transitioning between topics or activities, briefly summarize in students' home languages to help them stay engaged and informed. |

| | |
|----------------------------------|---|
| Problem Solving | Encourage discussions and group work by allowing students to use their home languages to brainstorm and solve problems collaboratively. |
| Assessment and Feedback | Offer written feedback and assessments in both the primary language of instruction and students' home languages (through translation), ensuring all students understand their progress. (e.g. Peer feedback can be done in different languages, then teachers can ask students in the school language to check their understanding) |
| Cultural Relevance | When discussing scientific discoveries or historical contexts, incorporate relevant information in students' home languages to create cultural connections. |
| Peer Interaction | Promote peer teaching and support by allowing students to explain complex ideas to each other using their home languages. |
| Project Work | Allow students to present projects or research findings in their home languages, promoting understanding and engagement. |
| Family and Community Involvement | Engage families and community members who speak the students' home languages to participate in classroom activities, providing support and insight. |



DIFFIT

Diffit is an AI-powered tool that allows teachers to adapt content to different levels and languages. Start with text, a video, or a PDF doc, and Diffit will get to work.

Try these AI tools to support you in creating multilingual activities in your classes!



MAGIC SCHOOL.AI

This AI-backed tool supports teachers in creating lesson plans, differentiated resources, and communication with families. It's multilingual and can support bringing students' languages into the classroom.

2.2 Teaching Tips & Tricks

VISUALS

Add visuals for your students who may need it.

| | | | | | | | | | | |
|------|------|--------|------|-----|------|-------|-------|-------|------|-----|
| ١٠ | ٩ | ٨ | ٧ | ٦ | ٥ | ٤ | ٣ | ٢ | ١ | ٠ |
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| عشرة | تسعة | ثمانية | سبعة | ستة | خمسة | أربعة | ثلاثة | اثنان | واحد | صفر |

READING DIRECTION

Remind your students about the reading direction.

Example: Use the table to help you understand numerals. Your answer should be written using the same numerals. (Remember that reading direction in some languages is from right to left ←)

FUNDS OF KNOWLEDGE

Ask your students about their knowledge and practices. Connect activities to students' experiences outside of school.

REASONING

Keep in mind that the way we understand and apply concepts vary. You may be familiar with a 12-month year, but what about 13?



BE PATIENT

Give students extra time to adapt to the new system.

Ethiopia has its own distinctive calendar called the 'Ge'ez Calendar'. It is based on the ancient Coptic Calendar, with a unique system of timekeeping. Below are some fun facts:

The Ethiopian Calendar!



Different Year Count & 13-Month Year 🇪🇹 ⌚

One of the most distinctive features of the Ethiopian calendar is its 13-month year. While the Gregorian calendar, widely used globally, has 12 months, the Ethiopian calendar adds an extra month. Each month consists of 30 days, with a final month having 5 or 6 days, depending on whether it is a leap year. The Ethiopian calendar has a leap year every four years. In a leap year, the additional month of 'Pagumē' has 6 days. The Ethiopian calendar follows a unique year count system. It is roughly 7-8 years behind the Gregorian calendar. For instance, Ethiopia celebrated the start of its millennium at midnight on September 12, 2007. The year 2023 in the Gregorian calendar would be around 2015 or 2016 in the Ethiopian calendar!

Learning

In this section, you will find information on:

3.1 assessment;

3.2 including parents & communities;

3.1 Assessment: How do you know what your students know?

3.2 Including Communities: Welcoming parents, families, and communities into the classroom can be supported through language-friendly resources. Check them out!

3.1 Inclusive Assessment



To effectively assess students in multilingual classrooms, it's important to appreciate the diversity of languages and cultures.

1

Welcome all languages! Recognize and embrace multilingualism in your classroom community, leveraging students' home languages for formative and diagnostic assessment.

2

Implement differentiated assessments to address the diverse learning needs of multilingual students. For instance, provide assessment tasks that offer language options or allow for responses in students' home languages, ensuring equitable opportunities for all.

3

Involve Families! Invite them to share cultural stories and resources for classroom activities, and host workshops to educate them on assessment methods and ways to support their child's learning at home.

4

Integrate digital tools to accommodate diverse learning and foster inclusivity in assessments. Promote literacy development in multiple languages and formats to ensure all students can participate and understand equitably.

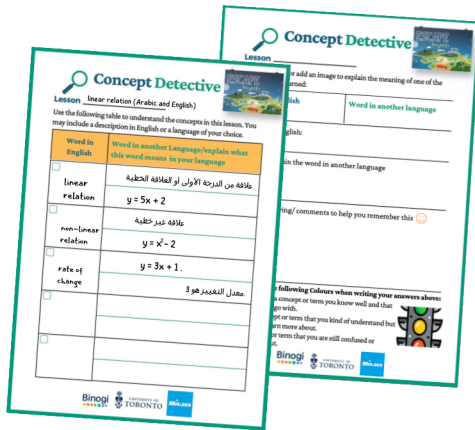
5

In assessment tasks, integrate various language registers with illustrations or drawings and encourage the use of students' home language. For example, students can create a visual representation of a concept, label it in their home language, and explain it using their preferred language style.

6

Acknowledge students' cultural backgrounds and respect their diverse traditions, values, and beliefs by integrating culturally relevant content into assessments to ensure students feel valued and represented in their learning.

Traditional assessment approaches may not always accurately gauge students' understanding due to language and cultural differences. Here, we suggest various tools to assess student learning.



CONCEPT DETECTIVE

Students can self-assess their confidence with new concepts, with teacher feedback for improvement. Encourage students to use this document in every class.

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



AI-BACKED TOOLS

Try Diffit, MagicSchool, Twee, or another AI-chatbot to create customized assessments for your learners. You can even make them in different languages!

Multiple Choice Questions

[Add Questions](#) [Standards](#)

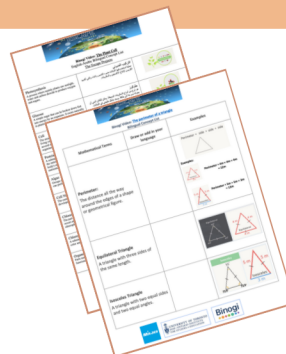
[Share feedback about questions](#)

1. What is the largest industry in Alberta?
 - A) Agriculture
 - B) Tourism
 - C) Oil
 - D) Mining
2. Which river in Alberta is the longest undammed river in the Canadian p
 - A) Athabasca River
 - B) Saskatchewan River
 - C) Columbia River
 - D) Fraser River



CONCEPT LISTS

Engage students with Bilingual or Add your Language Concept Lists, that include key scientific or math concepts. These compiled lists are useful for targeted assessment.



BINOZI QUIZZES

Assign students to watch a Binogi video lesson and complete the quizzes in their preferred language (including subtitles). Each Binogi lesson contains three quizzes, with increasing levels of difficulty, available in various languages.
<https://www.binogi.ca/>



3.2 Including Families & Communities

Consider different ways you can engage families. Communication includes newsletters sent home, and collaboration goes a step further and involves families in the content, For example: planning a workshop with parents.

FAMILY PORTAL

Our Family Portal includes many sections to inform and engage parents and families. Available in: English, French, Spanish, Arabic, Persian, Chinese, Korean, Urdu, Bangla, Pashto, Turkish, Polish.

Access it on our website!

Do you teach in Ontario?

There are resources connected to Grades 6-9 Math & Science curricula.

Ministry resources include sometimes hard-to-find links that are buried in government documents.

Direct parents to 'Other Resources' to find info on Binogi, our Research Project, and other related apps or learning materials that we recommend!

The image displays three screenshots of the Family Portal website, each with a light beige background and a dark teal header. The first screenshot, titled "Curriculum Resources", features a sub-header "Curriculum Resources" and a descriptive paragraph. Below it are two teal buttons: "MATH" and "SCIENCE". Under "MATH" are two bullet points: "Ontario Math Curriculum Overview" and "Expectations & Key Concepts". Under "SCIENCE" are two bullet points: "Ontario Science Curriculum Overview" and "Expectations & Key Concepts". The second screenshot, titled "Ministry Resources", has a sub-header "Ministry Resources" and a paragraph about ministry-approved tools. It also has "MATH" and "SCIENCE" buttons. Under "MATH" are four bullet points: "Ontario Math Curriculum", "Expectations by Strand", "Guides for Parents", and "EQAO". Under "SCIENCE" are three bullet points: "Ontario Science Curriculum", "Guides for Parents", and "Assessment". The third screenshot, titled "Other Resources", has a sub-header "Other Resources" and a paragraph about learning at home. It features three teal buttons: "BINOGI VIDEOS", "ESCAPE PROJECTS", and "RELATED RESOURCES". Under "BINOGI VIDEOS" are four bullet points: "Binogi @ Home", "Parents Info Poster", "Math Videos by Expectation", and "Science Videos by Expectation". Under "ESCAPE PROJECTS" are three bullet points: "Bilingual Math Concepts Posters", "Bilingual Science Concepts Posters", and "Interactive Games". Under "RELATED RESOURCES" are four bullet points: "Math: Prodigy", "Math: YouCubed", "Other Resources", and "Coding: Scratch" and "Coding: code.org".

Information Resources

QUESTIONS?

Reach out to us at apprendreenligne@outlook.com if you have questions or requests for us.

We are happy to hear from you!
Visit the resources for new resources and updates!



12 LESSON BOOKLET

Ready to jump in and start teaching? Check out our resource guide for teachers.

We have the 12 lessons in math and science with lots of activities to get you started.

Click here or go to escapeprojects.ca/uploads???



LANGUAGE FRIENDLY

SCHOOL

Consider learning more about the language friendly school approach.

Check out <https://languagefriendlyschool.org>



SIGN UP ON OUR SITE

Go to www.escapeprojects.ca to sign up for an account. You'll find all the resources in this guide and more!



Click the circle to register!



Glossary

Concept Detective: A document for students to journal new concepts, along with any translations, descriptions, or drawings. There is an included self-assessment for students to determine their own confidence with the concept.

Concept List: A multimodal, multilingual list of concepts found in STEM content areas. Students can work on adding images and concepts in other languages or describing terms in their own understanding.

Flipped Classroom: An instructional approach in which teachers assign instructional content, typically in the form of video lectures, readings, or multimedia resources, as homework before a class. The actual class time is dedicated to active, student-centred learning activities, discussions, and collaborative projects that allow students to apply, deepen their understanding, and seek clarification on the pre-learned material.

Funds of Knowledge: The experience, wisdom, and life skills that students bring to the classroom.

Language-Friendly Approach: Teaching and learning recognizes the importance of linguistic diversity and aims to create an inclusive environment for every student.

Reciprocal Knowledge: An approach in which teachers consider learning as mutual and understand that students have lots to teach us.

3-Part Lesson: A method of instruction. Minds On, Action, and Consolidation are the 3 parts that make a "3-Part Lesson".

1. **Minds On Activity:** A learning task that involves discussions, debates, hands-on experiments, critical thinking exercises, and tasks that stimulate the brain and foster deep understanding of a subject.
2. **Action Activity:** An activity that can be used to supplement a lesson, provide extra practice, and aid in the development of students' understanding and the application of concepts studied in class.
3. **Consolidation:** The third part of the three-part lesson plan. Taking new learning and practicing and summarizing it. For example: whole class discussion, gallery walk, etc.