# The cultural approach to elementary school mathematics

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Direction de la formation générale des jeunes
Ministère de l'Éducation

Québec

# Welcome!

- **Geneviève Côté**, Coordinator, Arts Education program and Culture-Éducation files
- **Éric Yelle**, Arts teacher (loan of service), Arts Education program and Culture-Éducation files
- **Geneviève Dupré**, Coordinator, Mathematics program
- **Raymond Nolin**, Elementary school teacher (loan of service), Mathematics program
- **Esther Veilleux**, Secondary school mathematics teacher (loan of service), Mathematics program

# Objectives of the meeting

- Show the importance of the teacher's role in integrating culture into school subjects
- Define the idea of a cultural reference
- Identify selected cultural references that are an integral part of mathematics

# Presentation outline

1. Professional competencies
2. Definition and characteristics of a cultural reference
3. Selecting cultural references
4. Cultural references in mathematics
5. Cultural activities
6. Reflection questions

# Culture

**All of the social phenomena specific to a community or society of people.**
[translation]

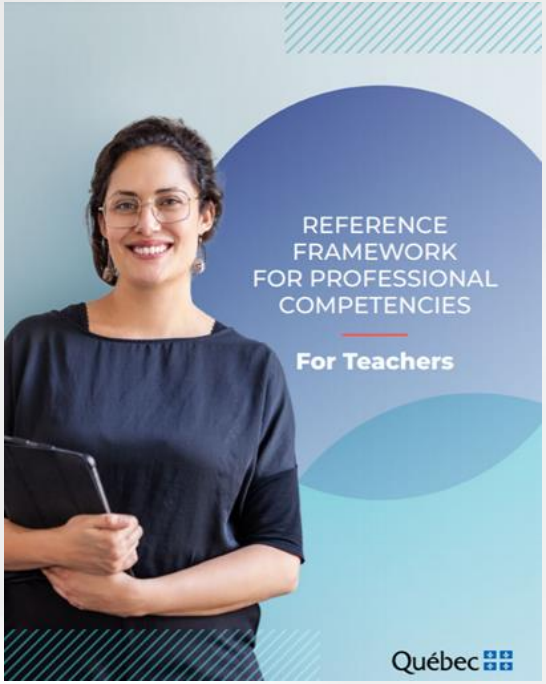
R. Legendre, *Dictionnaire actuel de l'éducation*. 2005

# 1 Professional competencies

## Statement of competency 1

"Act as a cultured professional who is at once an interpreter, facilitator and critic of culture when carrying out duties.".

"Competency 1" from MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Reference Framework for Professional Competencies*, For Teachers, Québec, Gouvernement du Québec, 2020. p 48- 49.



# Fundamental competencies

- Cultural competency
- Mastery of the language of instruction
- These competencies are described as fundamental because neither school nor teaching would exist without them.

# Culture: the basis of education and teaching

- Students take ownership of their cultural heritage through the agency of the teacher as facilitator.
- This cultural heritage is composed of symbolic languages developed by humans.
- These languages are essential to the construction of human identity.
- Culture varies based on the era and place as well as national and cultural traditions or political and pedagogical ideologies.

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Reference Framework for Professional Competencies*, For Teachers, Québec, Gouvernement du Québec, 2020. 112 p.

## Teachers' work as cultured professionals, interpreters, facilitators and critics of culture consists in:

- introducing students to a variety of cultural references that are part of the world heritage of humanity
- making the meaning of cultural objects explicit and pertinent
- making connections between these objects, the educational content and youth culture
- encouraging students to take a critical and reflective stance toward culture

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Reference Framework for Professional Competencies*, For Teachers, Québec, Gouvernement du Québec, 2020. p. 48-49. 112 p

# To integrate culture

- Demonstrates an in-depth understanding of the content of the Québec Education Program
- Makes connections between everything they learn in the classroom, between the subject taught and cultural heritage
- Encourages students to develop critical thinking skills
- Turns the classroom into an inclusive cultural space

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Reference Framework for Professional Competencies*, For Teachers, Québec, Gouvernement du Québec, 2020. p. 48-49. 112 p.

# To integrate culture

- Encourage students to share their culture
- Encourages open and critical dialogue between the culture of the students and that conveyed by the school
- Casts a critical look at own origins and cultural practices
- Collaborates with the community and local cultural organizations

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Reference Framework for Professional Competencies*, For Teachers, Québec, Gouvernement du Québec, 2020. p. 48-49. 112 p.

# Other competencies from the reference framework that pertain to culture

- Competency 6
  Manage how the class operates

- Competency 7
  Take into account student diversity

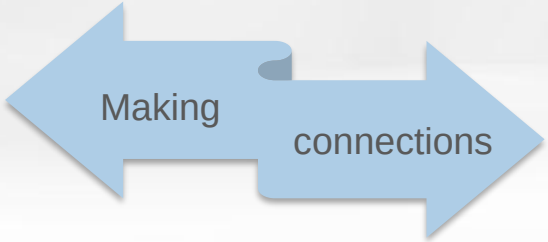
- Competency 8
  Support students' love of learning

Primary culture

## Immediate culture

Teachers help students become aware of their culture:

- Their original community
- The preconceptions and prejudices they have about cultural objects
- The influence of social agents: family, media, advertising, hobbies, etc.



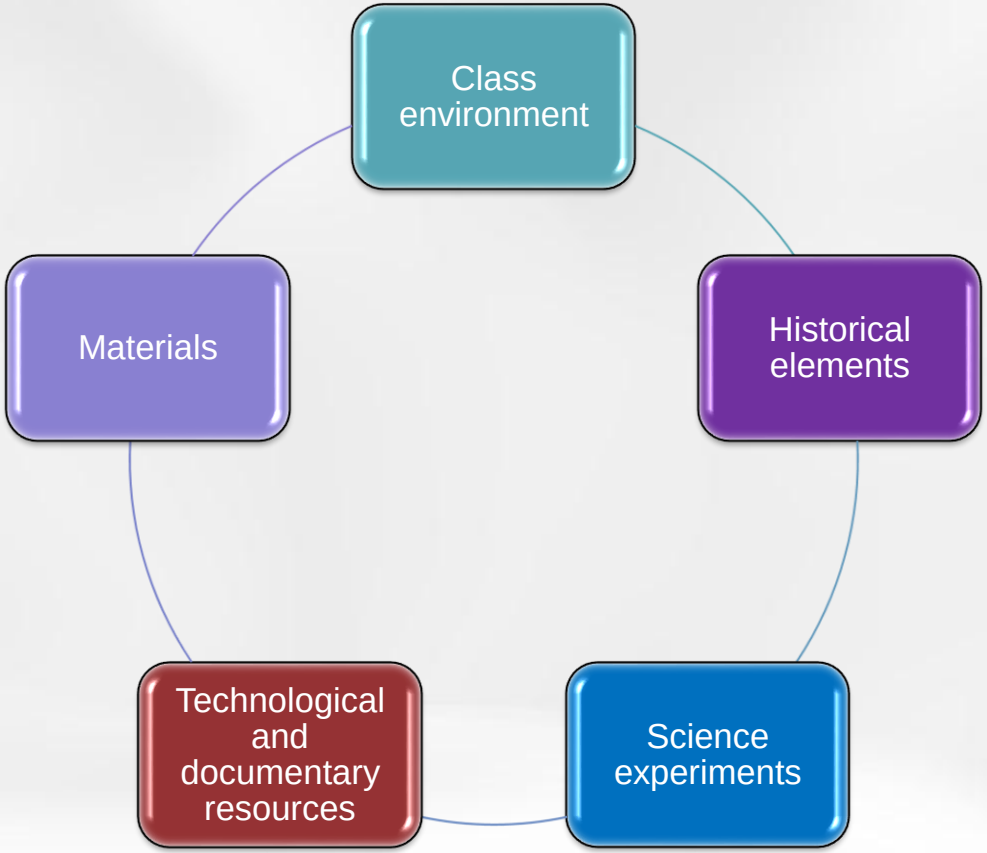

Secondary culture

## General culture

Teachers use the QEP and go deeper by:

- Suggesting different viewpoints
- Increasing the number of reference points
- Allowing students to understand diverse facets of the world and distance themselves from their primary culture
- Encouraging students to develop a new relationship with culture

# The cultural approach to mathematics



# 2 Definition of a cultural reference

"Cultural references are focuses of learning that are culturally significant and whose use in the classroom enables students to enrich their relationships with themselves and others and the world."

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Integrating the Cultural Dimension into School*, Québec, Gouvernement du Québec, 2003, p. 9.

# Short video on cultural references

www.youtube.com/watch?v=SUqD93dRT1s&list=RDCMUCgcPCv5VQhsAY3vNNoH6Zrw&index=1

# Different types of references

- An event
- A piece of media
- An object used in daily life
- A heritage object
- A personality
- A territorial reference
- A work of art
- A scientific discovery
- A school of thought
- Values, etc.

# References originate in different fields

- Art
- Sociology
- Science
- History
- Anthropology

# References represent

- A period
- A school of thought
- Societal values
- Responses to various historical issues
- The imaginativeness and creativity of human beings

# References enable students to:

- become open to other realities
- become open-minded when faced with elements that they do not have access to in their environments
- discover diversity and better understand differences
- make connections between the present and the past
- recognize the similarities and differences between here and elsewhere as well as the self and others

# References develop

- sensitivity
- awakened senses
- imagination
- critical thought
- interest in visiting cultural venues

# 3 Selecting cultural references

- Level 1: identify the origin
- Level 2: identify the nature
- Level 3: identify the knowledge
- Level 4: identify links with the QEP

# Selecting cultural references

## Mathematics

A cultural reference meets one of the criteria for levels 1, 2 and 3 as well as one of the criteria of each element for level 4

**Level 1**
**Identify the origin**

- ❑ Immediate culture: the world of the student
- ❑ General culture: local cultural heritage, cultural heritage elsewhere and manifestations of culture around the world.

**Level 2**
**Identify the nature**

- ❑ Represents a period, a school of thought, societal values, etc.
- ❑ Responds to problems faced over time
- ❑ Demonstrates the power of imagination and the scope of human creativity

**Level 3**
**Identify the knowledge**

- ❑ Openness to the immediate environment
- ❑ Openness to external realities
- ❑ Personal development of the student

**Level 4**
**Identify links with the Québec Education Program**

**SUBJECT-SPECIFIC COMPETENCIES**
To solve a situational problem
To reason using mathematical concepts and processes
To communicate by using mathematical language

**USE IN CLASS**
Interdisciplinary project
Learning and evaluation situations

**BROAD AREAS OF LEARNING**
Health and well-being
Personal and career planning
Environmental awareness and consumer rights and responsibilities
Media literacy
Citizenship and community life

**CROSS-CURRICULAR COMPETENCIES**
Intellectual competencies
Methodological competencies
Personal and social competencies
Communication-related competencies

References: *Integrating the Cultural Dimension into School,* MEES, 2003, p. 16-17; and the *Québec Education Program, Elementary Education,* MEES, 2001.

# Principles for integrating the cultural dimension into school

- Know the history, methods, principles and evolution of the subject taught
- Master the competencies, principles and concepts that are intrinsic to the subject
- Possess a pedagogical knowledge of the subject taught
- Make sure the information given to students is valid

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Integrating the Cultural Dimension into School*, Québec, Gouvernement du Québec, 2003, p. 20.

# Principles for integrating the cultural dimension into school

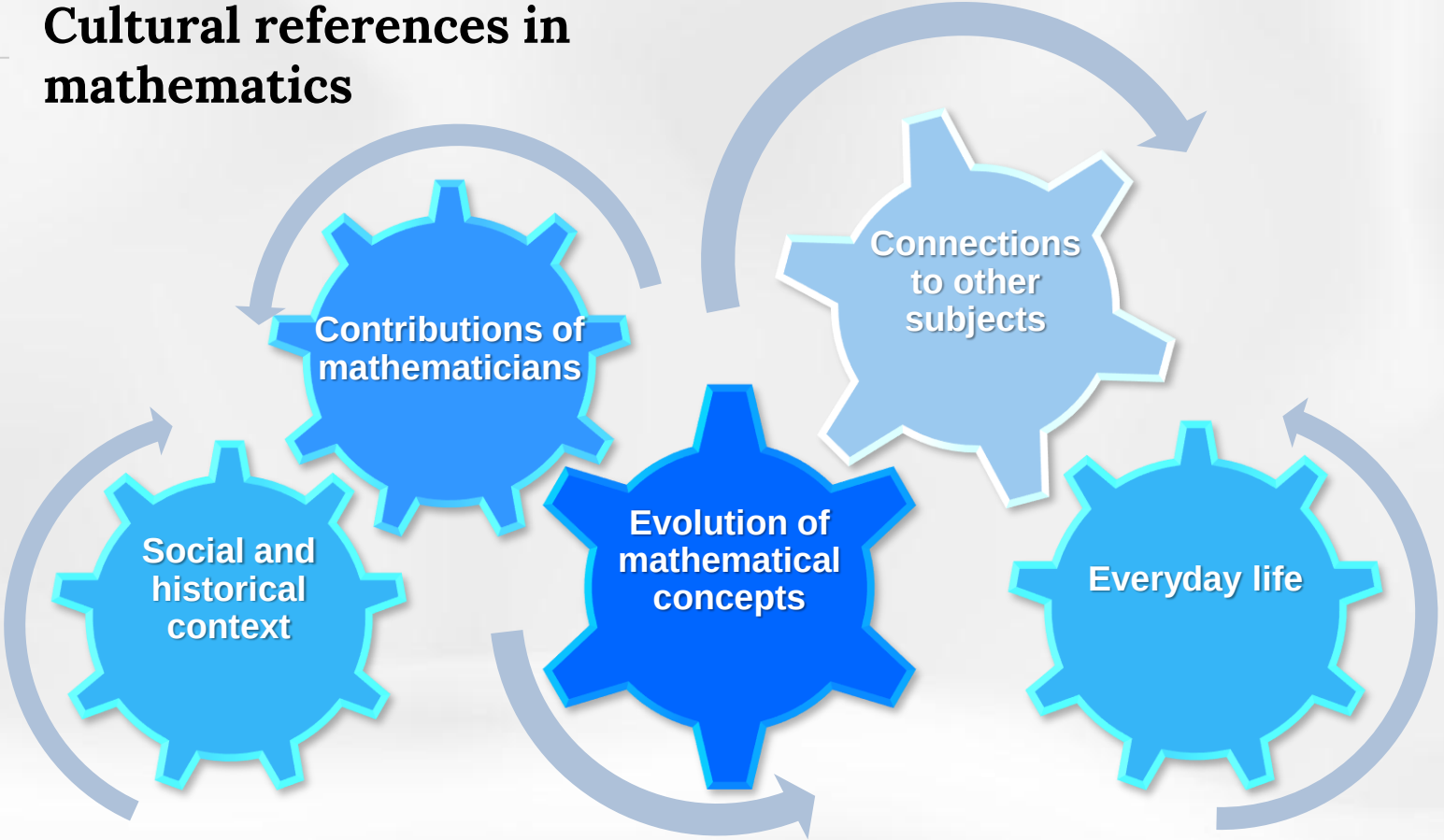
- Diversify human, material and technical or institutional educational resources.
- Avoid both elitism and excessive populism.
- Do not be dogmatic or moralistic
- Avoid drawing all cultural references from a single kind of culture (immediate or general)

MINISTÈRE DE L'ÉDUCATION DU QUÉBEC, *Integrating the Cultural Dimension into School*, Québec, Gouvernement du Québec, 2003, p. 20.

"Incorporating a historical dimension into the mathematics curriculum is an excellent way of enhancing its cultural component. This provides students with the opportunity to understand the evolution, meaning and usefulness of mathematics and to discover that the invention [...] of certain instruments [...] were [...] related to practical needs [...]. An overview of history can also illustrate the fact that mathematical knowledge results from the extensive work of mathematicians with a passion for their subject."

*Québec Education Program, Elementary Education, Mathematics,* MEES, 2001, p. 141.

# 4 Cultural references in mathematics



# Cultural references specific to each branch of mathematics

# Arithmetic – Numbers

- Origin and creation of numbers
- Development of systems for writing numbers
- Different number systems
- Social context

*Québec Education Program, Elementary Education, Mathematics*, MEES, 2001, p. 154.

# Arithmetic – Operations

- Own or conventional computation processes
- Development of computation tools and equipment
- Symbols such as +, −, >, <, =, ×, ÷, ≠, ( ) and %
- Interdisciplinary or social context

*Québec Education Program, Elementary Education, Mathematics,* MEES, 2001, p. 154.

# Geometry

- Geometric figures
  - Interdisciplinary or social context
  - Symbols such as ∠, // and ⊥

*Québec Education Program, Elementary Education, Mathematics,* MEES, 2001, p. 154.

# Measurement

- Systems of measurement
- Units of measure
  - development according to society's needs
  - Inventions of new instruments
- Unit symbols:
  - For length: km, m, dm, cm, mm
  - For mass: kg, g
  - For volume: L, mL
  - For time: h, min, s
  - For temperature: °C

*Québec Education Program, Elementary Education, Mathematics,* MEES, 2001, p. 155.

# Probability and statistics

- Origin and evolution of random experiments, probability calculations and development of statistics
- Mathematicians' contributions to the growth of this field
- Games of chance
- Statistical data

# 5 Cultural activities

- On the Ministère's website, in the Culture-Education section of the School Network tab

  www.education.gouv.qc.ca/en/teachers/dossiers/culture-education

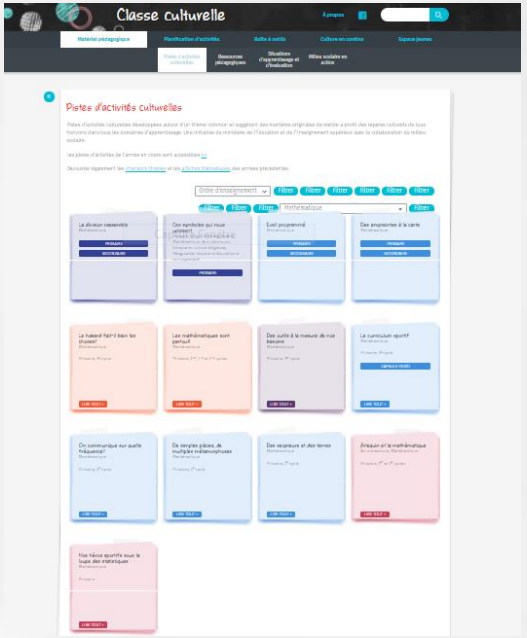
- On the *Classe culturelle* website, in the *Pistes d'activités culturelles* section of the *Matériel pédagogique* tab (available in French only)

  classeculturelle.ca

- Coming soon: the *Par ici la culture en mathématique* website (available in French only)

# Cultural activities

- **Arithmetic**:
  - Division brings us together
- **Geometry**:
  - Des seigneurs et des terres [available in French only]
- **Measurement**:
  - Des outils à la mesure de nos besoins [available in French only]
- **Probability**:
  - Le hasard fait-il bien les choses? [available in French only]
- **Statistics**:
  - Nos héros sportifs sous la loupe des statistiques [available in French only]



# DIVISION BRINGS US TOGETHER

**Cultural references**

- Origin and evolution of symbols in mathematical writing
- Mathematical reasoning used in daily life

**Anecdote**

Do you know about the eye of Horus, the falcon god? The sum of the fractions that make up this Egyptian symbol is only 63/64. Legend has it that Horus declared war on his uncle Seth to avenge his father's death. During a battle, he lost his eye, and it broke into six pieces. The 1/64 missing from this symbol represents the fragment that was never found.

**Context**

From the oldest forms of written division, notably from the Egyptians, to today, division appears in everyday life situations where sharing is involved. From a young age, children use personal processes to calculate how to share their snack or toys fairly. Students look at the principles, terms and symbols of division to solve various problems from everyday life that require this operation.

Activity 1

**Historical division**

Students discuss everyday situations where they are required to use the principles of division. They also research the origins of the first division algorithms and the symbols associated with them. They practice applying different methods of division used by various groups. Finally, students arrange the elements into a conceptual framework.

Activity 2

**Division in art**

Students learn about the mathematical aspect of the eye of Horus as well as artists who use mathematical concepts to produce their work. Working with a visual arts teacher, the students participate in an art project where, in small groups, they create images using one of the concepts studied and that can be assembled into a fascinating whole.

Activity 3

**Social divisions**

Students are visited, either in person or digitally, by members of different social justice organizations who use division or fractions on a regular basis. This can include humanitarian workers who need to ration food, economists or chefs who cook meals for the poor. Inspired by these visits, students find mathematical solutions to world issues that cause social and economic divisions.



# Additional resources

**Targeted elements of the QEP**

- Recognize different meanings of fractions (sharing, division, ratios)
- Represent a situation using an operation (use of different meanings of operations)
- Written computation of the four operations involving numbers that are easy to work with (including large numbers) using equivalent ways of writing numbers and the properties of operations

**Questions that students could be asked during the activity**

- How are fractions and decimals related to the concept of division?
- How have the processes used for division changed over time?
- What aspects of mathematics can be seen in art?
- What are some situations in everyday life that require the use of division?
- How can we reduce inequalities in how wealth is shared?

**Suggestions for activities with partners**

- Invite someone who works in a field that has ties to mathematical division
- As part of the *Culture in the Schools* program, invite an artist in the Répertoire culture-éducation who uses a mathematical approach in their work (English content available)
- Invite a sociologist or anthropologist to discuss the question of social inequalities in how resources are shared

**References**

- Discover the meaning of various math terms in French and in English in Mathematics Glossaries for Kids
- Learn about the history of division, from its origins to the Galley method (in French)
- Find out more about the connection between art and mathematics in English and in French
- Find information about the inequality of wealth in Québec (in French)

# Reflexion and discussion activity

**Topic 1:**

**The taste for discovery**

Be it science, the arts, languages or physical education, everything is open to investigation.

**Topic 2:**

**On the same frequency – in harmony with nature**

Across continents, the rhythm of human life is determined by the seasons, the weather and variations in climate.

**Topic 3:**

**Imagine what endures – Building bridges to the past**

When you look closely, you can see that our environment is dotted with footprints from the past.

# Cultural activities

## Example of a reference to Inuit culture

**INFO LANGUES**

De tradition essentiellement orale, les Inuits ont mis au point un système de dénomination des nombres qu'ils voulaient pratique et accessible à tous les membres de la société. Dans leur langue, l'inuktitut, chaque mot se présente sous trois formes : le singulier (par exemple, le mot *Inuk* fait référence à une seule personne), la dualité (*Inuuk* représente deux personnes) et le pluriel (*Inuit* renvoie à plusieurs personnes). Pour exprimer les nombres supérieurs à deux, les Inuits ont donc emprunté aux Européens leurs chiffres et ont introduit le mot *atausiq* pour désigner le chiffre un et *marruuk* pour désigner le chiffre deux. Cet exemple montre la dimension culturelle des mathématiques, qui évoluent toujours selon les besoins de la société.

Les Inuits utilisent un système en base 20 ; le mot *avatit,* qui signifie « vingt », représente les deux mains et les deux pieds, mais surtout les vingt doigts et orteils qui y sont attachés ! C'est ce qui explique que le mot *qulit* (ou dix) se traduit par *haut* (c'est-à-dire les deux bras) et que le mot *tallimat* (ou cinq) désigne un seul bras (car au bout de chaque bras se trouvent cinq doigts).

Source:

Louise Poirier, professeure au Département de didactique, Université de Montréal.

Would you like to learn more about different numbering systems?

www.languagesandnumbers.com/numbering-systems/en

# Cultural activities

**Examples of references to the cultures of Indigenous peoples**

- Wampum (tesselation): The necklace or belt that was key to trade for the Wendat
  https://www.canadashistory.ca/education/classroom-resources/wampum-belts
- Time and seasons
  The cyclical nature of seasons: birth, youth, adulthood and death. Indigenous peoples lived according to the rhythm of the seasons, as they governed the lives of the people.
  https://www.rcaanc-cirnac.gc.ca/eng/1316530132377/1535460393645#un2 (Unit 2)

# Cultural activities in mathematics

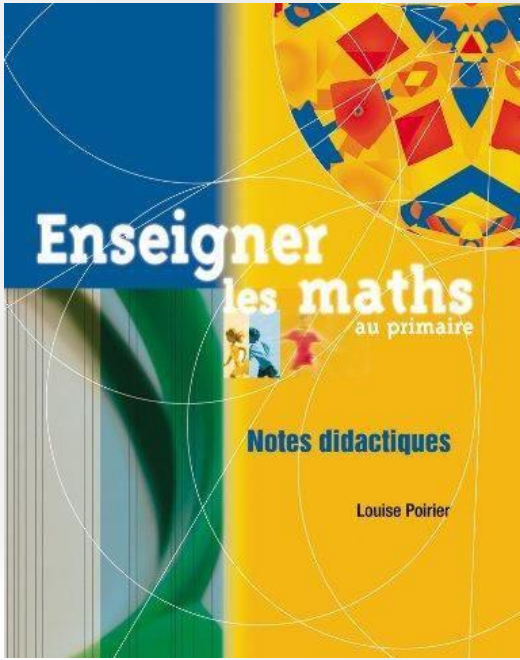
## Examples of references to historic cultures

**As Poirier (2001) states:**

”**In ancient times**, measurement was characterized by the use of parts of the human body and other more “contextual” units, and by the great diversity of the relative values of various units of measurement.” (p. 165) [Translation]

“The basic unit for measuring length **in Ancient Egypt** was the cubit (forearm), which measured about 52.3 cm. It was divided into palms (width of the palm of the hand, excluding the thumb) and fingers (width of the finger)” (p. 166) [Translation]

“The measure of length **in Mesopotamia** was based on the Sumerian cubit, which measured 49.5 cm.” (p. 167) [Translation]

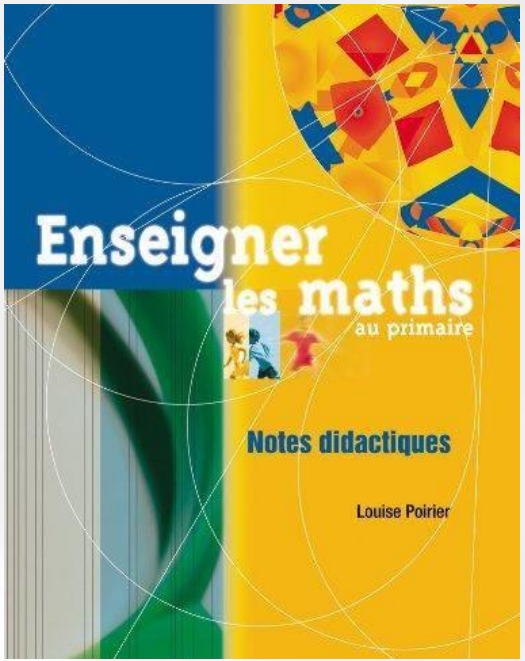


# Cultural activities in mathematics

## Examples of references to historic cultures

**As Poirier (2001) states:**

”**In Ancient Greece**, measurements of small lengths were based on the foot, which had a value that ranged from 27 cm to 35 cm in length, depending on the region. The method used to express large lengths depended on the context in various societies. **The Romans** used the pace; one pace was 5 feet. Romans expressed long distances in terms of travel on foot along their well-developed road system based on how fast an army could move. The Greeks used the “stadion”, which originally corresponded to the length of a running track.” (p. 168) [Translation]



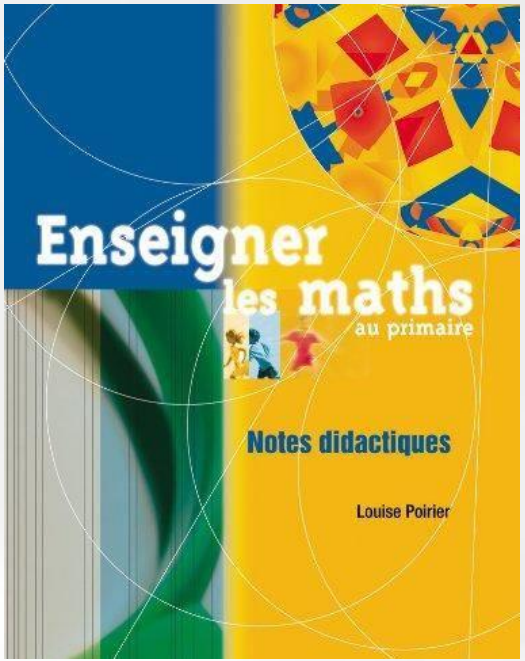
# Cultural activities in mathematics

## Examples of references to historic cultures

**As Poirier (2001) states:**

"**During the French Revolution**, thinkers wondered whether they should continue using the king's foot or inch in order to measure. After all, by overturning the monarchy, they were also getting rid of the system of measurement." (p. 168-169) [Translation]

"Therefore, scientists asked many questions. […] A unit of length was chosen based on immutable nature. The Earth was chosen. […] The geographic meridian was chosen because, as Denis Guedj said: "a meridian runs under the feet of each person and all meridians are equal". The question was settled in the spirit of the French Revolution." (p. 169) [Translation]



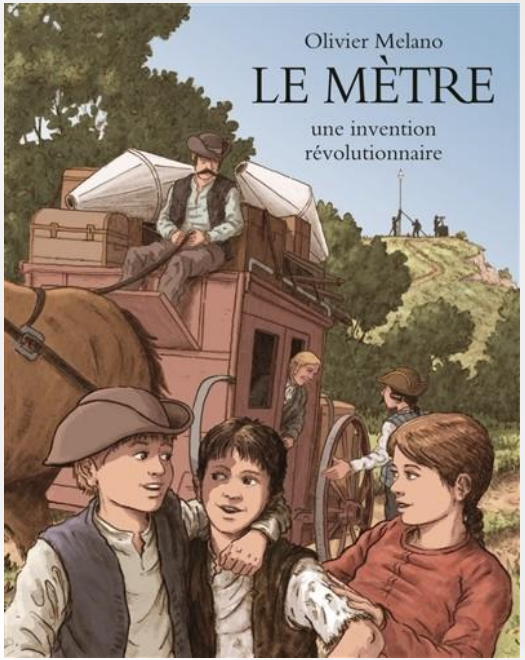
# Cultural activities in mathematics

## Example related to children's literature

**Summary:**

"In 1792, two men arrive in the village of Mennecy, in France. In these troubled times, the two men are soon suspected of being spies paid by the Prussians. However, they are just scientists sent by the Académie des sciences to measure the Paris meridian. Thankfully, the mayor and two brave children come to the aid of the scientists and allow them to avoid the worst.[…]

At the end of the book, a text including photographs provides specific historical and scientific information related to the subject." [Translation] constellations.education.gouv.qc.ca/index.php?p=il&lo=50834&sec=2



# Other resources

- Constellations: constellations.education.gouv.qc.ca
  - Suggested readings for all subjects
- Télé-Québec en classe: enclasse.telequebec.tv
  - Elementary School Mathematics
    - Short videos: À quoi ça sert… les maths?
  - Secondary School Mathematics
    - Short video: L'histoire du système métrique

# 6 Reflection questions

- And you? Can you imagine integrating a cultural dimension into your teaching?
- Concerns?
- Challenges?
- Ideas?

# Thank you!

## Any questions?

Contact us:

Mathematics program team:
FGJ-math@education.gouv.qc.ca

Culture-Éducation team:
politique-culturelle@education.gouv.qc.ca

# Reflection and discussion activity

## Topic 1: The taste for discovery

Be it science, the arts, languages or physical education, everything is open to investigation.

**WHAT?**

**WHY?**

**HOW?**

# Reflection and discussion activity

Across continents, the rhythm of human life is determined by the seasons, the weather and variations in climate

## Topic 2 : On the same frequency – in harmony with nature

WHAT?

WHY?

HOW?

# Reflection and discussion activity

## Topic 3 : Imagine what endures – Building bridges to the past

When you look closely, you can see that our environment is dotted with footprints from the past.

**WHAT?**

**WHY?**

**HOW?**