

# **An African and Aboriginal perspective on the use of the environment in mathematics education: What does the world stand to gain from this approach?**

**非洲与原住民视角关于利用环境教数学：世界能从这方法中获得什么？**

By

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**African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindsor, Oct. 2-4, 2019**

# Status of math/science education

## 数学/科学教育现状

- **Low enrolment/poor performance in math/science.**  
低录取，成绩差
- **In today's world, “students are bored by math, science and engineering. They buy smartphones and tablets by the millions but don't pursue the skills necessary to build them”** (*Adapted from New York Times, Dec. 8, 2013*).  
学生对数学、科学和工程感到厌烦
- **“Math is the worst curricular villain in driving students to failure in school. When math acts as a filter, it not only filters students out of careers, but frequently out of school itself”** (*National Research Council [NRC], 1989, p. 7*)  
数学是学校课程中促使学生失败的罪魁祸首

## STATUS OF MATH EDUCATION (Contd.)

### 数学教育现状

**“Public attitudes about mathematics are shaped primarily by adults’ childhood school experiences. Consequently, math is seen not as something that people actually use, but as a best forgotten (and often painful) requirement of school.**

公众对数学的态度主要来源于成人儿时的学校经历。因此，数学不被看作是使用工具，而是最好被忘记掉的痛苦。

**For most members of the public, their lasting memories of school mathematics are unpleasant – since so often the last math course they took convinced them to take no more” (NRC, 1989).**

对大多数人来说，数学造成持续的不愉快记忆。

## STATUS OF MATH EDUCATION (Contd.)

### 数学教育现状

- “To battle poor math scores, parents in Ontario, Alberta, and British Columbia” [all in Canada] started petitions...asking governments to revamp curriculums...” (*Alphonso & Maki, 2014*).  
为了提高数学成绩，安大略省、阿尔伯塔省和英属哥伦比亚省的家长开始向政府请愿，要求修改课程。
- “America’s results for literacy were disappointing, but mathematics and problem solving proved to be especially embarrassing...” (*Beard, 2013*).  
美国的识字水平让人失望，但是数学和解决问题能力尤其让人担忧。

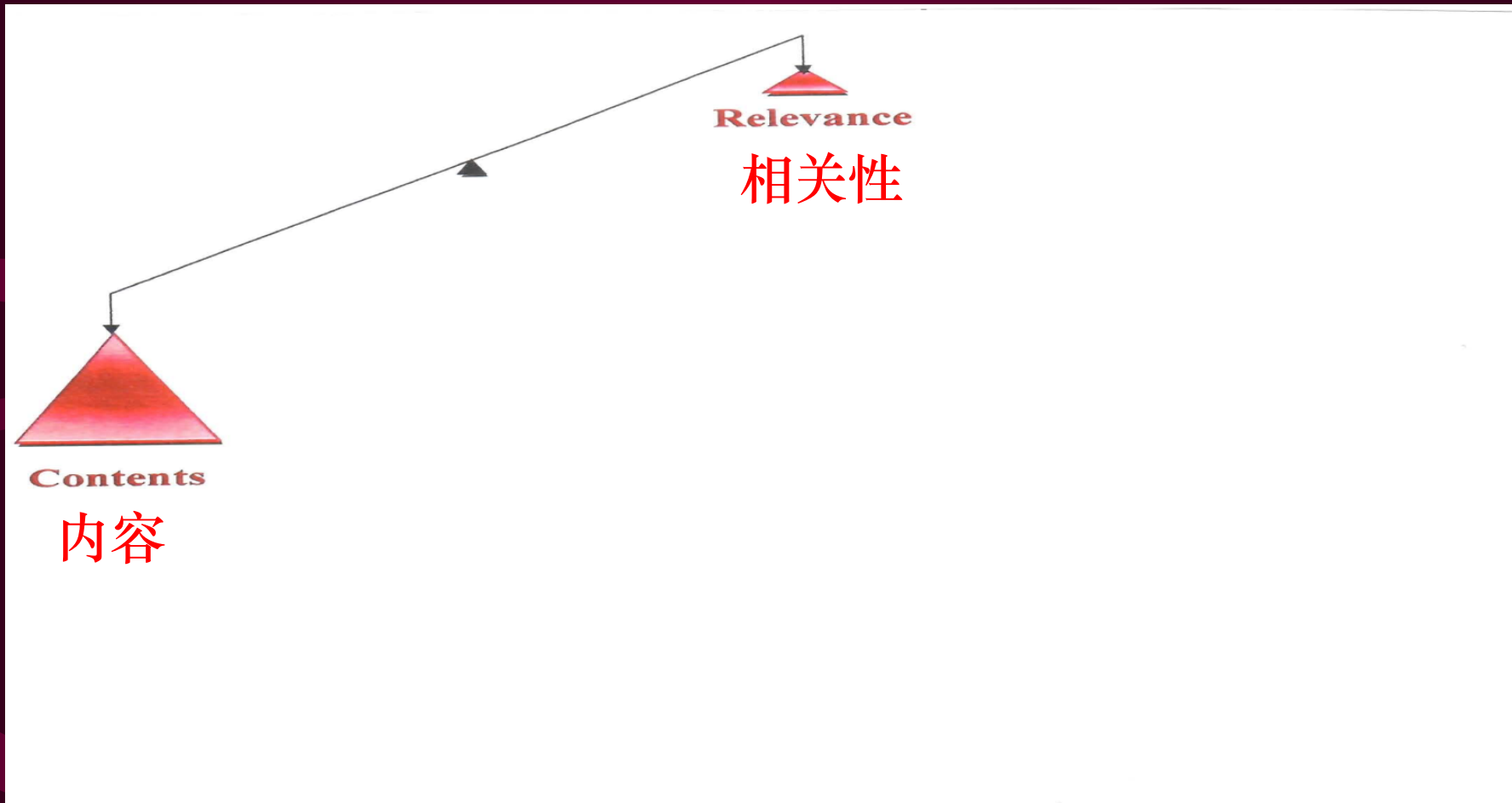


## Reasons for status quo (the lack of interest, poor performance, etc.

造成现状的原因（兴趣低，成绩差）

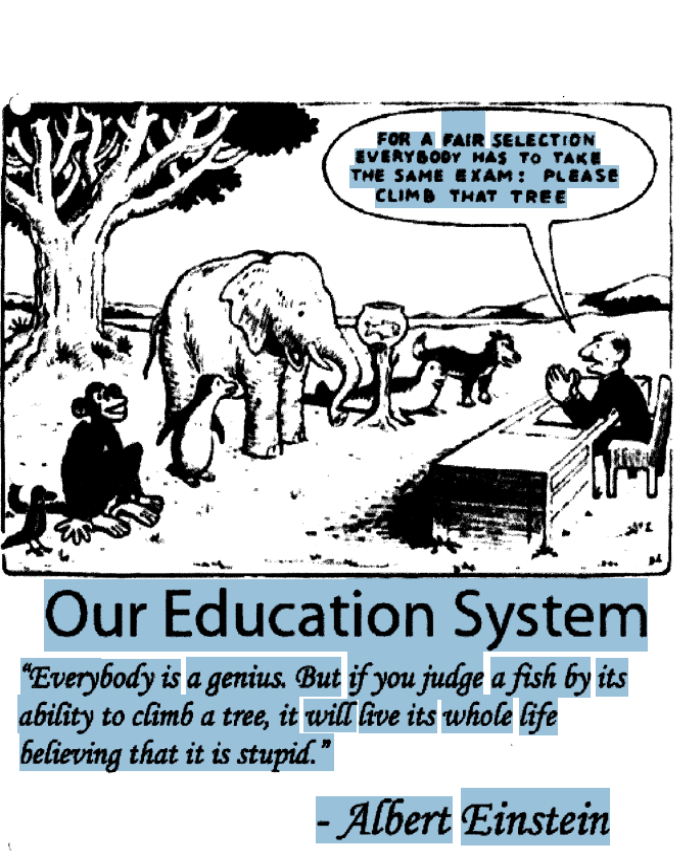
- The imbalance in math teaching – a lot of content, but little relevance. 数学教学失衡，内容多，相关性少
- The teaching methodology adopted. 教学方法不当
- The quality of teaching/qualification of teachers. 师资不高
- The students' *Entry Behaviour* – their state of readiness at the relevant grade level/s. 学生的入门基础
- The learners' general attitude to math as a school subject. 学生对数学的普遍态度
- The students' awareness (or otherwise) of the potential utility of their school-acquired math knowledge in their after-school life. 学生在课余生活运用数学知识的意识
- The textbook/s used in math teaching. 数学教科书

# Imbalance in math teaching and learning: Scale tilts heavily to 'contents' arm 教学的失衡：天秤严重偏向“内容”



# Albert Einstein on our education system (Discordant factors at play)

## 爱因斯坦对教育系统的评论（因素冲突）



FOR A FAIR SELECTION  
EVERYBODY HAS TO TAKE  
THE SAME EXAM: PLEASE  
CLIMB THAT TREE

**Our Education System**

*"Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid."*

- Albert Einstein

我们的教育系统  
每个人都是天才，但是  
如果你用是否能爬树来  
判断一条鱼，它会一辈  
子认为自己很笨。

——爱因斯坦

**Tackling constraints, barriers factors/obstacles to better math and science performance/  
higher enrolment by (and retention of) learners.**

解决制约因素，提高数学科学成绩和录取率

- Integrate the learners' culture, environment, traditional practices, phenomena, day-to-day life experiences (schema) into the math curriculum (Ezeife, 2012).  
把学生的文化、环境、传统、日常生活融入数学课程
- Recognition of math as a cultural product (Peng & Naiqing, 2014). 承认数学是一种文化产品
- Integration - would inject a breath of fresh air, meaning, relevance and even fun, into math teaching/learning – math no longer a ‘dreaded entity’, but **a familiar, everyday endeavour or engagement**. 融合能使数学成为一种熟悉的日常习惯，而不是枯燥无味的事情

## Math-oriented practices of African/EMILs

### 以数学为导向的非洲实践与EMILs（例子）

(Some examples - *Ezeife 2012, 2014, 2016, 2019*)

<u>Traditional practice</u> 传统实践	<u>Math Strand</u> 数学分类	<u>Math topic/concept</u> 数学主题、概念
Use of “willow” 用“柳”制作“捕梦网 to make “dream catcher” frame.	Geometry & 几何&空间感 Spatial Sense	Construction, types and 构建、种类、 measures of angles. 角度测量
Beadwork - beads (原住民族) worn by the 佩戴的珠子 Anishnabe.	Patterning & 规律&代数 Algebra.	Patterns in beadwork, 珠子首饰中的 Colouring and ordering 规律、颜色 of beads. 以及顺序
Games, e.g. the 游戏 Olingo game/song 如Olingo游戏、歌曲	Data management 数据管理 and Probability. &概率	Principles of probability, 概率的原则 Games of chance, odds. 游戏中的概率
The Spider Web 蜘蛛网 (Common in the (普遍出现在学生的生活) students’ environment)	Geometry/Spatial Sense 几何 Patterning/Algebra /空间感 Operations on Fractions. /规律/代数	Geometrical shapes, Areas of 几何图形、 two-dimensional figures, 平面图形的面积、 分数的计算

**African & Indigenous perspective: Utilisation and implementation in specific math/science teaching and learning research projects**

**非洲和原住民视角：在特定数学、科学教学研究项目的利用和实行**

- **The STEM (Science, Technology, Engineering, and Mathematics) Education Project (2012-2014);**  
科学、科技、工程和数学教育项目
- **The STEAM (Science, Technology, Engineering, Arts, and Mathematics) Education Project – an offshoot of STEM (ongoing);**  
科学、科技、工程、艺术、数学教育项目-STEM的分支（正在进行）
- **Canada-China RLP (Reciprocal Learning Project): A 7-year (2013-2020) longitudinal study.**  
加拿大-中国互惠学习项目：7年纵向研究



The STEM Project  
科学、科技、工程和数学项目

University of Windsor Strategic Priority Fund  
(SPF) Presents

Math Camp  
温莎大学战略优先基金  
数学营

**MATH FOR TAT**

数学为了今天与明天  
**(Math for Today And Tomorrow)**



## A meaningful & relevant example used in the STEM Project - Subsets, Proper subsets, Complements of sets (Set Theory).

有意义且相关的例子 - 子集、真子集、补集（集理论）

- **Textbook explanation of Subsets...**课本对子集的解释
- **If two sets, A and B, have precisely the same elements, then they are equal, and we write  $A = B$ . If  $A \subseteq B$  but  $A \neq B$ , we say A is a proper subset of B and we write  $A \subset B$ .** 如果两个集合(A&B)中的元素一样, 那么它们相等。如果A属于B, 但不相等, 那么A是B的真子集。  
**If  $A \subset B$ , there must be some element of B which is not also an element of A; that is, there is some x for which  $x \in B$  and  $x \notin A$**   
*(Long & DeTemple, 2000, p. 84).*

如果A是B的真子集, 那么B肯定包含不属于A的元素x

# The Three Fires Confederacy of the Anishnabe group (Walpole Island)

## 安尼斯拉贝部落三火联盟（沃尔波岛）

A = ANISHNABE 安尼斯拉贝

O = OJIBWA 奥吉布瓦

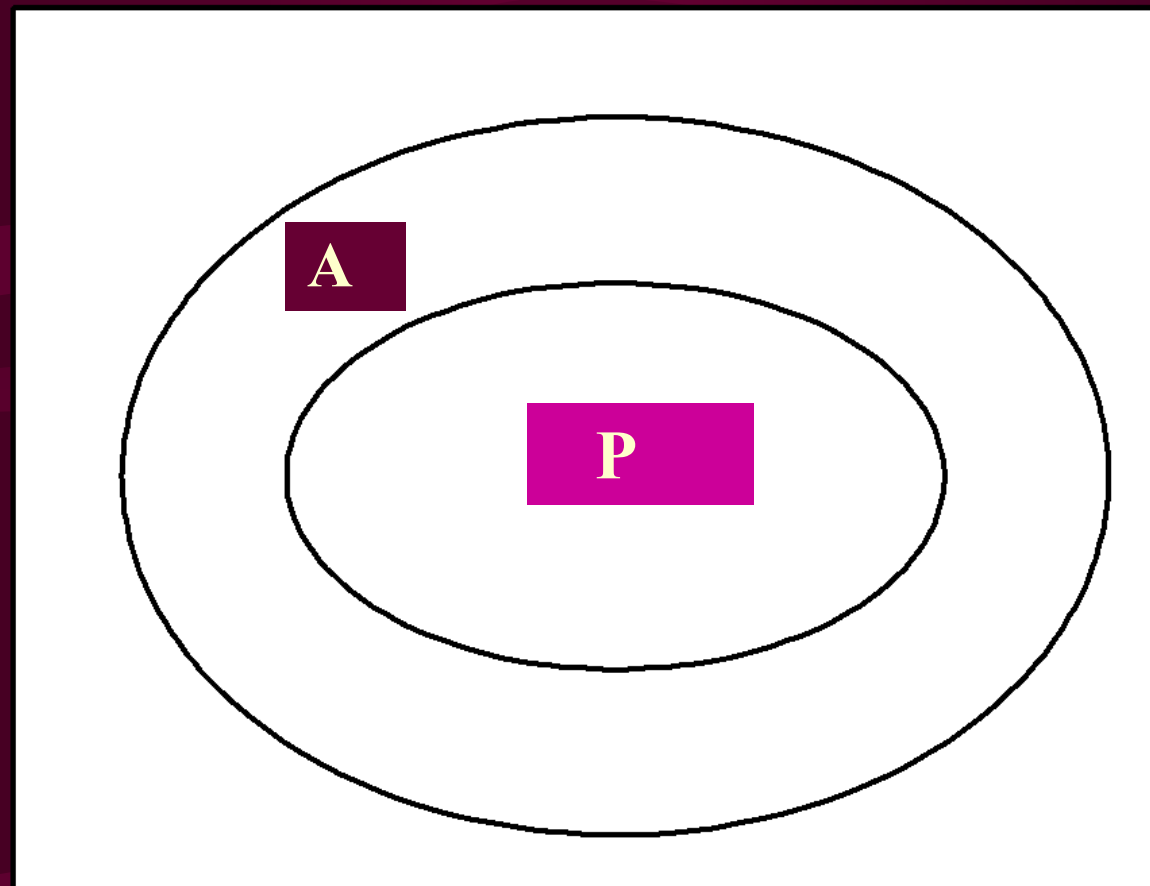
O = ODAWA 奥达瓦

P = POTTAWATOMIE 波特瓦特米

# CANADIAN ABORIGINALS AND THE ANISHNABE

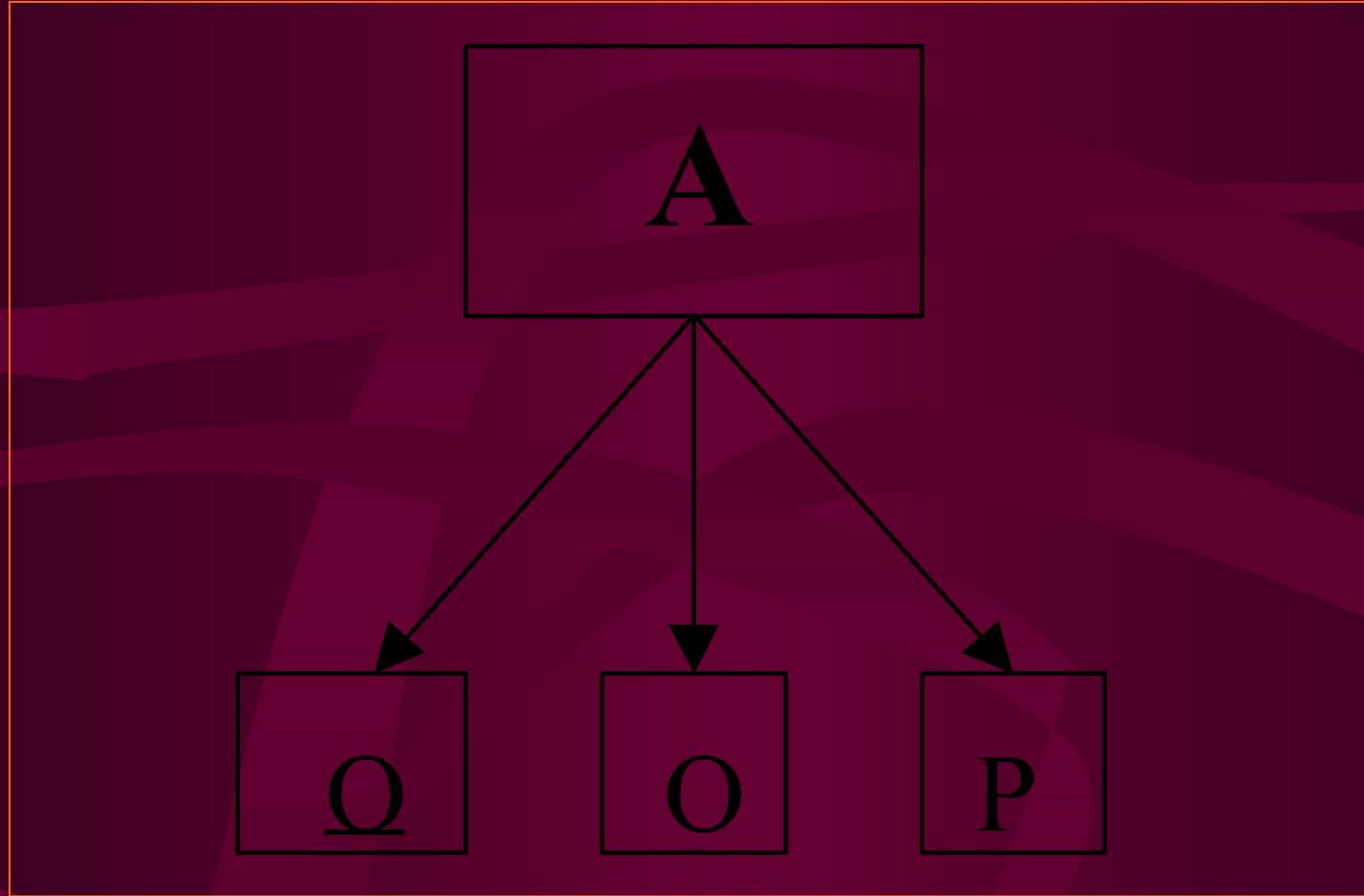
## 加拿大原住民及安尼斯拉贝族

U



# The Anishnabe and component sub-groups

## 安尼斯拉贝族及分部落



# Indigenous – w.r.t. Anishnabe (Culture-sensitive, meaningful & relevant) explanation

## 原住民-安尼斯拉贝（与文化相关且有意义）解释

$P \subset A$  since  $P \subseteq A$ , and  $P \neq A$

因为P是A的真子集，P属于A且P不等于A

Hence, we can define a set, D, thus:

$$\exists \{D\} = \{x \mid x \in A, \text{ and } x \notin P\}$$

那么我们可以定义存在集合D等于x，x是A的元素但不是B的元素

- **N/B:  $\exists$  = There exists (or “there is”) 存在；有**
- **$\mid$  = such that 那么**
- **$\in$  = is an element of (or “is a member of”) 是.....的元素**
- **$\notin$  = is not an element of (or “is not a member of”) 不是.....的元素**



Windsor This Week  
OCT 4, 2012 p 13

## UWindsor funds new Aboriginal youth program

Kirk Dickinson  
Windsor This Week

The University of Windsor is doing its part to encourage Aboriginal youth to participate in a new educational program.

It was announced on Sept. 24 that the University of Windsor will be funding a new two-year community youth program to encourage Aboriginal students in grades six, seven and eight to pursue education in science, technology, engineering and math (STEM).

The program is called the 4Winds STEM and will launch along with Beginning Time Teaching Aboriginal Youth Science Camps on Saturdays starting this month.

"A large number of our students are not graduating from high school, or when they do, they're not prepared enough to go into the sciences, the engineering programs or the math programs (of post secondary)," said Russell Nahdee of the Aboriginal Education Centre of U of W. "So we're hoping by offering these topics, that it will better help them plan their careers." The Saturday camps will encourage Aboriginal students to increase their competence and confidence in the STEM fields by engaging them topics that have roots in Aboriginal culture.

Dr. Anthony Ezefie, a professor at U of W, said the representation of Aboriginal youth in STEM programs is very low because there is a phobia that it is something that isn't in their culture.

"They see these areas as something that is foreign and that's why they shy away from it," said Ezefie. "The idea is to use what is abundantly present in the environment of the students, to teach them these subjects, such that they identify more easily with them."

Students in the program will take part in science experiments and field trips, as well as lectures from U of W faculty members and current science students.

The program was designed



Kirk Dickinson Windsor This Week

Russell Nahdee of the Aboriginal Education Centre of U of W, Chris and Edwin Wright of Walpole Island First Nation, and U of W professor Anthony Ezefie, pose outside of the CAW Student Centre at U of W after the announcement the 4Winds STEM community youth program, on Sept. 24. The program will encourage Aboriginal students to increase their competence and confidence in science, technology, engineering and math.

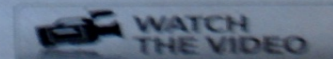
by an interdisciplinary team of educators, scientists and leaders of Windsor's Aboriginal community and the University of Windsor.

Edwin Wright of Walpole Island First Nation said the program should get a really great reaction from students.

"It's a great program, especially to target children of

such a young age," he said.

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[www.facebook.com/WindsorThisWeekNews](http://www.facebook.com/WindsorThisWeekNews)  
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The Tipi - African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindsor, Oct. 2-4, 2019

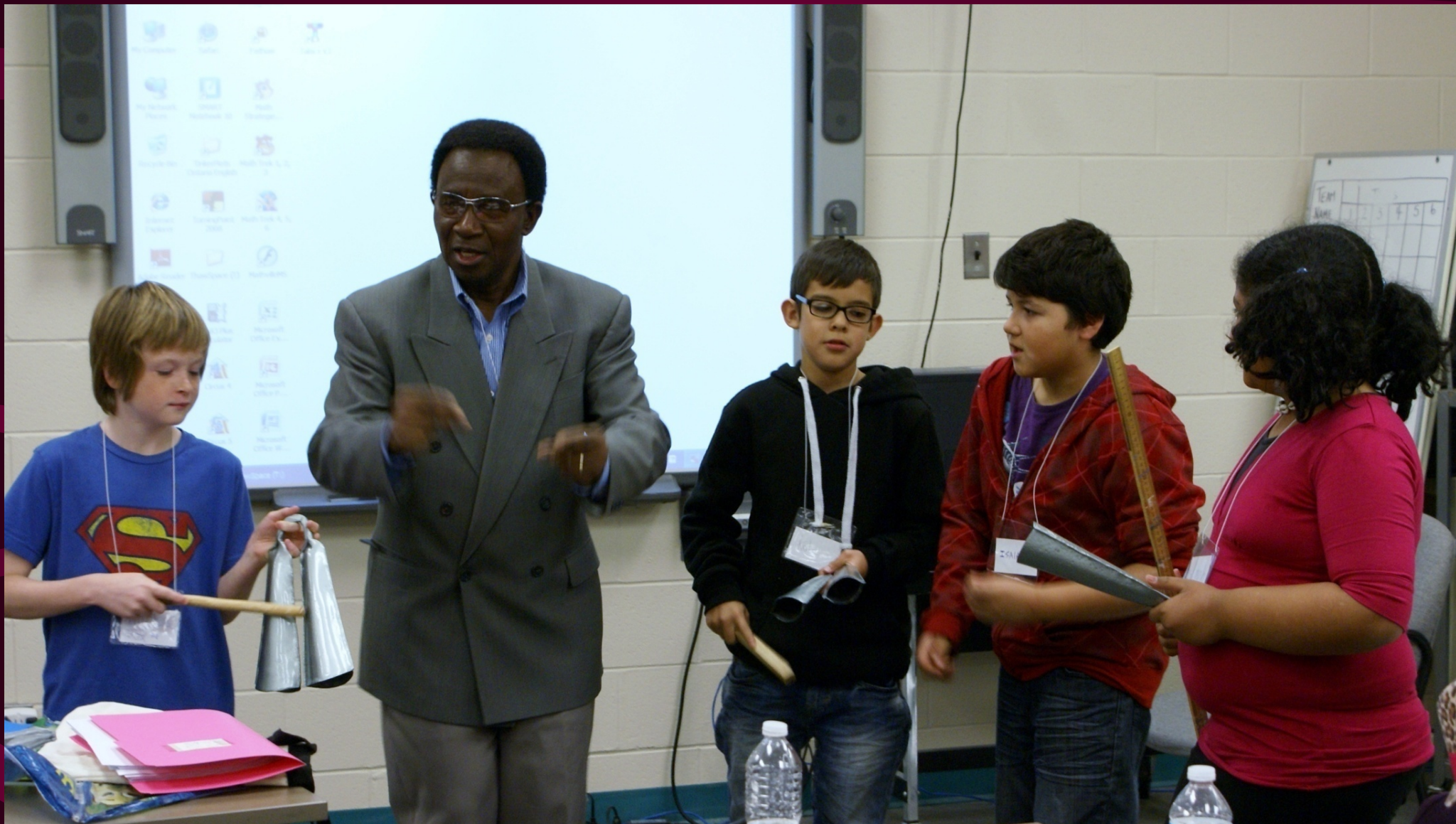








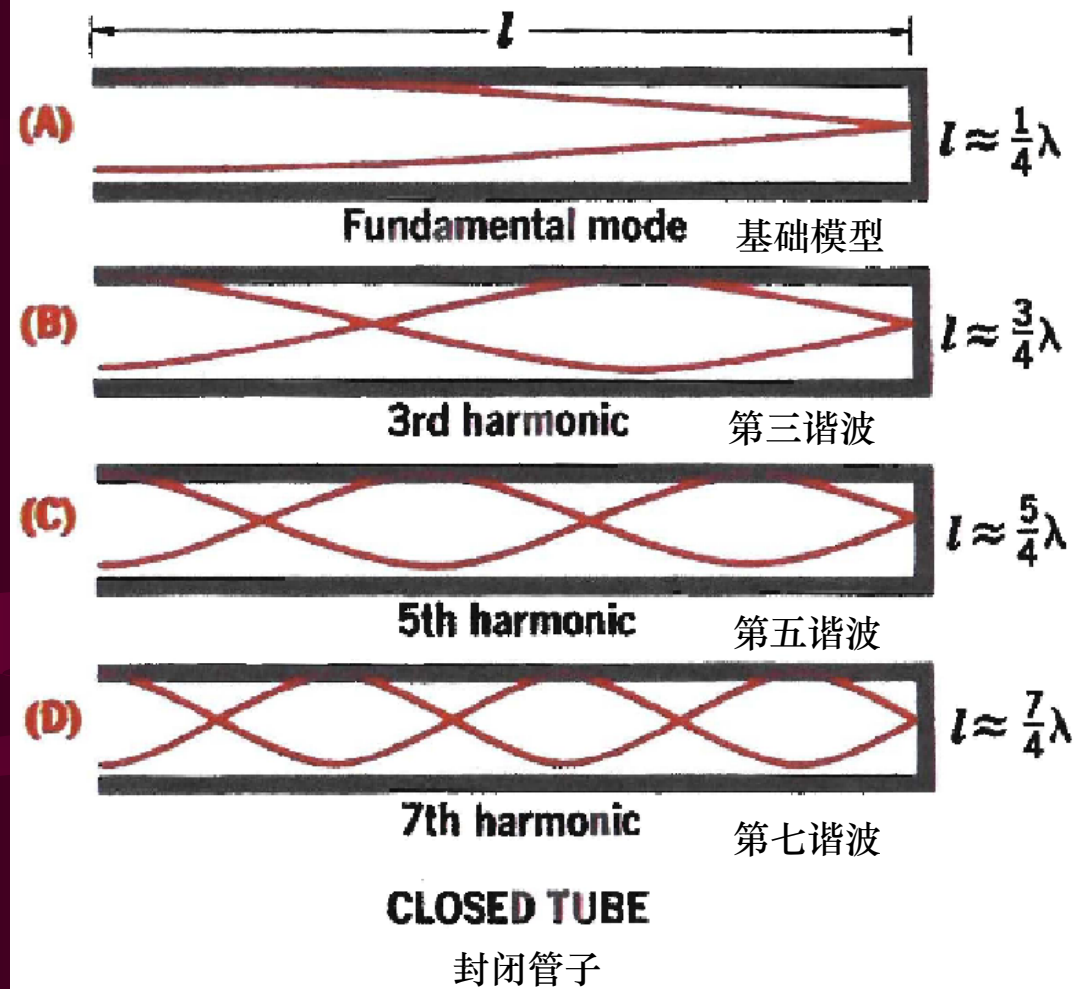




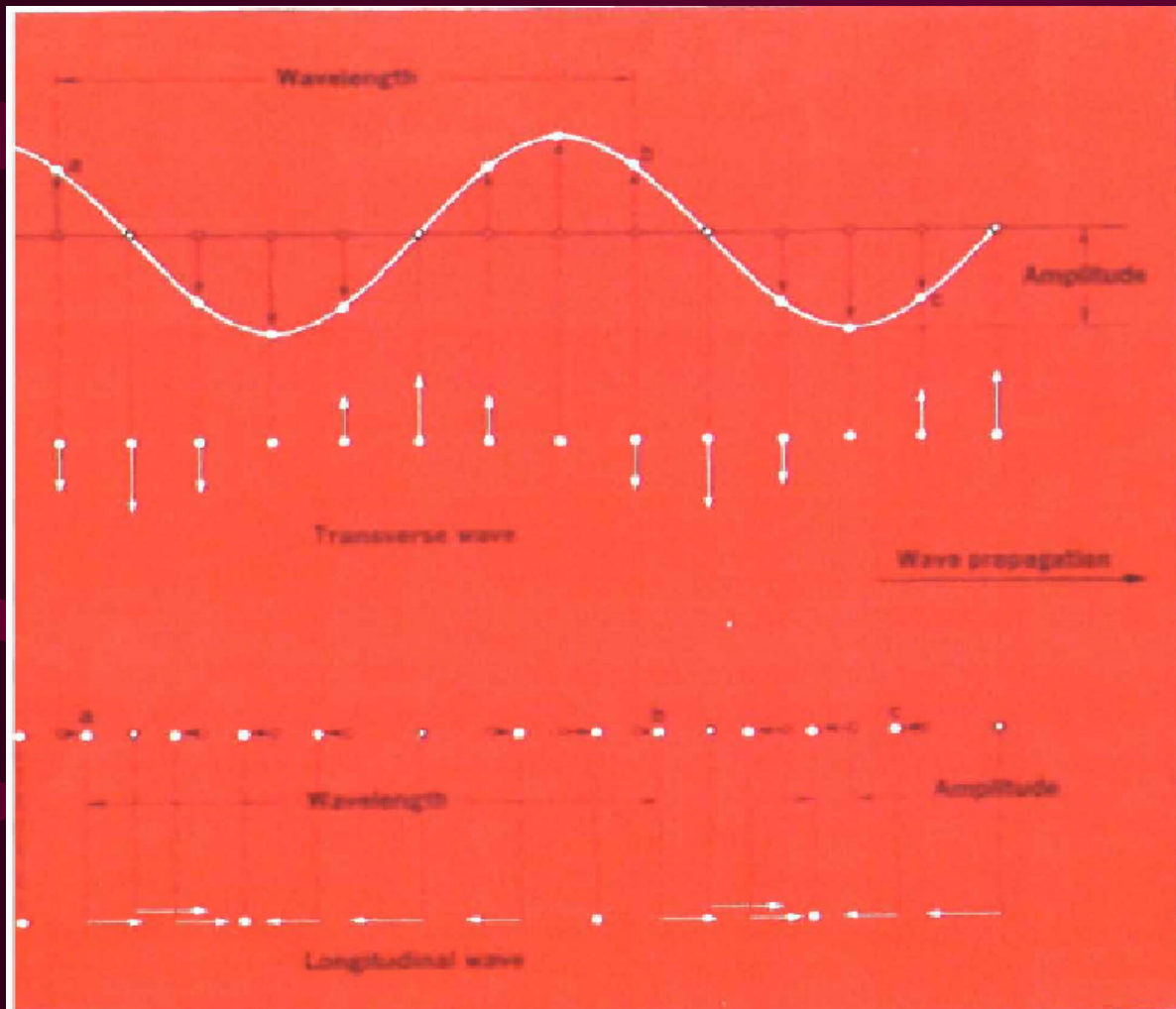
African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindso, Oct. 2-4, 2019





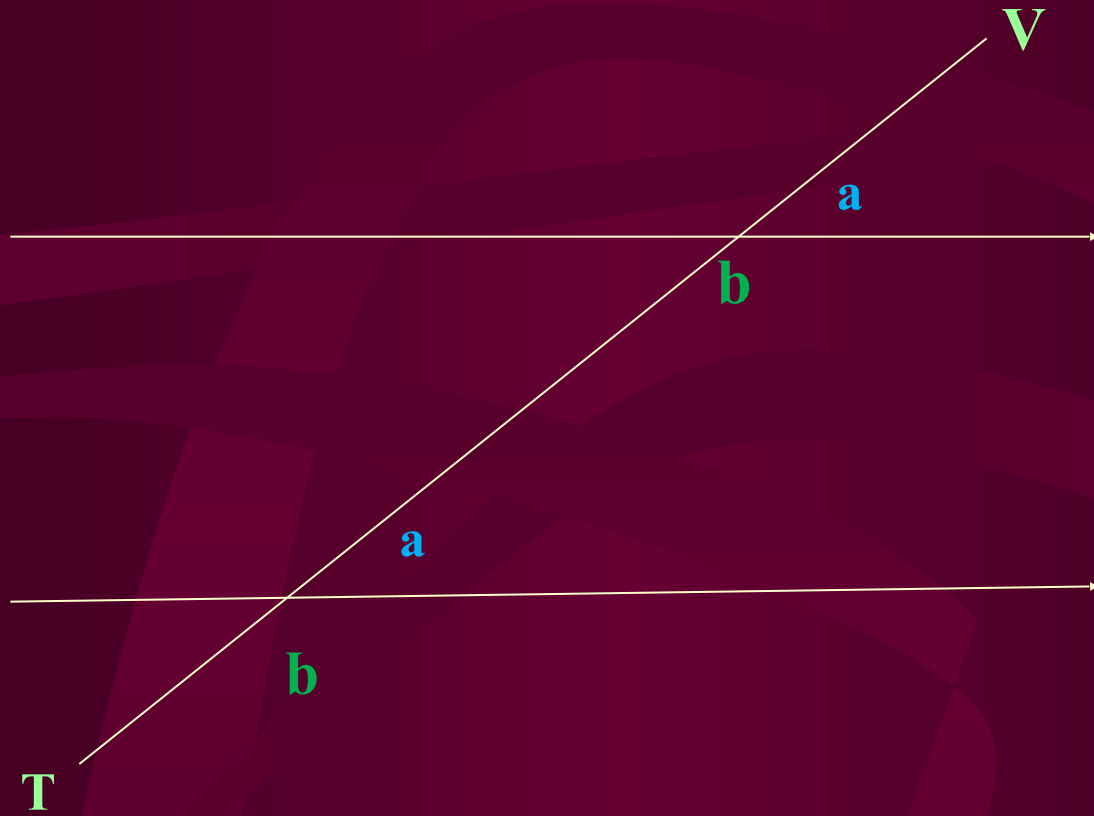






## Geometry: Transversals, Parallel lines, and Angles

几何：断面、平行线、角





Nature and learner's environment – Using a turtle shell to show **transversals**, **parallel lines**, & **angles**

大自然与学习者的环境- 用龟壳展示断面、平行线和角



## STEAM/BTT Examples (online)

### STEAM/BBT 例子（线上）

- Classroom lesson – Heartbeat of Mother Earth  
(Grades 5 & 6): **“Pilot project brings Aboriginal perspectives into elementary classrooms”**. 课例- 地球母亲的心跳（5&6年级）
- Workshop: 5<sup>th</sup> Graders bargain at the “Fur Trade and the Original People”. 作坊：五年级学生讨论“皮毛交易与原住民”
- Teaching mathematics and science with the ‘Dream Catcher’.  
用“追梦网”教数学和科学



# The Canada-China Reciprocal Learning Project

## 加拿大-中国 互惠学习项目



# The mathematics-culture book series

## “数学与文化”系列书籍

- **Drew on the day-to-day life experiences and environment of (potential) young math learners;**  
关注数学学习者的日常生活与环境
- **These experiences used as building blocks (foundation) on which to firmly anchor math education/development;**  
这些经验是数学教育的基础
- **Expected - that this solid foundation would lead to the elimination of the chasm or lacuna often perceived by students bwn. their life-world and the world of school math.**  
这些坚实的基础可以慢慢填平学校数学与真实世界之间的鸿沟
- **It is the chasm or lacuna (gulf) that usually puts students at-risk in their study of math in school. 这些鸿沟则会造成学生数学学习上的困难**



# Samples from “Life and math”, “Games and math” sub-volumes (Appendix I)

## “生活与数学”的例子，“游戏与数学”













African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindsor, Oct. 2-4, 2019









African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindor, Oct. 2-4, 2019





African & Indigenous Education plenary Symposium (Panel paper), RLP 6<sup>th</sup> annual conference, UWindor, Oct. 2-4, 2019

# The Bannock Cake – an example (illustration) from the learner's environment


## 班诺克蛋糕的制作 - 来自学生生活环境的一个例子

### Baked Bannock

**Suggested Ingredients:**


- 3 cups all-purpose flour
- 1 Egg (optional - makes softer)
- 2 tsp sugar
- 1 tsp salt
- 3 tsp baking powder (Yeast - let rise)
- ½ cup Butter - cut into it
- 2 cups lukewarm water (optional - use equal parts hot water and cold milk; buttermilk; broth instead of water for more flavour)
- 1 cup raisins, or cranberries, or chocolate chips...

**1.**




Place dry ingredients in a bowl. Mix well. Cut in butter, lard, etc...

**2.**




Stir in water and oil.

**3.**




Mix dough until it is hard enough to knead into a ball. Let dough stand for 10 min. before you roll out on cookie sheet. Mix dough until it is hard enough to knead into a ball. Let dough stand for 10 min. before you roll out on cookie sheet.

**4.**



Poke holes in the dough with a fork when it is big enough to fit on a cookie sheet and 1/2 inch (1.25cm) thick.

**5.**



Bake for 45 minutes in a 400 degree oven.

Top with your choice of fresh fruit, whip cream, honey, chocolate drizzle, cinnamon & sugar, cream cheese, honey or your favourite jam!

Pictures: <http://www.wikihow.com/Make-Fried-or-Baked-Bannock>



The chameleon – illustration of **ROYGBIV** colours (physics), and adaptation/camouflage (biology) - from the learner's environment.

变色龙- **ROYGBIV**颜色（物理）和适应/伪装（生物学）的插图



Usambara two-horned chameleon in the Usambara mountains of Tanzania

坦桑尼亚Usambara山区的Usambara两角变色龙

(Source: Wikipedia: (<https://en.wikipedia.org/wiki/Chameleon>))



The chameleon – illustration of **ROYGBIV** colours (physics), and adaptation/camouflage (biology) - from the learner's environment.  
变色龙- ROYGBIV颜色（物理）和适应/伪装（生物学）的插图



**The common chameleon (*Chameleon Africanus*) turned black**  
普通的变色龙（非洲变色龙）变黑

**(Source: Wikipedia: (<https://en.wikipedia.org/wiki/Chameleon>))**

# What the world stands to gain – in a reciprocal learning context: The triumph of Mr. Peter Tabichi

在互惠的学习背景下，世界将获得什么：彼得·塔比奇先生的胜利  
(My attempts to see/link up with him)



Kenyan teacher Peter Tabichi, center, reacts after winning the \$1 million Global Teacher Prize  
肯尼亚教师彼得·塔比奇（Peter Tabichi），赢得100万美元全球教师奖后

**Mr. Peter Tabichi - What the world stands to gain: Illustration from the environment - Using students themselves - Data Management & Probability**

**环境中的例子 - 从学生自身出发 - 数据管理和概率**

- **Olingo demonstration in Southwest University (SWU), Chongqing, China – 2016 RLP annual conference (Available online):**

**在中国重庆西南大学的一次展示 - 2016年项目年度会议**

**VID\_20160419\_150300.mp4-Google Drive**  
**(Here, retrieve and show the demonstration)**





育论坛暨第三届东西方教育  
研讨会

Higher Education Symposium Annual  
East-West Regional Learning Education

... and discussion  
... degree of connectivity across the  
... emphasis on some domains, such as  
... of mathematics, including the use  
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Mr. Peter Tabichi - What the world stands to gain – an illustration of the effective use of the environment: The Spider Web - Concept of Partitioning  
蜘蛛网-分区概念

**Using the concept of partitioning to add and subtract fractions**

用分区的概念来学习分数的加减

**Sample Problem:**  $3/4 + 5/6$  (This means to add three-quarters and five-sixths)

**Solution:** Represent the fractions as partitions (rows and columns) in a large rectangle made up of smaller rectangles, in a table format.

Thus, in the table, represent the sixths (6ths) as columns, and the quarters (4ths) as rows, thus:

→ **Sixths**

**Quarters** ↓




## Teaching fractions with the Spider's Web (Contd.)

### 用蜘蛛网来教分数

Looking at the table (big rectangle) above, we can easily see that:

1.  $\frac{3}{4} = 18$  rectangles;
2.  $\frac{5}{6} = 20$  rectangles;
3. Total number of rectangles in the table = 24 (six columns x 4 rows =  $6 \times 4 = 24$ ).

Hence,  $\frac{3}{4} + \frac{5}{6} = 18 \text{ rectangles} + 20 \text{ rectangles} = (18+20)$  out of a total of 24, that is,  $(18+20)/24 = 38/24 = 19/12 = 1\frac{7}{12}$ .

Practice problem (related): Find  $\frac{5}{6} - \frac{3}{4}$  using the table (partitioning) approach as demonstrated above for addition.

## **Mr. Peter Tabichi - What the world stands to gain: Illustration from the environment - Using students themselves - Demonstration of the formation of angles 演示角度的形成**

- Invite 6 or 8 participants to the floor/stage for this demonstration.  
邀请6-8人上台参与演示
- Use the African 'Ogene' (gong or cowbell) as part of the teaching/learning activity/tool/resource.  
使用非洲“Ogene”(锣或牛铃)作为教学活动的一部分
- Use a marker to draw a resulting line – thereby showing the angle/s formed. 用记号笔画一条线,从而显示形成的角度
- Types of angles formed – Acute, Obtuse, Reflex? 形成不同种类的角度 - 锐角, 钝角, 优角

# Math is (can be) fun: Jokes/puzzles

数学可以变得有趣：笑话/谜题

See how popular math is (can be)!看数学有多普遍！

•A young boy walks into a convenience store and orders six chocolate bars. Putting them in a row, he greedily chews the **first** bar, then the **third**, and finally the **fifth**.

一个男孩走进一家便利商店，买了六块巧克力。他把它们摆成一排，然后吃了第一块，第三块和第五块。

•“Excuse me”, the store owner says as the young boy turns to leave, “But you left three of the bars you bought untouched”.

“不好意思”，店家对将要离开的男孩说，“你还有剩下的三块没有动呢！”

•“Yes, I know”, the boy replies. “My mom says it’s okay to have the **odd** candy”.

“我知道”，男孩说，“我妈妈说吃奇数的糖果是可以的！”

•**Math anthem/songs – aimed at enticing learners.**

数学歌 - 旨在吸引学生



# Take home 总结

## Mathemagic: The age game

To play this game you must be at least 10 years old and at most 99 years old ( $10 \leq X \leq 99$ ).

Step 1: Write down your age.

Step 2: Multiply that age by 7.

Step 3: Multiply the result of Step 2 by 1443.

Step 4: Your final result is.....?

Question: What happened?

Answer: My mathemagic has done something to your age (Now, tell me what my mathemagic did to your age).

## 年龄游戏

你的年龄要在10-99岁之间，首先写下你的年龄，乘以7，得出的结果再乘以1443，你最终的结果是？

问题：发生了什么？

答案：我的数学魔法对我的年龄做了些什么。（告诉我是什么？）