## India’s Contributions to the World: Zero!

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**Grade Level**
6

**Duration**
4 class periods

### National Standards

**GEOGRAPHY STANDARDS**

**Element Four: Human Systems**

10. The characteristics, distribution and complexity of Earth’s cultural mosaics.

### Common Core Standards

**ELA COMMON CORE**

Reading Standards for 6-8 for Literacy in History/Social Studies

**Key Ideas and Details**

6-8.RH.1 Cite specific textual evidence to support analysis of primary and secondary sources.

6-8.RH.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

**Craft and Structure**

6-8.RH.4 Determine the meaning of words and phrases as they are used in a text, including vocabulary specific to domains related to history/social studies.

**Integration of Knowledge and Ideas**

6-8.RH.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

**6-8 Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects**

**Production and Distribution of Writing**

6-8.WHST.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

a. Produce clear and coherent functional writing (e.g., formal letters, envelopes, procedures, labels, timelines, graphs/tables, experiments, maps, captions, charts, diagrams) in which the development, organization, and style are appropriate.

**MATHEMATICS COMMON CORE STANDARDS**

**Ratios of Proportional Relationships**

6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

b. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or
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The Number System (NS)

Standards for Mathematical Practice
6.MP.2. Reason abstractly and quantitatively.

Expressions and Equations (EE)
(Extension Idea)
6.EE.1. Write and evaluate numerical expressions involving whole-number exponents

SIOP Elements

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Assessment

| Individual | Group | Written | Oral |

TESOL Standard(s)

ESL: English For Content
Through The Use Of ESL Methodologies, The Student Will:
EFC-A. Create, read and interpret visual information relating to science, social studies and math.
A1. Draw and label maps.
EFC-B. Use math skills to calculate and measure.
B3. Calculate conversions for different situations.
EFC-C. Compose in a variety of forms.
C1. Use Math, Social Studies, and Science target vocabulary.
C2. Paraphrase written information.
EFC-E. Comprehend reading materials.
E1. Read a variety of Math, Science, and Social Studies materials.
E3. Use new English vocabulary.

Arizona English Language Proficiency Standards

Stage IV
Basic
Reading
Standard 4: The student will analyze text for expression, enjoyment, and response to other related content areas. The student will demonstrate knowledge of reading comprehension by:
Overview

By 2025 India is projected to be the world’s most populated country, surpassing China. But population is just one facet of this amazing country. This sub-continent is home to some of the most ancient and varied civilizations. Each wave of people brought fresh ideas and ways of life. India has a legacy of mathematics, writing, architecture, literature, religion, and science.

Purpose

In this lesson students will gain insight into the cultural diffusion of Indian mathematical achievements, namely the zero. They will practice computing ratios and identifying numerical values. This lesson is modified for English Language Learners (ELLs).

Key Vocabulary

**Zero**: the symbol 0 that in math can be used to show nothing (0 dogs) or to hold a place in the number system (202 dogs)

**Placeholder**: a symbol in math that can show the relationship of the numbers (ones, tens, hundreds) (05, 50, 500)

**Spread**: to move from one place to another, get larger

**Cultural diffusion**: spread of ideas, religions, languages and other characteristics from one place to another

**Drain**: a pipe or a ditch to carry water or liquids

**Merchant**: person who sells things

Materials

- World Population Video
- Internet access and computer lab
- Classroom computer and projection system
- A Short History of Zero
- A Short History of Zero Map Assignment and Map Assignment Answer Key
- Colored pencils
- World map
- Map Scoring Guide
- A Short History of Zero Writing Assignment (Cloze paragraphs for ELLs) and Answer Key
- A Short History of Zero Writing Assignment (Writing prompt for English proficient students)
- Is Zero Nada? worksheet and Answer Key
- Indus Inch worksheet and Answer Key
- Vocabulary Cards
- Vocabulary Test and Answer Key

Extension Materials

- Tower of Brahma worksheet
- Kolams worksheet
- Brahmi Writing
- Sanskrit Writing

Objectives

The student will be able to:
1. construct a map to display geographic information
2. define cultural diffusion
3. identify an example of cultural diffusion
4. create a summary
5. compute ratios
6. identify numerical value
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**Procedures**

**Prerequisite Knowledge:** Students should have knowledge of the Cradles of Civilization. Students have experience with computing ratios and determining numerical values.

*Note: Tailor these procedures to your students’ needs. If you are teaching a self-contained class, you may choose to follow the order suggested. If you are departmentalized, you may choose to have social studies teachers do the reading, writing and map making lessons.. Then the math teacher can do the set of lessons highlighting mathematical achievements.*

**SESSION ONE AND TWO:**

1. **Engage:**
   a. Ask students what countries have the most people in the world. Record their responses on the whiteboard. *(Preparation: Linking to past learning)* Then show the 7-minute video on World Population.
   - http://www.youtube.com/watch?v=9_9SutNmfFk
   - Share that the Top Four are: China, India, United States and Indonesia.

2. **Explore:**
   a. Show the video once more pausing at the historically important events and have students discuss how they relate to today’s population. *(Preparation: Linking to past learning)* Now tell students that in 2025, India is projected to have more people than China.
   b. Ask them what they know about India. Write responses on the whiteboard. *(Preparation: Linking to past learning)* *(Application: Promotes engagement)*
   c. Introduce vocabulary words and create a word wall for students to access during this unit of study. *(Scaffolding: Comprehensible input)*

3. **Explain:**
   a. Distribute copies of A Short History of Zero and a World map. Project a map to point out where India is located. *(Scaffolding: Modeling)* Have students take turns and read aloud the information and discuss important parts. Reinforce use of vocabulary words. *(Scaffolding: Comprehensible Input)*
   b. End the reading portion of the lesson by discussing which of the cultures (Mayan, Indian, or Chinese) was responsible for cultural diffusion of the zero. *(Indian)* *(Grouping: Whole Group)* *(Integrating Processes: Reading and Listening)*

4. **Elaborate:**
   a. Now distribute the A Short History of Zero Map Assignment and clarify directions and scoring guide. Allow students to work in partners so everyone understands what is expected. It is important that each student have their own map and assignment sheets since this may become homework if time runs out. *(Grouping: Partners)* *(Assessment: Individual and written)*

**Evaluate:**

a. Distribute A Short History of Zero Writing Assignment (Cloze paragraphs) to ELLs, and distribute A Short History of Zero Writing Assignment (Writing prompt for English proficient students). Explain the directions and allow students time to complete their work in the computer lab. *(Assessment: Individual and written)*

**SESSION THREE AND FOUR**

1. **Engage:**
   a. Show students the YouTube video http://www.youtube.com/watch?v=wb4Npexda4A on India’s famous mathematician and astronomer, Aryabhata. *(Integrating Processes: Listening)*

2. **Explore:**
   a. Look back at the first session’s list on the whiteboard of what was known about India. Have any of these been discussed? Are there any that are misconceptions? *(Preparation: Linking to past learning)* *(Application: Promotes engagement)*

3. **Explain:**
   a. Review how to compute ratios and identify numerical values. *(Preparation: Linking to past learning)*

4. **Elaborate:**
   a. Distribute the worksheet, Is Zero Nada? Model how to write out the numbers in words by using the first example. *(Scaffolding: Modeling)* Have student pair up to complete the rest of the problems. *(Grouping Option: Partners)* Then have the whole class work on the next sections of the worksheet (Is the zero necessary or not and writing out the two numbers). *(Grouping Option: Whole class)* *(Assessment: Individual and written)*
   b. Read about the Indus Inch. Pair up students and have them complete the math computations. *(Grouping Option: Partners)* *(Assessment: Individual and written)*
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5. Evaluate:
   a. Have students trade papers and compare their answers to those of a partner’s. Then display the correct answers and let the students grade the work but also ask questions about those problems that were incorrectly done. (Integrating Processes: Listening) (Application: Promotes engagement)
   b. A vocabulary test can be given to the ELLs over the words stressed in this lesson.

Assessment

For mastery, students will score:

• 13 points or higher on the map assignment for a social studies grade.
• 80% or higher on the math worksheets (Indus Inch and Is Zero Nada?) for math grades.
• 80% or higher on filling in the A Short History of Zero Writing Assignment (Cloze paragraphs for ELLs) for a reading and writing grade.
• 4 or higher on the 6 Traits Writing Rubric for Content and Ideas for paragraph written on cultural diffusion for a reading and writing grade.
• 80% or higher on Vocabulary Test of the vocabulary words or a reading, mathematics and social studies grade.

Extensions

Have students read about the Tower of Brahma puzzle. Then show the website (http://www.sdmath.com/hanoi.html) on the classroom computer or take the students to the computer lab. Let the students play the computer version of the Tower of Brahma. An alternative is to print off the discs and poles from http://www.lawrencehallofscience.org/java/tower/towerprintout.html) and allow the students time to try and solve the puzzle using these paper manipulatives. When students have sufficient time to learn the process of solving the puzzle, then have students partner up and work on the math worksheet.

Show the YouTube video (http://www.youtube.com/watch?v=kbQcGdyT86M&list=LPhQ6TDsKgVcA&feature=plcp)

on Kolams. Have students share orally with their partners how the Indians create these designs. Distribute the worksheet on Kolams. Go over the Indian vocabulary for dot, row, straight, and centered. Add these new words to the word wall. Then have students work in groups of three to complete the worksheet.

Included are 2 types of early writing (Brahmi and Sanskrit) that was used in ancient India. Students can compare this to what our present day number system. Students can practice their math facts or use these to decorate their games.

Sources

Maps
World Map from Arizona Geographic Alliance
http://geoalliance.asu.edu/azga/

Video:
World Population
http://www.youtube.com/watch?v=9_9SutNmFFk
Father of Hindu Arabic number system
http://www.youtube.com/watch?v=wb4Npexda4A

Websites:


Other Sources are listed on lesson plan and worksheets.