Teacher Notes:

Lesson Objective: In this lesson, students will explore how the Mayan number system works. The purpose of this lesson is to get students thinking about place-value systems other than our own base-10 system. This is intended to be a challenging, but fun investigation that tasks students with gathering relevant clues and generating their own hypotheses as to how the Mayans counted.

Slide 1-6: Teacher overview

Slides 8-9: Who are the Mayans?   *Fun facts on Mayan Civilization*

Slide 10-11: Lesson Overview

Slide 12-13: Base-10 system *Students recall how Hindu-Arabic Number system works.*

Slide 14-17: Cracking the Code *Students use Mayan numbers and their values to come up with rules for how number system works*

Slide 18: Create your own! *Students can create their own number system! They can create their own symbols and place-value*

Slide 19: Optional Extension *For students who have completed their own system or want a take-home extensino*

Mayan Number System

The Mayan number system uses a base-20 number system consisting of 3 symbols...

● = 1

━━ = 5

◯◯◯ = zero / place-holder

Mayan Number System

After 19, Mayans would create another "floor" of values that each were worth 20, rather than 1:

1 x 20

0 x 1

= 20

2 x 20

15 x 1

= 55

Mayan Number System

As a result, the largest number that be created with just 2 floors is 399. Thus, after 399 a 3rd "floor" is required:

1 x 400

0 x 20

0 x 1

= 400

1 x 400

0 x 20

19 x 1

= 819

"Cracking the Code" Lesson Instructions (part 1-2)

Set-up: Students may work individually or in pairs. Likely that larger groups (3+) will be too big to ensure that students are able to generate their own ideas at their own paces.

Pacing: Students can progress through worksheet at their own pace with instructor circling to answer questions / offer hints *or* students can come back together at the end of each part (indicated below and in slides). If students are done early there are differentiated routes provided below.

Part 1: Students will first see just one level (numbers 0-20).
- Encourage students to see if they can identify values for each symbol they see. (they should have values for dots, lines and "canoe" / "shell"
- All students to formulate any rules they may notice of how to write the numbers (dots on top, lines on bottom etc)
- If students are done early, they can tackle challenges listed on bottom of slide.

Part 2 : Students will adapt their learning from part 1 to include multiple levels/floors
- Encourage students to create boxes around each level if necessary
- Ask students if they can make any parallels between the "levels" of mayan numbers to the place-values of our hindu-arabic system
- If students are done early, they can progress to part 3 and begin to write their own number.

"Cracking the Code" Lesson Instructions (part 3)

Part 3 : Students create their own number systems - pairs suggested as this is challenging
- This task is challenging as students often struggle to depart from the base-10 system they are so familiar with
- Students will create their own number systems using symbols and place-values other than Mayan / Hindu-Arabic systems
- Student may start by drawing new symbols for their numbers. This could help them understand that they are creating a number system that is totally new!
- If students are stuck, encourage students to decide what base they want to use and how that might relate to the number of unique symbols/digits they need to create.
- Students can have the option to present their number systems and/or make an investigation with it!

Part 4 : Optional extension for students to explore binary numbers

- Research and presentation project for students who are interested in learning more about new number systems

Class slides

Mayan Civilization
2600 BC – 900 AD

Chichén Itzá at dusk. (Image credit: Theodore Van Pelt / EyeEm via Getty Images)

Fun facts of Mayan Civilization

1. Mayan empire was in "Mesoamerica" – Mexico and parts of Central America.

2. Built over 60 cities

3. Invented their own calendars, farming methods, writing systems, sports and religion

4. Built palaces, pyramids, ceremonial structures and temple observatories – *all without metal tools.*

5. Had their own writing system with up to 800 glyphs

6. Mathematicians! The Maya invented the concept of 'zero'!

Facts: FunKidsLive.com

Map of Aztec, Mayan, and Incan Civilizations by Ducksters

Mayan Number System

Uncovering the Mayan Number System

Today's Lesson:

1. Intro: How do we keep track of numbers?
2. Cracking the code: using just a few clues, can we figure out how Mayans counted?
3. Creating our own number systems...

Part 1: How do we count?

Hindu-Arabic numerals (6th/7th century India)

1,348

What does each digit above represent?

1,348

1,000 + 300 + 40 + 8

1 x 1,000   +   3 x 100   +   4 x 10   +   8 x 1

You have been given only ten Mayan numbers and their corresponding values ...

Can you determine how to Mayans counted from these clues?
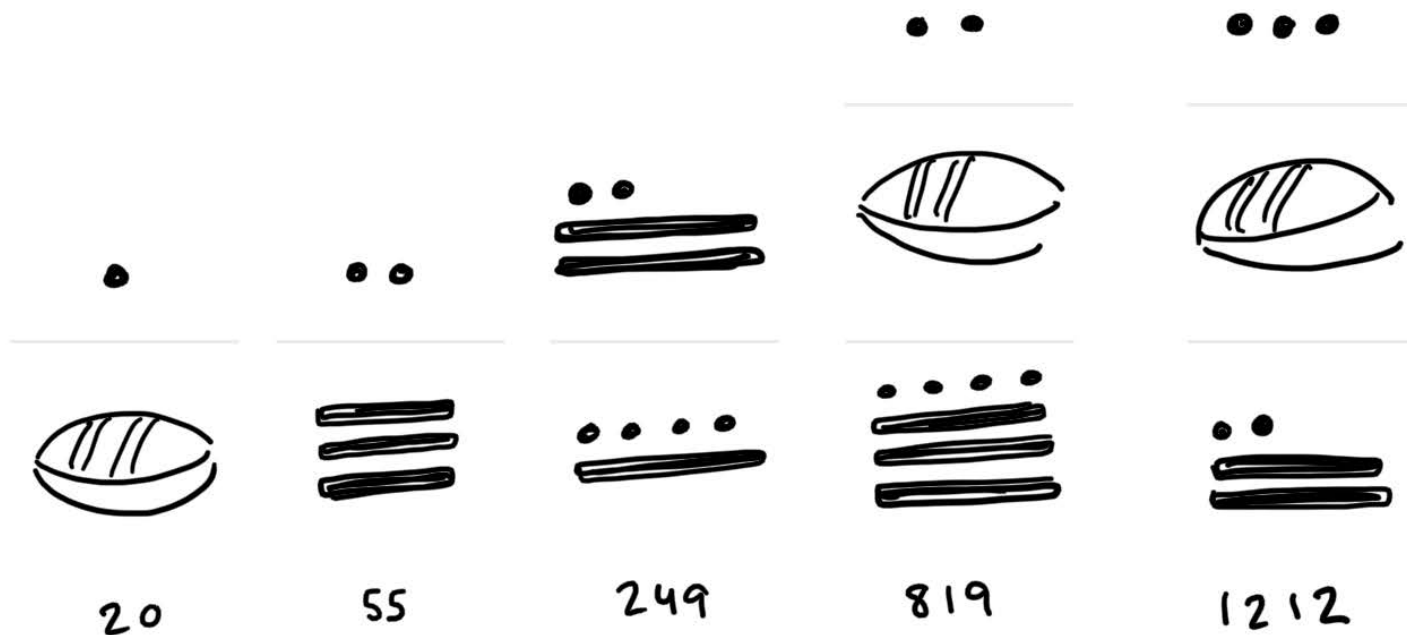
Cracking the code... part 1

Think you've got it? What would the numbers 7, 11 and 18 be?

Cracking the code... part 2

20   55   249   819   1212

Uh oh! Things just got harder...
What do you think the different levels could mean?

Cracking the code... part 3

= 5	= 11	= 30
= 35	= 300	= 335
= 401	= 1221	Create your own! =

Your turn!

Can you make your own, unique, numerical system? Use a different place-value system than the mayans and a different place-value system than our own (base 10)

Optional challenge...

Can't stop thinking about number systems?

Computers have their very own number system, called "binary numbers". Can you figure out how computers count? Option to do some research and create a 5-min presentation for your classmates on the binary number system for next class!