Teaching Human Dignity

China's One-Child Policy:
Exponential & Logarithmic Functions

CENTRAL QUESTIONS:

- **How do exponential and logarithmic functions contribute to understanding population growth? How did mathematical models influence China's adoption of the one-child policy?**
- **What was problematic about how the Chinese government achieved the goal of population reduction?**
- **Quantitative reasoning is not necessarily neutral. What role should mathematics play in ethical and policy decisions? What other considerations should be included in such decisions?**

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Developed in collaboration with John Brahier.

Unit-at-a-Glance

Curriculum Area:
Mathematics (Algebra II or higher)

Time Requirement:
Approximately five 50-minute class periods

Descriptors:
Exponential functions, logarithmic functions, mathematical modeling, population growth, one-child policy, abortion, China

Unit Objectives

Students will be able to:

- perform basic computations involving exponential functions or equations.
- perform basic computations involving logarithmic functions or equations.
- construct linear and exponential functions.
- understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- interpret expressions that represent a quantity in terms of its context.
- articulate the ethical challenges involved in China's one-child policy.
- integrate different types of knowledge to evaluate China's one-child policy.

Rationale

Understanding mathematics involves more than the accurate computation of functions. It also requires the ability to apply mathematics to real-world situations and events and to evaluate the relevance of computational data when making concrete decisions. In this unit, students review and apply their knowledge of logarithmic and exponential functions to explore China's one-child policy, both in terms of the accuracy of the computations and the ethical application of mathematical analysis to real-world situations. As they engage in mathematical inquiry, students are asked to evaluate how mathematical computations ought to influence governmental policy decisions about population control and to consider other relevant factors in the decision-making process.

Common Core State Standards

The following items are based on Appendix A from the CCSSM. These items are intended to be addressed in Algebra I and Algebra II (depending on the standard). Since most of the math instruction in this unit is intended to be a review instead of the primary instruction, all of the relevant descriptions from CCSSM will be included below.

CCSS.MATH.CONTENT.HSA.SSE.A.1

Interpret expressions that represent a quantity in terms of its context.

CCSS.MATH.CONTENT.HSA.SSE.A.1.A

Interpret parts of an expression, such as terms, factors, and coefficients.

CCSS.MATH.CONTENT.HSA.SSE.A.1.B

Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

CCSS.MATH.CONTENT.HSF.IF.A.2

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

CCSS.MATH.CONTENT.HSF.IF.C.8.B

Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.

CCSS.MATH.CONTENT.HSF.BF.A.1

Write a function that describes a relationship between two quantities.

CCSS.MATH.CONTENT.HSF.BF.B.5

Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

CCSS.MATH.CONTENT.HSF.LE.A.2

Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

CCSS.MATH.CONTENT.HSF.LE.A.4

For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

CCSS.MATH.CONTENT.HSF.LE.B.5

Interpret the parameters in a linear or exponential function in terms of a context.

Unit Summary

Lesson Title	*Description*	*Learning Objectives*
Lesson #1: Introduction and Review of Exponential Functions ***One 50 minute class period***	In this lesson, students are introduced to the main object of study in this unit and will be given an overview of the days to come. Students then review exponential functions in order to build a foundation for the days to come. Pages 2-5 in the **Student Packet**	Students will be able to perform basic computations involving exponential functions and equations. Students will be able to apply the standard exponential equation to a scenario that involves population growth or decline. Students will be able to explore the real life meaning of quantities involved in computations and take these into account when making rounding decisions. Students will be able to understand historical concerns of overpopulation that informed China's one-child policy.
Lesson #2: Review of Logarithmic Functions ***One 50 minute class period***	In this lesson, students engage in a review of logarithmic functions, which will lead to a review game. Finally, students will read historical background about China that will be used to understand the implementation of China's one-child policy. (This last item may be assigned as homework.) Pages 6-8 in the **Student Packet**	Students will be able to identify the logarithm as the inverse of the exponential function. Students will be able to perform basic computations involving logarithmic functions. Students will be able to apply the standard logarithmic equation to a scenario that involves population growth or decline. Students will be able to explore the real life meaning of quantities involved in computations and take these into account when making rounding decisions.

Unit Summary cont.

Lesson Title	*Description*	*Learning Objectives*
Lesson #3: Development of One-Child Policy ***One 50 minute class period***	In this lesson, students put themselves in China in the 1970s and examine the mathematical models being used to project population growth. They will develop simple models of their own and study the actual 1979 projections to understand how the one-child policy was developed. Pages 9-11 in the **Student Packet**	Students will be able to articulate the historical and political concerns that informed China's one-child policy. Students will be able to utilize historical data to build an exponential model and predict China's population. Students will be able to compare the results of computations with models developed by the Chinese government.
Lesson #4: Moral Considerations of the One-Child Policy ***One 50 minute class period***	In this lesson, students review the mathematical concepts from the previous lesson, read about the Catholic Church's stance on appropriate ways to approach population control, and discuss the important moral issues surrounding China's one-child policy. Pages 12-16 in the **Student Packet**	Students will be able to demonstrate understanding of exponential and logarithmic functions. Students will be able to articulate the historical circumstances that led to China's one-child policy. Students will be able to describe the central ethical issues of China's one-child policy, especially the role of the government and human dignity.
Lesson #5: Evaluating the One-Child Policy ***One 50 minute class period***	In this lesson, students will evaluate the one-child policy through a variety of methods, both mathematical and moral. This class period will culminate in the writing of a paragraph that analyzes the one-child policy from a moral standpoint. Students will be assigned a summative task that will ask them to synthesize what they have learned in a creative format. Pages 17-21 in the **Student Packet**	Students will be able to assess China's one-child policy through multiple lenses, including mathematical modeling, ethical reasoning, and social consequences.