Exponential vs. Power Functions

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TEACHER NOTES

Math Objectives

- Students will be able to use various graphical representations to determine which of two functions is greater for large values of *x.*
- Students will understand that any exponential function of base greater than 1 will be greater than any power function for sufficiently large values of *x.*
- Students will be able to determine which of two functions is greater given a graph of the ratio of the two functions.

Vocabulary

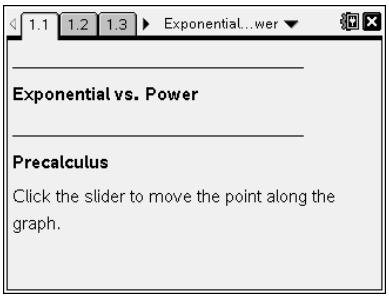
- exponential function
- power function
- base

About the Lesson

- This lesson is a follow-up lesson to the activity *Comparing Exponential and Power Functions*.

TI-Nspire™ Navigator™ System

- Use *Quick Poll* to assess student understanding
- Use *Screen Capture* to exhibit different exponential functions.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing ctrl G.

Lesson Materials:

Student Activity

ExponentialVsPower_Student.pdf

ExponentialVsPower_Student.doc

TI-Nspire document

ExponentialVsPower.tns

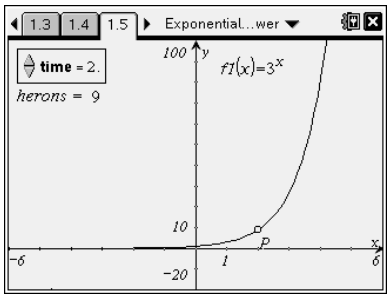
Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

Jorge is a wildlife conservationist whose job is to monitor the population of rare white herons in a wildlife refuge. In his first year, he only found three white herons. Since then, he has observed the population has tripled each year.

If the tripling trend continues, the population of herons can be graphed using the exponential function graphed on page 1.4, $y = 3^x$, where y represents the number of herons and x represents the time, in minutes.

Move to page 1.5.



1. Click the slider to move the point along the graph and fill in the table below.

Answers:

Time (*x*)	0	1	2	3	4
Herons (*y*)	**1**	**3**	**9**	**27**	**81**

Teacher Tip: Point out that the data is discrete, but the function is continuous. Only discrete points are found using the slider on the graph, though the negative values do not make sense in the context of this problem.

2. Why do the values of y become very small for negative values of x?

Sample Answer: Negative values of time do not make sense in the context of population growth. In the function, negative values of x create fractions for y: $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$.

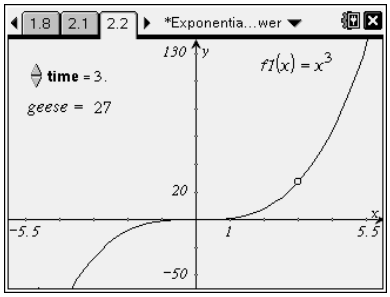
3. What is the domain of the function, $y = 3^x$? The range?

Answer: The domain of the function is all real numbers. The range is all real numbers greater than zero.

4. Describe the end behavior of the function $y = 3^x$.

Answer: As x increases, the values of y increase very quickly. As x decreases, the values of y approach zero.

Move to page 2.2.



Suppose after a couple years, Jorge notices that a population of wild geese seems to be increasing at the rate of the function on page 2.2, where *x* is the time in years and *y* is the population of wild geese.

5. Click the slider to move the point along the graph and fill in the table below.

Answer:

Time (*x*)	2	3	4	5
Geese (*y*)	**8**	**27**	**64**	**125**

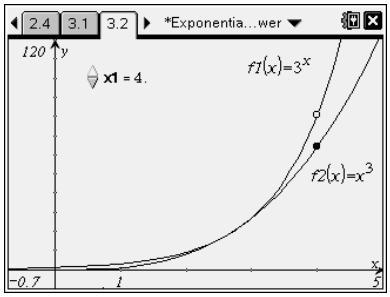
6. What is the domain of the function $y = x^3$? The range?

Answer: The domain and range of the function are all real numbers.

7. Describe the end behavior of the function $y = x^3$.

Answer: The function continues infinitely in each direction. As the values of *x* decrease, the values of *y* decrease to infinity. As the values of *x* increase, the values of *y* increase to infinity.

Move to page 3.2.



Page 3.2 shows both graphs together. Click the slider to move the points along each line and see where the merge and diverge.

8. Use the information you gathered to compare and contrast the two functions.

Samples Answers: Both graphs start out with slow increases but then start increasing rapidly. For negative values of *x*, the exponential function approaches, and never goes below, zero while the power function decreases to infinity. The power function starts out at zero when *x* is 0, but the exponential function starts out at 1.

9. When would the populations of herons and geese be the same? When would they diverge?

Answer: The population would be 27 for both types of birds after three years. Before three years, the population of herons outnumbers the population of geese, but after three years, the geese increase drastically and will continue to outnumber the herons.