# Algebra II Clarifying Lessons: Exponential Functions

**OLD Resources.** These resources have NOT yet been updated to align with the revised secondary mathematics TEKS. These revised TEKS were adopted by the Texas State Board of Education in 2005, with full implementation scheduled for 2006–07. These resources align with the original TEKS that were adopted in 1998 and should be used as a starting point only.

## What is a Clarifying Lesson?

A model lesson teachers can implement in their classroom. Clarifying Lessons combine multiple TEKS statements and may use several Clarifying Activities in one lesson. Clarifying Lessons help to answer the question "What does a complete lesson look like that addresses a set of related TEKS statements, and how can these TEKS statements be connected to other parts of the TEKS?"

### TEKS Addressed in This Lesson

Algebra and geometry: c.1.A, B

Exponential and logarithmic functions: f.2; f.3

### Materials

- Graphing calculator
- Blue, black, and red pens
- Student Worksheet A, Worksheet B, and Worksheet C

### Lesson Overview

Students compare graphs of different members of the family of exponential functions.

### Mathematics Overview

Students investigate, describe, and predict the effects of parameter changes on the graphs of exponential functions; describe limitations on the domains and ranges of these functions; and examine asymptotic behavior.

## Set-up (to set the stage and motivate the students to participate)

1. Have students work in pairs. Provide each pair of students with a graphing calculator, colored pens, and the necessary worksheets.

2. After a discussion of the definition of exponential functions, instruct students to work through Worksheet A on exponential functions.

3. Ask several pairs of students to share their answers to the free response question by writing them on the board or on butcher paper to hang up on the wall.

4. Lead a class discussion based on the displayed answers to clarify students' understanding of exponential functions.

5. Have students continue to work in pairs on Worksheet B to investigate parameter changes on exponential functions.

**Teacher Notes (to personalize the lesson for your classroom)**

## Guiding Questions (to engage students in mathematical thinking during the lesson)

- In what situations would you use the exponential function $y = 2^x$? (c.1.A)

- In what situations would you use the exponential function $y = 3^x$? (c.1.A)

- In what situations would you use the exponential function $y = 0.5^x$? (c.1.A)

- In general, what kinds of situations call for the use of an exponential equation, $y = a^x$? (c.1.A)

- How are these situations reflected in the shapes of the graphs, e.g., increasing or decreasing? (f.2, f.3)

- How do these situations reflect the reasonable domains and ranges you described for the exponential functions? (f.2, f.3)

- What kinds of situations might call for the additional parameters you see in Worksheet B? (c.1.B, f.2)

**Teacher Notes (to personalize the lesson for your classroom)**

## Summary Questions (to direct students' attention to the key mathematics in the lesson)

- How does the graph of $y = 2^x$ compare to the graph of $y = 3^x$? (c.1.A, f.2)
- Why do you think that difference occurs? (c.1.A, f.2)
- How does the graph of $y = 2^x$ compare to the graph of $y = 0.5^x$? (c.1.A, f.2)
- Why do you think that difference occurs? (c.1.A, f.2)
- How do the domains and ranges of the different functions of the form $y = a^x$ compare? (c.1.A, f.2, f.3)
- Why do you think the similarities in the domains and ranges occur? Why do you think the differences occur? (f.3)
- Why, in the general form for exponential equations $y = a^x$ must we define a as not equal to 1? (c.1.A, f.2)

**Teacher Notes (to personalize the lesson for your classroom)**

## Assessment Task(s) (to identify the mathematics students have learned in the lesson)

Use Worksheet C to assess students' understanding of parameter changes on exponential functions.

**Teacher Notes (to personalize the lesson for your classroom)**

## Extension(s) (to lead students to connect the mathematics learned to other situations, both within and outside the classroom)

Provide students with two sets of cards. On one set are drawn the graphs of $y = 2^x$ and other transformations of $2^x$. On the second set of cards are written the functions that correspond to each of the graphs. Have students match the graph to the appropriate function.

**Teacher Notes (to personalize the lesson for your classroom)**