Exponential Graph Similarity

In this activity, we will use GeoGebra in Algebra mode, and the laws of exponents, to show that all exponential graphs are similar.

Vertical Stretch

1. In a new window, graph $f(x) = 10^x$ and $g(x) = 3 \cdot 10^x$. Change the color of one of the graphs.

As it turns out, *these two graphs are congruent*. We will show that by using a well-chosen translation.

2. Make a vector, and use it to translate the graph of f(x). Change the vector until the image of the graph of f(x) is exactly superposed onto the graph of g(x).

3. a. **Conjecture**: for an exponential graph, a vertical stretch is a _____ translation.
   b. Use algebra to prove your conjecture.

4. Describe the graph of $y = 10^{x+1}$ as a translation and as a stretch of the graph of $y = 10^x$.

5. Generalize: $y = b^{x-p} = k \cdot b^x$, if k = _____

Dilation

6. In a new window, graph $f(x) = 10^x$

7. Make a point O at the origin, and dilate the graph of f(x) with center O and scaling factor 3.

8. GeoGebra gives an equation for the dilated graph. Explain it.

But we know from #3 above that the dilated graph is congruent to $h(x) = 10^{x/3}$.

9. Explain why the graphs of f(x) and h(x) are similar.

10. Explain why the graphs of $y = 2 \cdot 3^x$ and $y = 5 \cdot 2^x$ are similar. (**Hint:** you will need to use logs.)

11. **Challenge**: Explain why the graphs of $y = a \cdot b^x$ are all similar to each other.