## Unit 4 Lesson 12: The Number $e$

### 1 Matching Situations and Equations (Warm up)

#### Student Task Statement

Match each equation to a situation it represents. Be prepared to explain how you know. Not all equations have a match.

$f(t)=400⋅(0.5)^{0.1t}$

$g(t)=400⋅(1.25)^{0.1t}$

$h(t)=400⋅(0.75)^{0.1t}$

$j(t)=400⋅(2)^{10t}$

$k(t)=400⋅(2)^{0.1t}$

1. A scientist begins an experiment with 400 bacteria in a petri dish. The population doubles every 10 hours. The function gives the number of bacteria $t$ hours since the experiment began.
2. A patient takes 400 mg of a medicine. The amount of medicine in her bloodstream decreases by 25% every 10 hours. The function gives the amount of medicine left in her bloodstream after $t$ hours of taking the medicine.
3. The half-life of a radioactive element is 10 years. There are 400 g of the element in a sample when it is first studied. The function gives the amount of the element remaining $t$ years later.
4. In a lake, the population of a species of fish is 400. The population is expected to grow by 25% in the next decade. The function gives the number of fish in the lake $t$ years after it was 400.

### 2 Notice and Wonder: Moldy Growth

#### Student Task Statement

A spot of mold is found on a basement wall. Its area is about 10 square centimeters. Here are three representations of a function that models how the mold is growing.

|  |  |
| --- | --- |
| time (weeks) | area of mold (sq cm) |
| 0 | 10 |
| 1 | 27 |
| 2 | 74 |
| 3 | 201 |
| 4 | 546 |

$a(t)=10⋅e^{t}$



What do you notice? What do you wonder?

### 3 $(1+tiny)^{huge}$

#### Student Task Statement

1. Here are some functions. For each function, describe, in words, the outputs for very tiny, positive values of $x$ and for very large values of $x$.
* $a(x)=1^{x}$
* $b(x)=-x$
* $d(x)=\frac{1}{x}$
* $f(x)=\left(\frac{1}{x}\right)^{x}$
* $g(x)=\left(1+\frac{1}{x}\right)^{x}$
* $h(x)=e^{x}$
* $k(x)=1+x$
*
1. Remember that $e≈2.718$. What does the function $g$ have to do with the number $e$?
2. What do you notice about the relationship between $h$ and $k$ for very small, positive values of $x$?

#### Activity Synthesis









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