Essential Question: How can we represent exponential relationships symbolically?

Do Now: Read the scenario below and answer the questions that follow.

When a piece of paper is folded in half, the total thickness doubles. Suppose an unfolded piece of paper is 0.1 millimeter thick. The equation $t(n) = 0.1(2)^n$ represents the total thickness, $t(n)$, as a function of the number of folds, n.

a) The function $t(n) = 0.1(2)^n$ is an explicit rule created from $t(n) = ab^n$. In the explicit rule, what is the value of **a**? What does this number represent in the context of the problem?

b) What is the value of **b**? What does this number represent in the context of the problem?

c) Using the function, determine the thickness of the paper after 5 folds.

How do we write a function rule to represent an exponential relationship?

1. Identify the values of **a** and **b** in $f(x) = ab^x$.
   - **a** represents the initial value (0, a)
   - **b** represents the common ratio
2. Write the function rule by substituting the values of **a** and **b** into $f(x) = ab^x$.

1. The height $h(n)$ of a dropped ball is an exponential function of the number of bounces n. The ball was dropped from an initial height of 40 inches. On its first bounce, it reached a height of 30 inches and on its second bounce, it reached a height of 22.5 inches. Write an exponential function in the form of $h(n) = ab^n$ that represents this scenario.

2. A pharmaceutical company is testing a new antibiotic. The number of bacteria present in a sample 1 hour after application of the antibiotic is 50,000. After another hour, the number of bacteria present in the sample is 25,000. The number of bacteria remaining, ***r*(*n*)**, is an exponential function of the number of hours, ***n***, since the antibiotic was applied.

   a) Complete the table below that describes the relationship.

Hours *n*	0 Initial Amount	1	2	3	4
Bacteria *r*(*n*)					

   b) Write an exponential function to represent the above scenario.

   c) Using your function rule, determine the amount of bacteria that will remain in the sample after the 7th hour.

   d) How many hours have passed if approximately 12 bacteria are left in the sample?

3. Suppose you invest some money in an interest bearing account. After the first month, the balance, including interest, is \$10,500. Following the second month, the balance is \$11,025. Following the 3rd month, the balance is \$11,576.25. Write a function rule to represent the balance in the account after **x** months. Use the table below to help you.

Months x				
Balance f(x)				

TAKE AWAY

In order to represent an exponential relationship as a function in the form of **f(x) = ab^x^**, identify **a**, the ____(y-intercept) and identify **b,** the ____.

Describing Relationships with Exponential Functions

1. The population of fish in a local stream is decreasing at an alarming rate. The original population was 48,000. After one year, the population was 28,800. After the 2nd year the population was 17,280. Write an exponential function, **P(*t*)**, that models this situation where ***t*** represents time in years. If this trend continues, how many fish are expected to be living in the stream after the 10th year?

2. A painting is sold to an art gallery. Over time, the painting increases in value exponentially. After one year, the painting is worth $1,540. After the second year, the painting is worth $1,694. Write an exponential function that models this situation. What will the painting be worth after seven years? *Define your variables.*

3. The breakdown of a sample of a chemical compound is represented by the function $\mathbf{p(t) = 300(0.5)^t}$, where **p(*t*)** represents the number of milligrams of the substance and ***t*** represents the time, in years. In the function **p(*t*)**, explain what 0.5 and 300 represent.

4. Write an exponential function that models the table of values below.

x	1	2	3	4
f(x)	1	4	16	64