Warm Up

A population of 250 animals is decreasing by 5.5% each year. Write the equation you can use to calculate how many animals will remain after 12 years.

What do we need to know to write the equation?

Decay Factor: $100\% - 5.5\% = 94.5\%$

$1 - 0.055 = 0.945$

Factor = 1 + Rate

$= 1 - 0.055$ (decreasing)

$= 0.945$

Equation: $y = 250(0.945)^x$

≈ 127 animals left

↑ rounding

2. Using your data, what is the calculated decay factor? Show below how you calculated this.
Note: As the experimenter, you can decide which data points you want to include in your calculations as long as you have valid reasoning.

0.71 0.63 0.63 0.70 0.67 0.85 0.73

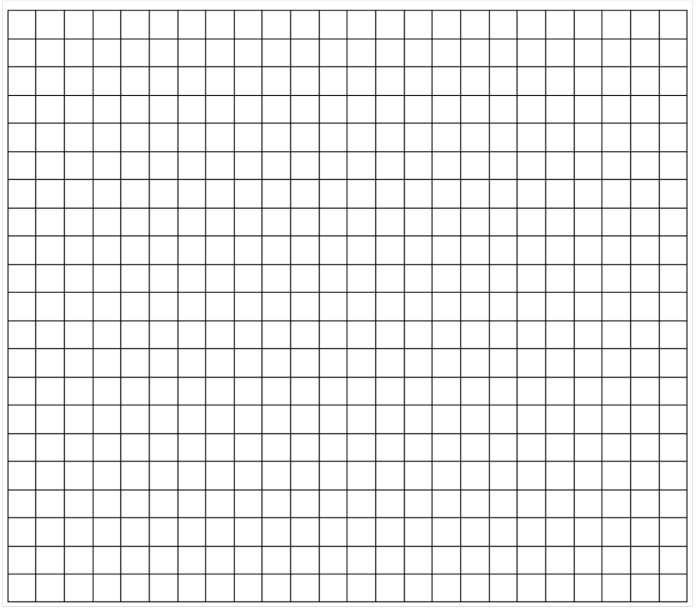
3. What is the decay rate?

0.71

If we use 0.71 → Decay Rate = 29% ↓

4. Write an equation you can use to calculate the number of beads remaining after "x" number of trials.

5. Graph your data: Create a graph of Trials (x) and Total Beads Remaining (y).



6. Thinking about what we know about probability we could have predicted this decay factor. Explain what the probability would be for one of the beads to fall hole side up?

6 total sides
4 sides no hole

$\frac{4}{6} = 0.67$

Based on this probability, what should the **decay factor** be?

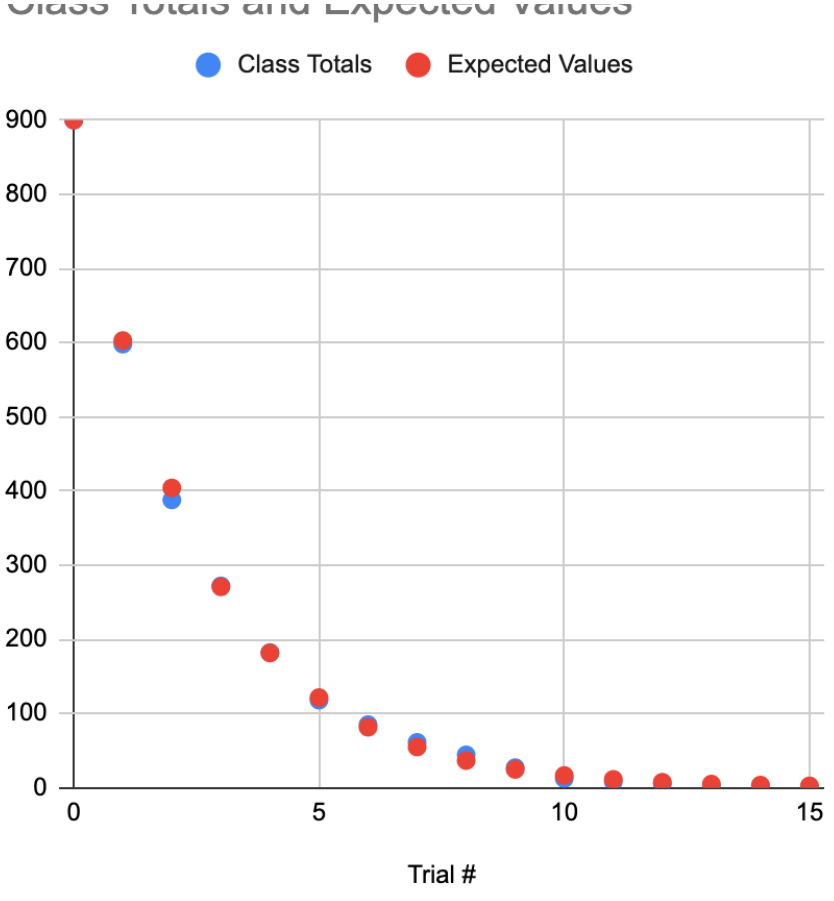
7. Compare the number of remaining beads we would expect based on probability to the number of beads the class actually had in the experiment.

   a. In the left-hand column fill in the total number of beads the class had after each trial. (Class totals are in the spreadsheet shared in Drive)

   b. In the right-hand column fill in the number of beads you would expect to remain after each trial based on your **predicted decay factor from #6**.

Trial Number	~~**ACTUAL** Number~~ Expected of Remaining Beads (class totals)	~~**EXPECTED** Number~~ Actual of Beads Remaining ~~based on **decay factor from #6**~~
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

8. How does the **actual** number of beads remaining calculated above compare to your **expected** amount? Why might there be a difference?


Class Totals and Expected Values
Class Totals
Expected Values
900
800
700
600
500
400
300
200
100
0
0
5
10
15
Trial #

9. Assuming the same decay factor that you calculated for the class data, if there are 43 beads remaining after 10 trials, how many beads were there initially?

$y = ab^x$

$y = a(0.67)^x$

$\frac{43}{0.67^{10}} = \frac{a(0.67)^{10}}{0.67^{10}}$

$2359 = a$

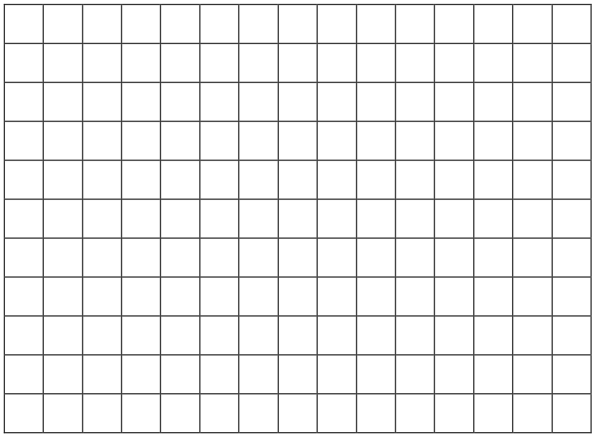
10. If we had used Skittles instead of beads and had removed the Skittles with the "S" side up at each trial, what would the **decay rate** have been? (Skittles only have an "S" on one side.)

50%

11. What would the equation be if we started with 100 Skittles?

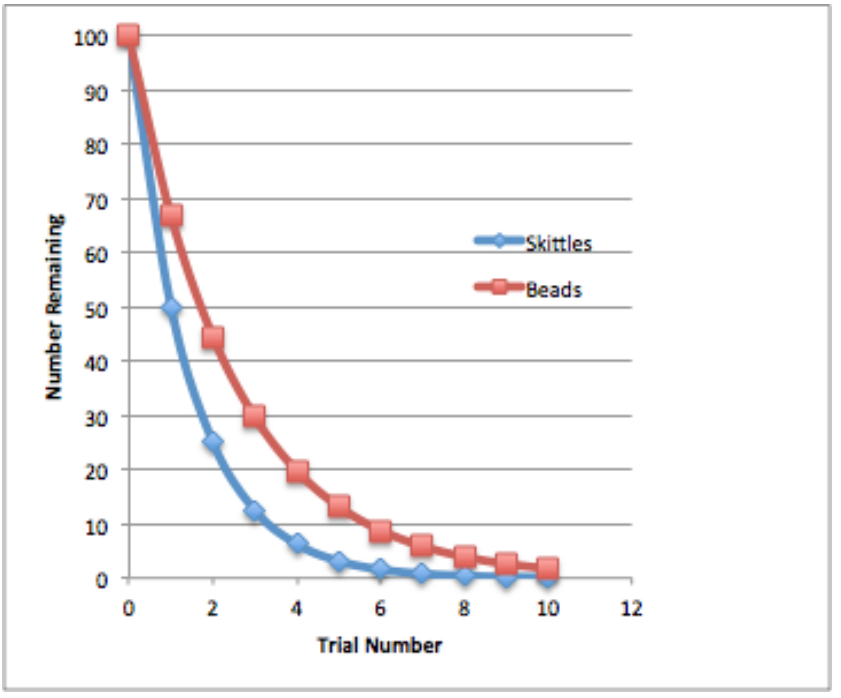
$y = 100(0.5)^x$

12. Using two different colors draw below (on the same plot) the expected graphs for the exponential decay relationship if we started with 100 beads, compared to that with 100 Skittles. Explain how the graphs are the same, and how they are different.



Same:

Different:


100
90
80
70
60
50
40
30
20
10
0
Number Remaining
0
2
4
6
8
10
12
Trial Number
Skittles
Beads

Name _____ Period _____ Date _____

Exponential Decay – Practice Problems

1. Garden City introduced a recycling program. The goal of the program is to reduce the number of pounds of trash sent to landfills by 25% each year. In 2010, Garden City produced 100,000 tons of trash. If the recycling program were to reach its goal, how many tons of trash can Garden City expect to produce in the year 2025?

2. A city of 2,950,000 has a 2.5% annual decrease in population. Determine the city's population after each of the following:

   a. 1 year

   b. 5 years

   c. 15 years

   d. 25 years

3. Several species of whale have been declared endangered. When the populations of a particular whale species fall dangerously low, biologists encourage governments to agree to a ban on hunting the species. Suppose that, in the year 2000, there were only 5,000 whales of a particular species and that the population was predicted to continue to decline as shown in the table.

Year (y)	Whales (w)
0 (2000)	5,000
1	4,500
2	4,050
3	3,645
4	3,281
5	2,952
6	2,657

a. Which equation below models this population pattern?

A. $W = 5{,}000(0.1^y)$

B. $W = 5{,}000(0.9^y)$

C. $W = 5{,}000 - 500^y$

D. $W = 5{,}000^y$

b. What is the decay factor for the relationship? Explain how you determined your answer.

c. Define all the numbers and variables in the equation in the context of the problem.

d. According to this model, what will the whale population be in 2007?

e. What is the decay rate?

4. Write an equation for the exponential relationship in the graph below. Show your work.

5. The population of a certain species of bird is decreasing by 10% each year. If the population in year 0 is 15,000, which of the following statements are true? *Select all that apply.*

- ☐ In year 7, there will be fewer than 7,000 of this species of bird.
- ☐ After 5 years, there will be approximately 8,857 of this species of bird.
- ☐ The graph of this relationship shows exponential decay.
- ☐ The decay factor is 0.10.
- ☐ After 1 year, there will be 13,500 of this species of bird.

6. In some areas, home values have decreased over the past 10 years. The table shows the decrease in the home value of one house.

Year	Home Value
0	$250,000
1	$242,500
2	$235,225
3	$228,168
4	$221,323
5	$214,684

Using the tiles, write an equation that represents the value of the home, v, after t years.

1.03	0.03	250,000
0.97	1.30	t

$v = (\square)(\square)^{\square}$

7. A tree farm has begun to harvest a section of trees that was planted a number of years ago. The table shows the number of trees remaining for each of 8 years of harvesting.

Year	0	1	2	3	4	5	6	7	8
Trees remaining	10,000	9502	9026	8574	8145	7737	7350	6892	6543

a. Suppose the relationship between the year and the number of trees remaining is exponential. Approximate the decay factor for this relationship. Explain how you found this.

b. Write an equation for the relationship between time and trees remaining.

c. Use your equation to find how many trees will be left after 20 years?

9. Another tree farm plans to harvest their trees so that there was a linear relationship with the initial data presented in the table below.

Year	0	1
Trees remaining	10,000	9502

b. Write an equation for the relationship between time and trees remaining.

c. Use your equation to find how many trees will be left after 20 years?

Homework

Finish classwork