1.3 Exponential Functions

1.3.1 Kittens[4]

Description	**Kittens** (2-3 days)
Core Math	Exponential functions can be used to help model problems of population growth.
CCSS-M Standard(s)	N-Q Reason quantitatively and use units to solve problems F-LE Construct and compare linear, quadratic and exponential models and solve problems
Standards for Mathematical Practices	MP 1: Make Sense and Persevere MP 2: Reason Abstractly and Quantitatively MP 3: Construct Viable Argument and Critique the Reasoning of Others MP 4: Model with Mathematics (especially)
Potential Misconceptions	Students may think you add the same number of kittens every generation (linear)
Resources and Setup	Teacher Materials for Kitten Problem Kitten Poster Copies of Sample Student Work Calculators Graph paper Poster paper and Marker Mini white boards with pens and erasers

[4]Source: Mathematics Assessment Project
http://map.mathshell.org/lessons.php?unit=9100&collection=8&redir=1

Lesson:	
Launch	**Day 1** Project ***Having Kittens*** Poster on the board and discuss context. - A humane group is trying to encourage spaying and neutering of cats. - Note that the activity is about what happens if we don't have a given cat spayed. Their task is to decide whether the statement on the poster is correct. Be sure everyone understands the meaning of descendants, average in this context, and importance of units.
Instructional Activities	Have students individually work on the task. At the end of class debrief: - Ask about strategies used - Ask about assumptions - Ask for representations used. - How can you show which kittens descended from which? - How can you show the numbers of kittens at each month? - Discuss what might be problematic, e.g. sex of offspring. Collect papers at end of day 1 and give comments/questions to each student. Make notes for discussion next day. **Day 2:** - Take a class poll as to yes or no for the reasonableness of the 2000 descendants. Ask for justification for some responses. - Organize the class into groups of two or three students and give each group a large sheet of paper and a felt-tipped pen. Ask students to try the task again, this time combining their ideas. - While students work in small groups you have two tasks: to note different student approaches to the task and to support student problem solving. - Remind them to take turns to explain each had initially solved their problem and how they think it could be improved. Then have them put their individual work aside and try to produce a joint solution. - Ask questions of groups to help their problem solving, e.g., o Can you organize your work in a table or diagram? o Can you show time elapsing on your diagram? o Can you break the problem up into manageable chunks? o How many cats/kittens will there be after 6 months? 12 months? 18 months? o What assumptions have you made? o How can you check your solution? o Do you think there is just one solution?

	○ What is your strategy for solving this problem? ○ What do you know now that you did not know before? ○ Are there other approaches you could try? ○ Have you considered all the conditions? N - Make a status poster outlining your assumptions and your solution - Sharing posters: - - Have one student from each group visit another group to read through their solution and ask questions. - Based on findings have the groups consider how to improve their poster.
Share	Day 3: 1. Share posters. Either have several different groups share unique approaches or have a gallery walk. Either way students should comment on: a. Did they choose a good method to represent the situation? b. Did they make sensible assumptions? c. Is the reasoning correct? Are the calculations accurate? d. Are the conclusions sensible? e. Was the reasoning easy to understand and follow? 20 min 2. Provide sample student work. You may give each group one student work to discuss and critique or more than one. 3. Choose something different from how their group approached the problem if possible. a. Imagine you are the teacher and have to assess this work. b. What has each student done correctly? c. What assumptions have they made? d. How can their work be improved? Discuss each sample solution, having groups respond to the three questions above.
Universal Support	Some students may benefit from a graphic organizer
Homework	Compare and contrast the approaches of Alice, Wayne and Ben. Did your group use a method similar to any of theirs? What was the same? Different?

Having Kittens

Cats can't add but they do multiply!

In just 18 months, this female cat can have 2000 descendants.

Work out whether this number of descendants is realistic.
Here are some facts that you will need:

Length of pregnancy

About
2 months

Age at which a female cat can first get pregnant

About
4 months

Number of kittens in a litter

Usually
4 to 6

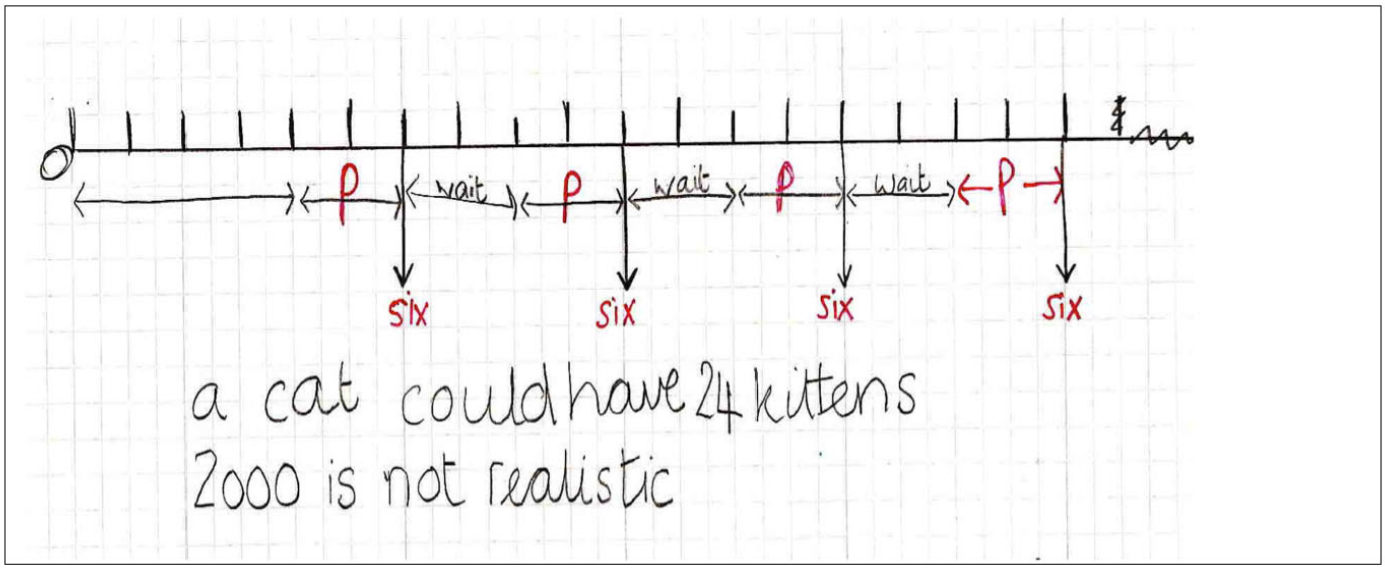
Average number of litters a female cat can have in one year

3

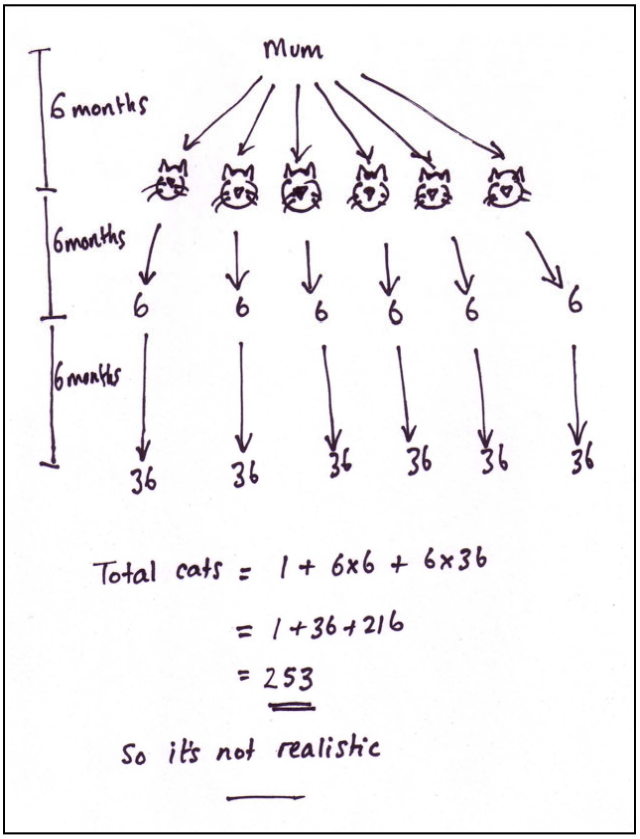
Age at which a female cat no longer has kittens

About
10 years

Sample Responses to Discuss: Alice



Sample Responses to Discuss: Wayne



Sample Responses to Discuss: Ben