

THE 2017 ROSENTHAL PRIZE for Innovation in Math Teaching

Growing Alligators: How Big Will It Grow? Application of Surface Area and Volume, Proportional Reasoning, and Statistical Analysis







Lesson Plan: Grade 7 **David Poras**

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Part I - Lesson Introduction

Lesson Overview

In this lesson, students use their knowledge of three-dimensional geometry and proportional reasoning to predict the new measurements of a Magic Grow alligator after the animal is left in water for 72 hours. In groups, students decide how to interpret the instructions on the package as shown below and then use that interpretation to predict the resulting measurements of the enlarged alligator. Each group shares their interpretation and prediction with the class.

DIRECTIONS

Place Mega Grow animal in a large container full of cool water. Leave animal in water for at least 72 hours (3 days). Animal will continue to grow for 1 week if left in water. A container that is too small will inhibit animals growth. Animal can grow up to 600%. The animal will very slowly shrink back to original size when it is removed from the water. Use over & over! DO NOT USE WARM OR HOT WATER.



After the alligator grows for 72 hours and all groups share their predictions, students use their knowledge of data analysis and measures of center to create an algorithm to determine the winning group. The winning group takes the alligator home as a pet!

This lesson is a summative task at the end of a unit on three-dimensional geometry. However, the lesson could be modified to be taught during the geometry unit.

Prerequisite Knowledge

This lesson is designed to be taught in a common-core aligned 7th grade math class after students have completed units of study on Ratios and Proportional Relationships, The Number System, Expressions and Equations, and Geometry. Below are the most important pre-requisite topics from those units of study:

- Determining if a relationship is proportional or not by testing equivalent ratios.
- Using proportions to solve percent problems including percent of a number, percent increase and percent error.
- Performing calculations involving absolute values, squares and square roots, and cubes and cube roots.
- Measuring length, and calculating surface area and volume of various threedimensional objects.

• Calculating the mean of a data set.

Lesson Goals

1) Proportional and Non-Proportional Relationships

Going into this lesson, students have completed a thorough study of proportional relationships including percent increase and decrease, and a thorough study of volume and surface area of various three-dimensional objects. In this lesson, students will learn about the relationship between increasing side lengths of a three-dimensional object by a constant scale factor and the corresponding increases to that object's surface area and volume.

2) Mathematical Modeling

Students will apply their understanding of surface area, volume and other geometric attributes to create an interpretation of the statement "Grows 600%" on the alligator package. Students will use their interpretation to predict the new measurements of alligator. Students will compare their model to the actual lengths and reflect upon how their model performed and how their model could be improved for future use.

3) Data Analysis

In deciding upon a process to determine the winning group, students will learn about the difference between calculating the mean of the absolute differences between the predictions and the actual measurements, compared to calculating the mean of the percent error between the predictions and the actual measurements.

Student Outcomes

After completing this lesson, students will be able to:

- 1) Calculate the new surface area and volume of a three-dimensional object if each length of the object is increased or decreased by a constant scale factor.
- 2) Calculate the new side lengths of a three-dimensional object if the surface area and/or volume is increased or decreased by a constant factor.
- 3) Reflect on their use of a mathematical model by explaining how they created their model, explaining how they tested the model for accuracy, and explaining how they would improve their model for future uses.

Common Core Standards¹

Grade 7 Content Standards

<u>CCSS.MATH.CONTENT.7.G.B.6</u>: Solve real-world mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

<u>CCSS.MATH.CONTENT.7.RP.A.2.A</u>: Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

<u>CCSS.MATH.CONTENT.7.RP.A.3</u>: Use proportional relationships to solve multistep ratio and percent problems.

<u>CCSS.MATH.CONTENT.7.SP.B.4</u>: Use measures of center and variability of numerical data from random samples to draw informal comparative inferences about two populations.

Standards for Mathematical Practice

The full descriptions of these standards are lengthy. Listed below are the most pertinent parts of the standards.

<u>CCSS.MATH.PRACTICE.MP3</u>: Construct viable arguments and critique the reasoning of others.

- Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments.
- They justify their conclusions, communicate them to others, and respond to the arguments of others.

CCSS.MATH.PRACTICE.MP4: Model with mathematics.

- Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society and the workplace.
- Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.
- They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

¹ "Mathematics Standards." *Mathematics Standards – Common Core State Standards Initiative*. Web. 19 July 2017. http://www.corestandards.org/Math/.

Part II - Lesson Details

Time Required

Preparation Time: 1 hour

Class Time: $1\frac{2}{3}$ hours

Homework Time: $1\frac{1}{2}$ hours

- Lesson 1 10 minutes (end of a class period)
- Lesson 2 45 minutes (a full class period)
- Lesson 3 45 minutes (a full class period)
- Homework Assignment 1 30 minutes
- Homework Assignment 2 30 minutes
- Homework Assignment 3 30 minutes

The lessons and homework assignments can be shortened to complete this lesson in a shorter time period. An abbreviated timeline is presented at the end of this lesson plan.

<u>Materials</u>

- 1 Magic Grow alligator per class. These can be purchased for about \$5 each. Other animals are available as well.
- 1 large plastic tub in which the alligator will grow for 72 hours. Teachers can likely find these in their schools or they can be purchased for about \$10.
- iPads with the free <u>Adobe Spark Video app</u>.² This lesson assumes the school is a 1:1 iPad environment. Students could also create a video on other 1:1 devices or shared devices. Additionally, the lesson can be easily modified if students do not have access to devices. iPads are not an essential component to the lesson.
- Rulers 1 per student
- Copies for each student of the following:
 - o Homework Assignment 1
 - o Do Now
 - o Task Overview
 - Homework Assignment 2
 - Homework Assignment 3

² https://spark.adobe.com/about/video

Class Preparation

Prior to teaching the lesson, the teacher should prepare the following:

- When groups have finished making their predictions, they will enter their results into a Google Form so the teacher will be easily able to view and manipulate the data in a spreadsheet. If a Google Form is not available, the teacher can use any other survey tool or simply have students record their predictions on a piece of chart paper.
 - Click the link below for an example of the Google Form <u>https://goo.gl/forms/VpYbCOmfsWKyP5RS2</u>

The first question will allow the teacher to sort the results by each class to easily determine the winning group for each class.

- Removing the alligator from the water and immediately measuring the new lengths in front of the students helps build the authenticity and engagement of the lesson. Therefore, it is important to plan backwards from this moment and place the alligator in the water 72 hours prior. Depending upon the class schedule, it might not be possible to drop and remove the alligator from the water during class. In these situations, the teacher should schedule the drop time so the removal happens during class.
- Create groups of 3 4 students in each class.

Part III - Lesson Plans

Lesson 1 – 10 minutes

This introductory mini-lesson should be conducted at the end of a class period. The purpose of the lesson is to show students the alligator toy, introduce the general question about growing the alligator, and prepare students for that night's homework assignment.

Introduction and Toy Observations – 3 minutes

Show the students the Magic Grow alligator toy in the package. While holding it up, project the following two images.





In pairs, students will look at the front and back of the package and write down their responses to the following two questions.

- 1) What do you notice about the toy?
- 2) What do you wonder about the toy?³

Class Sharing - 5 minutes

For 5 minutes, write down on the board the ideas that students share with the class. During this time, encourage creativity in the student responses. Although this lesson will ultimately focus on how large the alligator will become in water after 72 hours, the focus of this part of the lesson is eliciting a range of creative ideas from the students.

Below are some possible student responses:

- 1) What do you notice about the toy?
 - It can grow up to 600%.
 - Water should be cool.
 - The animal will shrink back when taken out of the water.

2) What do you wonder about the toy?

- How big will it get?
- Will it ever stop growing if it stays in the water?
- What happens if you use warm or hot water?
- Do the other animals grow to different sizes?
- How quickly does it grow?
- What if other liquids are used?

³ See <u>http://mathforum.org/pow/noticewonder/</u> for more information about these questions.

<u>Closure – 2 minutes</u>

To end this mini-lesson, share with the class that they will be growing the alligator in water for 72 hours and that students will be working in groups during the next class period to predict the size of the new alligator. Pass out the homework assignment and tell the students that the questions on this assignment will help prepare them for their work tomorrow. The homework assignment is <u>HW: Mega Grow Alligator 01</u>.

Students will have questions about the task at this point. However, there will likely not be time for questions. Students should be able to successfully complete the homework assignment without knowing much about the alligator task, so it is fine to leave those questions unanswered for now.

Lesson 2 – 45 minutes

Do Now and HW Review – 10 minutes

As class begins, project the "Do Now" on the board or pass it out to students. The questions are below and the document is at the end of the lesson plan.

As your teacher comes around to check your homework, discuss and answer the following questions with your partner in your "Do Now" section of your binder:

- 1) How did your partner interpret the "Grows 600%"?
- 2) What two numbers would complete the table below? You don't need to copy down the table just write down the two numbers.

	Cube A	Cube B
Side Length	3 cm	12 cm
Surface Area	54 sq. cm	
Volume	27 cu. cm	

- 3) Copy and complete the following sentences. Use your HW answers to help you:
 - a. When all the side lengths of a 3D object are all increased by a scale factor of N, the **surface area** increases by a factor of _____.
 - b. When all the side lengths of a 3D object are all increased by a scale factor of N, the **volume** increases by a factor of _____.

When reviewing the answers to #2, some students might not fully grasp the relationships at this point. As they begin their work on the project, they will have more time to discuss

and work with these ideas. Be mindful of not spending too much time on the "Do Now" as students will need ample time to work in their groups.

Task Introduction – 5 minutes

Pass out the Task Overview worksheet and review it together as a class. Do not spend too much time reviewing the instructions or taking questions from students. Once they begin working in their groups, they'll be able to discuss any questions.

Share groups with students and have them begin on the task.

Work Time – 25 minutes

Students will spend this time in their groups completing the task. They should be able to complete the entire task during these 25 minutes. Students will need to work efficiently, stay focused on the task and delegate responsibilities to different group members. Depending upon the class composition, consider assigning roles to each member of the group to keep students on-task and focused.

Below are some items to keep in mind as you circulate the room during the group work time:

- All groups will need to measure the original alligator before it is placed in the water. Depending upon how many alligators are available, groups may not be able to work with the alligator immediately. As they are waiting, they can work on the following:
 - Decide how they will interpret "Grows 600%"
 - Determine any needed growth factors
 - Research an interesting alligator fact
- Some groups might initially decide to apply the 600% growth factor to the <u>length</u> (rather than the surface area or volume) of the alligator. Before they settle on this interpretation, encourage them to increase their Measurement #1 (length of alligator from end-to-end) by 600% and draw that actual length on the class whiteboard. Hopefully, they will see the unreasonableness of this interpretation (it is very, very long) and shift to applying the 600% growth factor to the surface area or volume of the alligator. If they do not decide to change their approach, don't force them. Their predictions will be way too big, but they will learn a good lesson in evaluating the reasonability of mathematical models.
- For those groups that decide to apply the "Grows 600%" to the surface area or volume of the alligator, they may need assistance in connecting the work on the Homework and the "Do Now" to this current task.

For example, some groups may attempt to calculate the actual volume of the alligator. Their strategy might be:

- Find the current volume by splitting up the alligator into shapes studied (prisms, pyramids, cylinders, cones and spheres)
- Increase the volume by 600%
- Work backwards from the increased volumes to find the new side lengths.

The shape of the alligator makes it difficult to split it up into the known shapes. Accordingly, the alligator presents a good challenge that some of the other animals (like the starfish) do not.

For groups that are committed to finding the current volume and surface area of the alligator, encourage them to review questions from the Homework and the "Do Now". If that is not sufficient in moving their thinking, ask them questions like "If the volume of a 3 x 3 x 3 cube is multiplied by 8, what are the side lengths of the new cube?" Hopefully, they can answer this correctly and will be able to connect this to the alligator work. If not, providing additional examples will help.

For students that have yet to connect the work on the Homework and the "Do Now" to the alligator task, be sure to spend ample time with them to solidify the connection. The relationship between increasing the volume or surface area of an object by a constant factor and the corresponding scale factors to the lengths of the object is an essential idea of this lesson.

Hopefully, through continued conversation, they will understand that if they think the volume (or surface area) will increase by a factor of 7 (growing by 600% is equivalent to 700% of the original number), then the side lengths will increase by a scale factor of $\sqrt[3]{7}$ (or $\sqrt[3]{7}$).

• Finally, some groups might use different scale factors than 7. The instructions on the package say "Leave animal in water for at least 72 hours. Animal will continue to grow for 1 week if left in water. ... Animal can grow up to 600%." Some groups might only use $\frac{3}{7}$ of 7 as the scale factors (since 72 hours is $\frac{3}{7}$ of a week). Ask students if this seems reasonable. Other groups might have even more creative interpretations.

Students might be initially overwhelmed at all the tasks to complete in a relatively short time-period. However, posting the list below on the board and encouraging them to delegate tasks should help them stay on track. If needed, they could finish some of the tasks for Homework or at the start of class the next day.

Measuring the alligator	(4 mins)
Discussing and deciding on the interpretation of "Grows 600%"	(6 mins)
Applying the scale factor to the measurements	(6 mins)
Completing the survey	(1 min)

Finding an alligator fact Uploading pictures and recording the Spark Video (3 mins) (5 mins)

<u>Closure – 5 minutes</u>

To close the lesson, each group should discuss what tasks they need to finish outside of class. If there is time, groups can share with the class how they are interpreting the "Grows 600%." Then, pass out the homework assignment – <u>HW: Mega Grow Alligator 02</u>.

Lesson 3 – 45 minutes

This lesson should take place 72 hours after the alligator is dropped in the water. Students will enjoy seeing the alligator removed from the water and helping with the measuring of the new, larger alligator. Accordingly, there will likely be some class days in between Lesson 2 and Lesson 3. This lesson is a summative task in the Geometry unit, so the day(s) in between the lessons could be used for other review work in preparation for a Geometry Unit Summative Assessment. Alternatively, Lesson 2 could be on Friday and Lesson 3 on Monday.

<u>Measure the Alligator – 3 minutes</u>

Remove the alligator from the water and determine the four new measurements. Write them on the board.

Student Sharing – 15 minutes

Each group will share their Spark Video with the class. As students watch the videos, they should record the following on a piece of paper:

- Group members' names
- How the group interpreted the "Grows 600%"

Below are links to Spark Videos from the Spring of 2017:

https://spark.adobe.com/video/eN7xcQvr8vqOz https://spark.adobe.com/video/RRPI9deuluu0x https://spark.adobe.com/video/mv24CTI1sTRsL https://spark.adobe.com/video/sW5KmSMFjzYKr

Selecting a Scoring Method – 15 minutes

For Homework 02, students thought about how to determine a winner. Have some students share their ideas with the class and record them on the board. As ideas are shared, encourage the students to ask questions and offer their opinions about the methods. Likely suggestions include:

• Find the difference between the predicted and actual measurements for each of the four lengths. Sum the four differences and the group with the smallest number is the winner.

- Find the difference between the predicted and actual measurements for each of the four lengths. Find the mean of the four differences and the group with the smallest number is the winner.
- Find the percent difference of estimation and actual measurement for each of the four lengths. Sum (or find the mean) of the four percentages and the group with the smallest number is the winner.

Before having the class vote on a method, ask the class the following questions (if these ideas don't come up naturally in the discussion):

- Is there a difference in being 1 cm off on the length of the full alligator compared to being 1 cm off on the width on the right flipper? Which, if any, is more impressive?
 - Hopefully, students will conclude it is more impressive being 1 cm away from the actual length of the alligator since this is much larger than the flipper width. This discussion might help students see the value in selecting a method that involves percentages or ratios, rather than just find the differences.
- If we just calculate the mean of the differences (actual subtracted from predicted), could a group have wildly inaccurate predictions yet have a mean of <u>zero</u> and win the contest?
 - Hopefully, students will think of a scenario in which two of the predictions could be much <u>smaller</u> than the actual measurements and two of the predictions could be much <u>larger</u> than the actual measurements. If the sum of the first two differences (negative values) is equal to the sum of the last two differences (positive values), the mean will be zero. While this is unlikely, it should be considered in deciding upon a scoring metric. This discussion might help students see the value in finding the absolute value of the differences between the predicted and actual measurements.

As the discussion continues, make necessary changes to the proposed scoring systems. Once the conversation seems to be wrapped up, have the students vote on which method they want to use.

Finding the Winner – 10 minutes

Once a method has been selected, open the spreadsheet with the survey responses (all the groups' predictions) and use the selected method to determine a winner.

Some math courses have embedded technology standards. If a technology goal of this course is the use of spreadsheets, additional time can be spent here instructing students about using formulas in spreadsheets.

Below are links to spreadsheets from previous school years (student names have been removed):

This class decided to find the percent error of each guess, sum the four percentages and then find the absolute difference of the sum and 400%. The group with the smallest number is the winner.

https://docs.google.com/spreadsheets/d/174awV9mW_IVwFkUCjUq_xWzONeKYVjb5hZJPzo8WhGY/edit?usp=sharing

This class decided to find the absolute difference between the prediction and the actual measurement and then find the sum of the four absolute differences. The group with the smallest number is the winner.

https://docs.google.com/spreadsheets/d/1MO5US9lc_ucyNpsQ9ZpI8W0kQ4MMK0hPw4wL0DqJMjc/edit?usp=sharing

This class decided to find the ratio of predicted to actual for each measurement and then sum the four ratios. The group whose sum is closest to 4 is the winner.

https://docs.google.com/spreadsheets/d/1PYCQCmxobBz-kA8xEZxN5-XQgRs29CLWgU2-oT2tXDg/edit?usp=sharing

Closure – 2 minutes

Congratulate the winning group and give them the alligator as a prize! Then, pass out the homework assignment – <u>HW: Mega Grow Alligator 03</u>.

Part IV - Lesson Documents

The lesson documents begin on the next page.

Document 1 – Homework Assignment 1

HW: Mega Grow Alligator 01 Grade 7 Math Name: _____ Block: ____ Date: _____

- 1) In class today, you saw a MegaGrow alligator toy. The package says the alligator can grow up to 600%? What attribute of the alligator do you think the 600% is referring to? Why?
- 2) The volume of Cube A is 64 cubic inches and the volume of Cube B is 8 cubic inches. What are the side lengths of each of the cubes? Compare the ratio of the volumes to the ratio of the side lengths.
- 3) Cube A has a volume of 1000 cubic cm. You will shrink the cube so the volume becomes $\frac{1}{8}$ the original. What is the side length of the smaller cube?
- 4) The surface area of Sphere A is 400 square inches and the Surface Area of Sphere B is 100 square inches. What are the lengths of the radiuses of each sphere? Compare the ratio of the surface areas to the ratio of the radiuses.
- 5) Sphere A has a radius of 5 inches. You will enlarge the sphere so the surface area becomes 9 times larger. What is the radius of the larger sphere? By what scale factor did the radius increase?
- 6) Sphere A has a radius of 3 inches. You will enlarge the sphere so the volume becomes 8 times larger. What is the radius of the larger sphere? By what scale factor did the radius increase?
- 7) Cube A has a side length of 7 cubic inches. You will enlarge the cube so the volume becomes 11 times larger. What is the side length of the larger cube? By what scale factor did the side length increase?
- 8) Use your answers above to think about the relationship between increasing the side length of an object and the resulting increase to the surface area and volume of the object. Does the scale factor stay the same? Is the relationship proportional? Why or why not?

Answers

2) 4 inches and 2 inches. The ratio of volumes sf 8 to 1. The ratio of side lengths is 2 to 1.

3) 5

- 4) 5.6533 inches and 2.8217 inches. The ratio of surface areas is 4 to 1. The ratio of side lengths is 2 to 1.
- 5) 15 inches. A scale factor of 3.
- 6) 6 inches. A scale factor of 2.
- 7) Approx. 15.5679 inches. A scale factor of $\sqrt[3]{11}$ or approx. 2.2240.
- 8) We will talk about it in class.

<u>Document 2 – Do Now 1</u>

Do Now: Mega Grow Alligator 01 Grade 7 Math Name: _____ Block: ____ Date: _____

Complete the following questions in the classwork section of your binder. Use your HW from last night to help you answer the questions.

- 1) On your HW, how did you interpret the "Grows 600%" on the alligator toy? What attribute of the alligator do you think the "Grows 600%" is referring to?
- 2) What two numbers would complete the table below? You don't need to copy down the table just write down the two numbers.

	Cube A	Cube B
Side Length	3 cm	12 cm
Surface Area	54 sq. cm	
Volume	27 cu. cm	ROOP

- 3) Copy and complete the following sentences. Use your HW answers to help you:
 - a. When all the side lengths of a 3D object are all increased by a scale factor of N, the **surface area** increases by a factor of _____.
 - b. When all the side lengths of a 3D object are all increased by a scale factor of N, the **volume** increases by a factor of _____.

Document 3 – Task Overview

Magic Grow Task Overview Grade 7 Math





In this task, you will predict what the new alligator will look like after it is left in cool water for 72 hours. Specifically, you'll be predicting the following 4 lengths (in cm) in the larger alligator:

- 1) Length of a straight line from the end of mouth to the end of the tail.
- 2) Height from the ground to the tallest part of the head.
- 3) Width of the right, front flipper.
- 4) Body width at the point directly behind the back legs.



You have two items to complete in this task:

<u>Item #1 – Spark Video</u>

You must create a Spark Video that is 90 seconds or less in which you do the following:

- Introduce the assignment.
- > Show pictures of the alligator with your original measurements labeled.
- Discuss how you interpreted the "Grows 600%" and how you used that to calculate your predicted measurements.
- > Show pictures of the alligator with your predicted measurements labeled.
- > Share one interesting facts about alligators.

All group members should have a speaking role in the video. When you've completed the video, email the link to your teacher.

Item #2 – Upload your Guesses

Once you have your final predictions of the four measurements, click on the link below to enter your predictions (you might need to copy and paste link). Be sure to enter the predictions into the correct part on the survey.

https://goo.gl/forms/aehuABcOYVSMLc9k1

Document 4 – Homework Assignment 2

HW: Mega Grow Alligator 02 Grade 7 Math

Name: _____ Block: ____ Date: ___

- 1) How did your group decide to interpret the "Grows 600%" on the alligator package? Why did you make that choice?
- 2) How close do you think your predictions will be to the actual measurements?
- 3) What are some factors that could cause your predictions to be off by more than you'd like them to be?
- 4) What specific tasks did **you** complete in your group today?
- 5) After the alligator is left in the water for 72 hours, we will remove it and measure the four lengths. We'll then compare the actual measurements with all the group guesses. <u>How should we determine the winner</u>?

Please come up with a detailed process we can follow to determine which group is the winner. Explain each step of your process and use appropriate mathematical vocabulary. Create a sample data set of actual measurements and predicted measurements and use that as an example to show how your process works.

Document 5 – Homework Assignment 3

HW: Mega Grow Alligator 03 Grade 7 Math

Name: ______ Block: ____Date: _____

1) In class today, you wrote down the <u>four</u> actual measurements on the enlarged alligator. You also have your measurements of the original alligator. Copy and complete the table below.

	Original Length	New Length	Percent Increase from Original Length to New Length
Measurement #1	555		
Measurement #2	JSS		
Measurement #3	5.0		
Measurement #4		88	

- 2) Based on what you learned about the relationship of growth factors between length, surface area and volume of three-dimensional objects, what do you think is the correct interpretation of the claim "Grows 600%" on the package?
- 3) Describe how well your model predicted the new measurements. If you were to do this task again, would you use the same approach or would you change it? If you were to keep it the same, explain why. If you were to change it, explain how and why you would change it.

Part V – Adaptations and Extensions

This lesson above is designed to be completed in 2.5 class periods. The adaptations and extensions below add time to the lesson plan, but provide deeper exploration for students.⁴

- Allow the alligator to grow for a full week in the water. In class each day, remove the alligator from the water and measure the four lengths. Create a line-graph of the lengths (day on the x-axis and length on the y-axis) and update the graph each day with the new measurements.
 - Each group could make their own graph with their predicted measurement for Day 7 plotted. Each day, they'll see how the line is progressing towards their prediction.
 - On Day 3 or Day 4, students could change their predictions based on the data up until that point. Students could create a scoring system that factors in the accuracy of the original prediction and the updated prediction.
 - Over the course of the 7 days of growing, the class could discuss the rate of alligator growth – Constant growth? Increasing or decreasing rate of growth?
- Rather than growing one animal as a class, each group could use a different animal. There are 6 different animals available for purchase. Students could explore if some animals become bigger than others, if the growth rates are different and other comparative questions.
- Partner up with a science teacher and study the chemical make-up of the animals that allows them to grow.
- Track additional measurements of surface area (by tracing the body print of the animal on graph paper) and volume (by displacement).

Part VI – Shortened Lesson Plan

If teachers need to spend less time on this lesson, a shortened time-line is below:

Homework 1 – Same assignment without questions about the alligator.

Lesson 1 (1 class period)

• Do Now and Review Homework 1. (10 mins)

⁴ Some of these extension ideas come from <u>https://www.stevespanglerscience.com/lab/experiments/giant-growing-creatures/</u>.

- Introduce alligator task and assign groups. (5 mins)
- Measure original alligator as a class. (5 mins)
- In groups, students predict new measurements. Rather than creating a Spark Video, they simply write their predictions on a piece of chart paper. Their only task is to decide how to interpret the "Grows 600%" and then make their predictions. (20 mins)
- Closure assign Homework 2 (5 mins)

<u>Lesson 2</u> ($\frac{1}{2}$ of a class period – 72 hours after placing the alligator in the water)

- Remove and measure the alligator (5 mins)
- Discuss and vote on a scoring system (15 mins)
- Determine the winner (5 mins)