Preface

Purpose: The purpose of this ibook is to provide current and preservice teachers with ideas about using Isles strategies in their math classrooms through a Functions unit in Math II.

Audience: This book is intended for preservice teachers to use to gain understanding on ISLES-S strategies. Current teachers can use this to find resources that can be used that incorporate the ISLES-S strategies. It can serve as a book of resources to pick and choose from in addition to their current teaching strategies. Teachers can also allow their students to follow along on their ipads and complete interactive activities as the teacher teaches the material.

The text highlighted in light blue throughout the text indicates that the term is an ISLES-S strategy. Keep in mind that the ISLES-S strategies are not the only available strategies, but serve as a general agreed upon group of commonly used strategies in education.
Function Review

Objectives:
1) To assess prior knowledge of linear and quadratic functions
2) To gain knowledge of how a function should be read and understood
3) To prepare students to learn about quadratic and exponential functions
Make a Double Bubble Map

Directions For Teacher:

1. Put students in groups to brainstorm ideas about what they know about linear functions and exponential functions. How are they similar? How are they different?

2. Bring the class together to fill out the Double Bubble Map on this page. The map and an example key are on the Keynote presentation.

3. Be sure students tell why they chose their similarities and differences.

Sketchpad

Instructions: Students may complete the Double Bubble Map using this application. Then, they can click “email” and email you the results. You will need to give students your email address.
Section 2

Tony’s Walk

Directions For Teacher

1. Display the following task for students or make copies of the task for students.

2. Have students complete the task, either on paper or by using the Sketchpad application below.

3. Students should work in pairs to compare their answers.

4. Have students share their responses with the class. They could do this using the Sketchpad application on this page as well.

Click the above presentation to display the Tony’s Walk activity to your class.

Sketchpad

Instructions: Students may complete the task using this application. Then, they can click “email” and email you the results. You will need to give students your email address.
In this game, students will match situations with filling a container to a graph. They will begin by choosing two bottles filled at a constant rate that will model the given graph. Then, they can increase in difficulty as they go through the levels.

Have the students begin on the Easy level and progress through the difficulties as time permits.
Function Review Quiz

Options For Teacher

1. Display the quiz for your students and have them answer questions as a class.

2. If your students have Ipads, have your students take the quiz themselves.

3. Have the quiz in a paper version or displayed to the class using a projector (use the presentation version for this).

Note: The presentation version is on the following page.

Question 1 of 10
Determine whether the following relationships could be descriptions of functions: The volume of a cube varies as the length of one of its edges is changed.

A. Yes
B. No
Pre-Assessment Quiz

Directions: Determine whether the following relationships could be descriptions of functions:

1) The volume of a cube varies as the length of one of its edges is changed.
2) To each student enrolled in the course, a grade (A-F) is assigned.
3) Ms. Spencer decides to record her students’ birthdays, so she asks students whose birthdays are in January to raise their hands, then those whose birthdays are in February, and so on.
4) The measurement of one wall of your classroom taken in inches is related to that measurement taken in meters.
5) For any popular musician or music group today, you can list the albums attributed to that group.
Quadratic Functions

Objectives:
1) Determine the shape of a quadratic function
2) Determine intercepts, axis of symmetry, and vertex of quadratic function
3) Find the domain and range of quadratic functions
4) Use transformations of functions to transform graphs of quadratic functions

This lesson was constructed using Backwards Design
Sample Lesson Plan Chapter 1
Topic: Quadratic Functions

Objectives

1) Determine the shape of a quadratic function
2) Determine intercepts, axis of symmetry, and vertex of quadratic function
3) Find the domain and range of quadratic functions
4) Use transformations of functions to transform graphs of quadratic functions

Strategies

1) Examples & Non-Examples
2) Compare & Contrast
3) Higher-Order Questioning
4) Summative Assessment
6) Game

Explanation of Purpose
The following page will have day 1 lesson plans for Quadratic Functions. The page following the Day 1 lesson plans will have the day 2 lesson plans. These are a general example of how you could use these materials in your lessons, and leave plenty of room for your own teaching styles to flourish. Feel free to pick and choose from the available activities for your own lesson plans.
<table>
<thead>
<tr>
<th>Day 1</th>
<th>Explanation</th>
<th>Materials</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Students will complete the three quizzes on Quadratics to assess prior knowledge.</td>
<td>The link to the quizzes found in section 2</td>
<td>15 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A device for all students (Ipad, Notebook, Chromebook, etc)</td>
<td></td>
</tr>
<tr>
<td>Discovering Ideas</td>
<td>Introduce terms. Display “Real World Shapes” on a projector or on handouts for the students. Talk about the examples of Quadratics vs. the Non-examples of Quadratics. Why are the non-examples not examples? Any student notes to be given should be given after “Real World Shapes”</td>
<td>Real World Shapes</td>
<td>25 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A projector or handouts of Real world Shapes (Can be displayed on a document camera or on devices)</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>Give students (or project) Short Task 1: Building Functions. Allow students to work on this independently, then come together as a group to discuss.</td>
<td>Task 1: Building Functions found in section 3</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Assessment</td>
<td>Give students the handouts found in section 3. Have them work on them independently and walk around the room to answer questions and assess understanding of the material. Go over commonly missed handouts to close, and allow students to complete the handouts for homework.</td>
<td>Handouts found in section 3</td>
<td>35 minutes</td>
</tr>
<tr>
<td>Day 2</td>
<td>Explanation</td>
<td>Materials</td>
<td>Time</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Introduction</td>
<td>Students will complete the three quizzes on Quadratics to assess current knowledge.</td>
<td>The link to the quizzes found in section 2 &lt;br&gt;A device for all students (Ipad, Notebook, Chromebook, etc)</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Review</td>
<td>Teacher will share answers to homework with students, either through students answering or the teacher answering. Students will be given an opportunity to ask questions, both about the homework and about the Quadratics Quizzes.</td>
<td>Handouts found in section 3</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Practice</td>
<td>Give students a copy (hard copy or google document) of the Advanced Organizer found in section 3. Allow students to fill out what they can, then assist in a whole-class setting where needed. Then, have the students complete the “Birds and Quadratics” Game. This will be an independent task.</td>
<td>“Linear vs. Quadratic” Advanced Organizer found in section 3&lt;br&gt;“Birds and Quadratics” Game found in section 3</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Assessment</td>
<td>Students will complete the “Comparing Linear and Quadratic.”</td>
<td>“Comparing Linear and Quadratic” Formative Assessment found in section 3</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>

*Note: If there is extra time or an extra day to spend on this topic, give the students the performance task found in section 3*
Essential Question & Standards

Essential Question: What Are The Parts Of A Quadratic Function And How Do You Transform The Graph Of The Function?

1. Integration of Universal design for learning and English Language Learners
2. TQP common core strand
3. 21st century themes or skills
4. Common Core Standards
5. Performance task(s)

Integration of Universal design for learning and English Language Learners:

Multiple means of presentation: Multiple concretizations and visualizations of mathematical ideas; kinesthetic activities; Multi-media

Multiple means of engagement: Task based activities; Pair ELL students with Spanish speaking students; cooperative groups; Discovery learning

Multiple means of assessment: Formative assessment, Class Discussion, Observation Checklists, Pre-Assessment
TQP common core strand:

1. Derive meaning of problem.
2. Reason and construct viable arguments.
3. Construct viable arguments and critique the reasoning of others.
4. Mathematical structure.

21st Century Themes:

Financial, Economic, Business, and Entrepreneurial Literacy
Health Literacy
Environmental Literacy

21st Century Skills:

Communication and Collaboration
Critical Thinking and Problem Solving
Information Literacy

Common Core Standards:

IF-C.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.

Performance task(s): Quadratic Functions Performance Task
Warm Up Activity

Have students complete the following three quizzes to see how many they already know. Students will complete the three quizzes again at the conclusion of this chapter.
Real World Shapes

View the following shapes and determine which group of pictures displays examples of quadratic shapes and which group displays examples of shapes that curve but are not quadratic. This is an example of examples & non-examples.

Is the picture an example of a quadratic?

Question 1 of 5

A. Yes
B. No
1) The drums are an example of a quadratic.
2) The overhead lamp is not an example of a quadratic because a quadratic will not change direction.
3) The satellite dish is an example of a quadratic.
4) The sign is an example of a quadratic.
5) The tops of the windows are not examples of quadratics because they form semicircles.

Building Functions Compare and Contrast

Display the following task or hand out worksheets with the task. Have students fill in the three bubbles with the three functions. Also have the students explain the reasoning behind their answers.

Mathematics Assessment Program
College and Career Readiness Mathematics

Short Tasks: Building Functions 1

1. These three graphs show the functions
   \[ y = x^2, \quad y = x^2 + 3, \quad y = 3x^2 \]
   Label the three graphs.

Have students complete the building functions activity by clicking the icon below. They can email it to you if you provide them with your email address. Have students clear out their work before exiting.
Quadratic Tasks

Give the following handouts to students one at a time, or all at once.

Higher-Order Questioning:

The parabola above represents the graph of the function of the form, \( y = ax^2 + bx + c \). Is it possible to have a point on the graph when \( x \) is 20?

a. Yes
b. No.

Reason(s)…………………………………………………………………………………...
………………………………………………………………………………………………
………………………………………………………………………………………………

Open the form below to answer the previous question. Results can be emailed to the teacher. Students will need the teacher’s email address and their own email address. Have students clear out their work before exiting.
If the parabola below is extended indefinitely, do you think that it will ever cut the y-axis?

a. Yes
b. No.

Reason(s) ………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………………………

Open the form below to answer the previous question. Results can be emailed to the teacher. Students will need the teacher’s email address and their own email address. Have students clear out their work before exiting.
A parabola of the form \( y = ax^2 + bx + c \), is sketched below.

If one of the x intercepts is 8 as shown in the sketch, what is the other x-intercept of the parabola?

a. 0 I chose this answer because .................................................

b. -1 I chose this answer because ..................................................

c. -2 I choose this answer because ..................................................

d. -3 I choose this answer because ..................................................

e. -4 I chose this answer because ..................................................

Open the form below to answer the previous question. Results can be emailed to the teacher. Students will need the teacher’s email address and their own email address. Have students clear out their work before exiting.
The equations of two parabolas are given below:

\[ y = ax^2 + bx + 3 \]
\[ y = ax^2 + bx + 7 \]

Complete the table below. Mark X in the correct column, and justify your choice in the last column.

<table>
<thead>
<tr>
<th>Do the two parabolas have:</th>
<th>Yes</th>
<th>No</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The same line of symmetry?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The same vertex?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Space for calculations

Have students complete the previous activity by clicking the icon below. They can email it to you if you provide them with your email address. Have students clear out their work before exiting.
In the diagram below, the graph of \( y = x^2 \) has been indicted. Other graphs are labeled “a” to “e”. Which of the graphs labeled “a” to “e” could be the graph of \(-2x^2\)?

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
</table>

Give reason(s) for your answer ………………………………………………………………
………………………………………………………………………
………………………………………………………………………………………………

Open the form below to answer the previous question. Results can be emailed to the teacher. Students will need the teacher’s email address and their own email address. Have students clear out their work before exiting.
The parabola \( y = -(x - 2)^2 + 4 \) is shown in the diagram below.

If this parabola is shifted 3 units to the right, use this information to complete the table that follows.

<table>
<thead>
<tr>
<th>(i) The equation of the parabola</th>
<th>Before the shift</th>
<th>After the shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = -(x - 2)^2 + 4 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) x coordinate of the turning point</td>
<td>( x = 2 )</td>
<td></td>
</tr>
<tr>
<td>(iii) y coordinate of the turning point</td>
<td>( y = 4 )</td>
<td></td>
</tr>
<tr>
<td>(iv) The x intercepts</td>
<td>( x = 0 ), and ( x = 4 )</td>
<td></td>
</tr>
</tbody>
</table>

Give reason(s) for your answer

(i) .......................................................................................................................... 
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

(ii) ..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

(iii) ..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

(iv) ..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

Have students complete the previous activity by clicking the icon below. They can email it to you if you provide them with your email address. Have students clear out their work before exiting.
The parabola below is the graph of \( f(x) = x^2 - 3x - 4 \)

Which of the following has the same graph as \( f(x) = x^2 - 3x - 4 \) above?

a. \( f(x) = 2x^2 - 6x - 8 \) I chose this answer because……………………………………

b. \( f(x) = 3x^2 - 9x - 12 \) I chose this answer because……………………………………

c. \( f(x) = 4x^2 - 12x - 16 \) I chose this answer because……………………………………

d. All of the above. I chose this answer because……………………………………

e. None of the above. I chose this answer because……………………………………

Have students complete the previous activity by clicking the icon below. They can email it to you if you provide them with your email address. Have students clear out their work before exiting.
Linear vs. Quadratic **Compare & Contrast**

The following worksheet serves as a compare & contrast activity for comparing linear and quadratic equations.

<table>
<thead>
<tr>
<th>Function</th>
<th>Domain and Range</th>
<th>Degree</th>
<th>Leading Coefficient</th>
<th>End Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( y = 2x + 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ( y = x^2 - x - 6 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ( y = -x^2 + x + 6 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ( y = 2x - 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. ( y = x^2 + x - 6 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. ( y = -2x - 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. ( y = -x^2 - 5x - 6 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. ( y = -2x + 1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Birds & Quadratics

The following website includes a game where students can use what they know about quadratic functions to make one bird hit the other bird.

Click the icon below to access this game.

Quadratic Performance Task

The following link contains a performance task to be completed upon conclusion of the Quadratic Functions Chapter.

The performance task can be found by clicking the icon below.
Have students consider how quadratic equations could be used in real life. After a few moments, have the students talk to a partner about their ideas. After brief discussion, allow students to share with the class. This is an example of the grouping strategy Think-Pair-Share.
Comparing Linear and Quadratic:

The following task serves as a summative assessment.

Functions

On the grid are eight points from two different functions.
A certain linear function passes through exactly four of the points shown.
A certain quadratic function passes through the remaining four points.

For the linear function:

1. Write the coordinate pairs of its four points.
   ______________________
   ______________________
   ______________________
   ______________________

   Draw the line on the grid.

2. Write an equation for the function.
   ___________________________________________
   Show your work.

For the quadratic function:

3. Write the coordinate pairs of its four points.
   ______________________
   ______________________
   ______________________

   Draw the graph of the function on the grid.

4. Write an equation that fits the quadratic function.
   ____________________________
   Show your work.
Objectives:
1) To differentiate between exponential growth and decay using graphs and tables as well as symbolic and verbal representations.
2) To calculate percent of increase or decrease given an equation.
3) To calculate the growth/decay factor when given the percent of increase or decrease.
4) To solve problems involving exponential growth and decay.
5) To solve problems involving exponential growth and decay.

This lesson was constructed using Backwards Design
Sample Lesson Plan Chapter 3

Topic: Exponential Growth & Decay

Objectives
1) To differentiate between exponential growth and decay using graphs and tables as well as symbolic and verbal representations.
2) To calculate percent of increase or decrease given an equation.
3) To calculate the growth/decay factor when given the percent of increase or decrease.
4) To solve problems involving exponential growth and decay.
5) To solve problems involving exponential growth and decay.

Strategies
1) Examples & Non-Examples
2) Graphic Organizer
3) Higher-Order Questioning
4) Formative Assessment

Explanation of Purpose
The following page will have day 1 lesson plans for Quadratic Functions. The page following the Day 1 lesson plans will have the day 2 lesson plans. These are a general example of how you could use these materials in your lessons, and leave plenty of room for your own teaching styles to flourish. Feel free to pick and choose from the available activities for your own lesson plans.
<table>
<thead>
<tr>
<th>Day 1</th>
<th>Explanation</th>
<th>Materials</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Students will complete the Warm-Up Quiz on their own and check their answers. The teacher will answer any questions the students have about the warm-up questions. The students should then be asked to submit the SketchPad warm-up activity.</td>
<td>Ipad with Ibooks Author for each student</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Discovering Ideas</td>
<td>Have students read “One Grain of Rice” or read it as a class. Then, allow students to work on the questions that follow. Come together as a class to discuss conclusions. Then, have students watch “Pay it Forward” and answer the questions. Then discuss their answers as a class. Any lesson examples or vocabulary may be introduced now.</td>
<td>Handout of “One Grain of Rice” Video Projector to Project “Pay it Forward” or a link to the video on each student’s device</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Practice</td>
<td>Have students complete the jigsaw lesson. Then, give students the “Is Depreciation Good or Bad” and “SmartChoice” activities. Have them complete the activities. Then, come together as a class to discuss.</td>
<td>Jigsaw Lesson “Is Depreciation Good or Bad” SmartChoice</td>
<td>35 minutes</td>
</tr>
<tr>
<td>Assessment</td>
<td>Have students complete the Quiz “Review 2.2” on their own and write down which answers they got right and wrong. Have them hand this in to get an idea of student understanding.</td>
<td>Ipad with Ibooks Author for each student</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Day 2</td>
<td>Explanation</td>
<td>Materials</td>
<td>Time</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>Introduction</td>
<td>Have students fill in the Polynomial Degree Graphic Organizer together as a class and discuss answers.</td>
<td>Handout of Polynomial Degree Graphic Organizer</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Discovering Ideas</td>
<td>Have students complete the Skittles Mania Activity in small groups, individually, or in pairs.</td>
<td>Handout of “One Grain of Rice” Video Projector to Project “Pay it Forward” or a link to the video on each student’s device</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Assessment</td>
<td>Students should present their Skittles Mania Activity</td>
<td>Room for students to present their activities</td>
<td>20 minutes</td>
</tr>
</tbody>
</table>
Essential Question: What Is The Difference Between Exponential Growth And Exponential Decay?

1. Integration of Universal design for learning and English Language Learners
2. TQP common core strand
3. 21st century themes or skills
4. Common Core Standards
5. Performance task(s)

Integration of Universal design for learning and English Language Learners:

Multiple means of presentation: Multiple concretizations and visualizations of mathematical ideas; kinesthetic activities; Multi-media

Multiple means of engagement: Task based activities; Pair ELL students with Spanish speaking students; cooperative groups; Discovery learning

Multiple means of assessment: Formative assessment, Class Discussion, Observation Checklists, Pre-Assessment
TQP common core strand:

1. Derive meaning of problem.
2. Reason and construct viable arguments.
3. Construct viable arguments and critique the reasoning of others.
4. Mathematical structure.

21st century themes or skills:

21st Century Themes:
- Financial, Economic, Business, and Entrepreneurial Literacy
- Health Literacy
- Environmental Literacy

21st Century Skills:
- Communication and Collaboration
- Critical Thinking and Problem Solving
- Information Literacy

Common Core Standards:

F-LE.1c: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Performance task(s): “Skittles” Activity
Warm Up

Review 3.1 Evaluate the following expressions for the value given:

Question 1 of 3
$2^x$, $x = 3$

- A. 6
- B. 0
- C. 5
- D. 8

Interactive 3.1 $y = 2^x$

a. Create an $x$, $y$ table.

b. Graph the ordered pairs.

c. Graph the function.
Class Activities

Activities

1. “Pay it forward” (Higher-Order Questioning & Advanced Organizer)
2. One Grain of Rice (Graphic Organizer)
3. Is depreciation good or bad?
4. Smart Choice
5. Polynomial Degree Organizer (Graphic Organizer)
6. Skittle-Mania! (Formative Assessment)
7. Is it Exponential? (Examples & Non-examples)

“Pay it forward” Advanced Organizer

Watch the movie clip “Pay it forward” and discussion the following questions in small groups.

Pay it Forward

1. Write an exponential function based on the movie.
2. Does the function grow or decay?
3. What is the growth factor, if the function grows?
4. What is the percentage of increase?
5. How many people will have received help after “Pay it forward” 10 times in the future?
One Grain of Rice

Read the article and answer all the following questions in small group.

One Grain of Rice a mathematical folktale by Demi

Long ago in India, there lived a raja who believed he was wise and fair, as a raja should be. The people in his province were rice farmers. The raja decreed that everyone must give nearly all of their rice to him. "I will store the rice safely," the raja promised the people, "so that in time of famine, everyone will have rice to eat, and no one will go hungry." Each year, the raja’s rice collectors gathered nearly all of the people’s rice and carried it away to the royal storehouses.

For many years, the rice grew well. The people gave nearly all of their rice to the raja, and the storehouses were always full. But the people were left with only enough rice to get by. Then one year the rice grew badly and there was famine and hunger. The people had no rice to give to the raja, and they had no rice to eat. The raja’s ministers implored him, "Your highness, let us open the royal storehouses and give the rice to the people, as you promised." "No!" cried the raja. How do I know how long the famine will last? I must have the rice for myself. Promise or no promise, a raja must not go hungry!"

Small Group Discussion Questions:

1. Estimate how many grains of rice you think Rani will have at the end of 30 days.

2. Use the chart below to record the number of grains of rice Rani would receive each day.

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Total After 5 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 5 Days</td>
</tr>
<tr>
<td>Day 6</td>
<td>Day 7</td>
<td>Day 8</td>
<td>Day 9</td>
<td>Day 10</td>
<td>Total After 10 Days</td>
</tr>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 10 Days</td>
</tr>
<tr>
<td>Day 11</td>
<td>Day 12</td>
<td>Day 13</td>
<td>Day 14</td>
<td>Day 15</td>
<td>Total After 15 Days</td>
</tr>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 15 Days</td>
</tr>
<tr>
<td>Day 16</td>
<td>Day 17</td>
<td>Day 18</td>
<td>Day 19</td>
<td>Day 20</td>
<td>Total After 20 Days</td>
</tr>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 20 Days</td>
</tr>
<tr>
<td>Day 21</td>
<td>Day 22</td>
<td>Day 23</td>
<td>Day 24</td>
<td>Day 25</td>
<td>Total After 25 Days</td>
</tr>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 25 Days</td>
</tr>
<tr>
<td>Day 26</td>
<td>Day 27</td>
<td>Day 28</td>
<td>Day 29</td>
<td>Day 30</td>
<td>Total After 30 Days</td>
</tr>
<tr>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>grains of rice</td>
<td>Total After 30 Days</td>
</tr>
</tbody>
</table>

3. If the story continued and you know how many grains of rice Rani receives on Day 30, how can you determine how many grains of rice she would receive on Day 31?

4. How can you determine how many grains of rice she would receive on Day 35?

5. How can you determine how many grains of rice she would receive on Day 40?

If you know how many grains of rice she receives on a certain day, how can you determine how many grains of rice she will receive 2 days later? …10 days later?
Whole Class Discussion Questions:

1. Compare your work with the standard definitions of Exponential Growth and Decay. Is there anything you can do to improve your own version?

2. Think of three words that represent growth and three words that represent decay.

3. Growth and Decay factor can be represented as $1 + r$ or $1 - r$. $R$ is the rate of change ($R$ is non-negative.)

Is depreciation good or bad?

In small groups, write a story that contains an exponential Decay function on one document and name that document as Exp-DecayFunStory_Yourfirstnames.

Open a new document in groups and label it as ExpDecayFun-AnsKey_Yourfirstnames. In this document, include the following information.

1. Function that builds from your story.

2. Identify the decay Factor

3. Percentage of decrease.

4. Graph of the function.

5. Three predictions based on your story and your function.
Linda has $500 and shops for investments. Company A offers 5% compound annually and Company B offers $20 instant reward and 3% compound annually.

1. Write equations to model her investment on Company A and Company B.
2. What will be her return after one year investment with Company A? with Company B?
3. How many years would it take to break even?
4. If Linda wants to continuously invest her money for 5 years, which company is her best choice?

Open the form below to answer the previous question. Results can be emailed to the teacher. Students will need the teacher’s email address and their own email address. Have students clear out their work before exiting.

**Polynomial Degree Graphic Organizer**

You can use the following graphic organizer after covering exponential functions and quadratic functions. Use the three organizers to determine what is alike about the two types of functions and what is different about them.

### Linear vs. Exponential

<table>
<thead>
<tr>
<th>Alike</th>
<th>Different</th>
</tr>
</thead>
</table>

### Linear vs. Quadratic

<table>
<thead>
<tr>
<th>Alike</th>
<th>Different</th>
</tr>
</thead>
</table>

### Exponential vs. Quadratic

<table>
<thead>
<tr>
<th>Alike</th>
<th>Different</th>
</tr>
</thead>
</table>
Skittle-Mania!

EXPERIMENTAL GROWTH AND DECAY ACTIVITIES

OVERVIEW: You will conduct two simulations that result in exponential functions. A simulation is a procedure for conducting an experiment that models a real-world situation. In this activity, you will use Skittles as models to simulate population growth and isotope decay.

MATERIALS: You will need a bag of 150 Skittles and a box.

PART I: AN EXPLOSION OF TRIBBLES

Introduction: Investigating the planet Iota Geminorum IV, Kirk and Spock are surprised to find a previously unreported life form with an amazing reproductive rate. These new life forms, called Tribbles, are small furry creatures with an “S” shaped pattern on one side. Tribbles reproduce asexually (by themselves). Reproduction is triggered when the side of the Tribble with the S pattern is exposed to light. Initially, only two Tribbles were living and capable of actively reproducing.

Instructions: Place the first 2 Tribbles in the box, close the lid, and shake it a few times (make sure to shake the Tribbles thoroughly). Open the lid; for every “S” that appears, add another Tribble (i.e., Skittle). Record the total number of Tribbles now in the box (even if unchanged). This is the end of that shake (round). The number of Tribbles present at the end of a shake is the total population at that time. Remember that at shake 0, the number of Tribbles was 2. Record your data in the chart below for 10 rounds, then proceed to page 2.

Note: Throughout the activity, make sure that each skittle has an “S” on it.

<table>
<thead>
<tr>
<th>Round</th>
<th>Population of Tribbles</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>128</td>
</tr>
<tr>
<td>7</td>
<td>256</td>
</tr>
<tr>
<td>8</td>
<td>512</td>
</tr>
<tr>
<td>9</td>
<td>1,024</td>
</tr>
<tr>
<td>10</td>
<td>2,048</td>
</tr>
</tbody>
</table>

1. Using your own paper, create a scatter plot of your population data. Let the x-axis represent the number of shakes and the y-axis represent the population. Label your graph accordingly.

2. Exponential Functions

Question 1 of 4
Determine whether y = 3^x is an exponential function.

A. Yes
B. No
Jigsaw is a cooperative learning strategy that enables each student of a “home” group to specialize in one aspect of a learning unit. Students meet with members from other groups who are assigned the same aspect. After mastering the material, they return to the “home” group and teach the material to their group members. Just as in a jigsaw puzzle, each piece—each student’s part—is essential for the completion and full understanding of the final product. If each student’s part is essential, then each student is essential. That is what makes the Jigsaw instructional strategy so effective. Jigsaw learning allows you to introduce students to material while maintaining a high level of personal responsibility. The purpose of Jigsaw is to develop teamwork and cooperative learning skills within all students. Additionally, it helps develop a depth of knowledge not possible if the students were to try and learn all the material on their own. Jigsaw will often disclose a student’s understanding of the material and display any misconceptions.

Access the jigsaw for exponential equations by clicking the icon below.
Compound interest

The overall interest earned on investment when the total interest earned in each period is added back to the original capital.

If an initial capital $C$ is invested in an account paying an annual interest rate $r$, then the balance in the account after $n$ years will be $C(1+r)^n$ when the total interest earned each year is added back to the account.

Related Glossary Terms
Drag related terms here
Definitions of Exponential Growth and Decay

**Growth**
When \( a > 0 \) and \( b > 1 \),
the function models growth.
\((b \text{ is called the growth factor})\)
\((a \text{ represents the initial amount})\)

**Decay**
When \( a > 0 \) and \( 0 < b < 1 \),
the function models decay.
\((b \text{ is called the decay factor})\)
\((a \text{ represents the initial amount})\)

\[ y = ab^x \]

Where \( a = \text{initial amount} \)
\( b = \text{growth/decay factor} \)
\( x = \text{time} \)
\( y = \text{ending amount} \)

Related Glossary Terms
Drag related terms here

Index
Chapter 3 - Class Activities
Double Bubble Map

Graphic organizer used to compare and contrast two concepts with the freedom to add as many similarities or differences as needed and to add ideas about the concepts that are not necessarily similar or different.

Related Glossary Terms

Drag related terms here
Exponential decay occurs when a quantity decreases by the same proportion \( r \) in each time period \( t \). If \( A_0 \) is the initial amount, then the amount at time \( t \) is given by \( A = A_0(1 - r)^t \), where \( r \) is called the decay rate, \( 0 < r < 1 \), and \((1 - r)\) is called the decay factor.
Exponential Growth

Exponential growth occurs when a quantity increases by the same proportion \( r \) in each time period. If \( A_0 \) is the initial amount then the amount at time \( t \) is given by \( A = A_0(1 - r)^t \), where \( r \) is called the growth rate, \( 0 < r < 1 \), and \( (1 + r) \) is called the growth factor.

Related Glossary Terms

Drag related terms here
Grouping

This is a method used in the classroom for students to go over a concept with each other. Students are paired or put in groups of a manageable number to work on an assignment. This is an excellent method for discovery lessons, where the teacher can walk around the room and help a group stay on track and complete the task effectively.

Related Glossary Terms

Drag related terms here
Interest

The amount of money paid for money invested or the charge for borrowing money.

Related Glossary Terms
Drag related terms here

Index
Investment

The investing of money or capital in order to gain profitable returns, as interest, income, or appreciation in value.

Related Glossary Terms

Drag related terms here
Number of times compounded

**The Compound Interest Equation**

\[ P = C (1 + \frac{r}{n})^{nt} \]

where
- \( P \) = future value
- \( C \) = initial deposit
- \( r \) = interest rate (expressed as a fraction: eg. 0.06)
- \( n \) = # of times per year interest is compounded
- \( t \) = number of years invested

**Related Glossary Terms**

Drag related terms here

**Index**
Principal amount

The amount of money as a capital sum, as distinguished from interest or profit.

Related Glossary Terms
Drag related terms here

Index
Find Term
Think-Pair-Share

This is a method used in the classroom in which students are asked to think independently about a concept or question, then pair together to discuss with a partner, and finally are asked to share with the class. Each step is essential in the effectiveness of the think-pair-share method.

Related Glossary Terms
Drag related terms here