The Big Race Calendar (90 min block)

Week	Mon	Tues	Wed	Thur	Fri	

1	- Group intro activity
	- Group contracts
	- Entry Doc
	- K/NTK/NS
		- Do Now: Linear vs non-linear
		- Function Lab Part 1
		  - py code
		  - ch code
			- Function Lab Part 2
			  - py code
			  - ch code
				- Do Now: Linear Functions
				- Write code for linear function
					- Test linear function code with robots
					- Record results	

2	- Do Now: Quadratic Functions - Write code for quad. function	- Test quad. function code with robots - Record results	- Do Now: Exponential Functions - Write code for exponential function	-Test exp. function code with robots - Record results	- Do Now: Lin Quad Exp Quiz	
3	-Do Now: Comparison worksheet - Review results for linear, quadratic and exponential code for robots	- Students present results, justify why their graph represents the function they claim it is - Grading Rubric	- Lab: Students compete to see who can make robot go furthest in 6 seconds			Twist: After 6 seconds restart speed to 10 deg/sec then accelerate using a different model for 6 more seconds.

Survival Game Lesson Plan

Overview:

Students, in the role of plane crash survivors, are given an interesting problem about prioritizing actions and equipment to ensure continued survival. They are given time to come up with an action plan, and must present as a group. However, during presentation, the teacher ignores issues of the problem, and asks students questions only about the group process. This opens the door to a conversation about what is the best way for groups to work, and can lead directly into new ideas for contract writing, and also a foundation for norms.

The idea is to use this activity as a way to get students to Need To Know how to make groups work best. If you let the students see what kind of group interaction they might naturally fall into, then the need to know will certainly arise. Hence, it is a good idea *not* to tell the students that you are going to do a "team building" exercise, or a "group work" exercise. Rather, you can pose the activity as a "critical thinking" exercise, or something like it.

This can create a rather rich conversation, and if you set it up correctly, you can have students move seamlessly into contract writing or norm-setting, depending upon your classroom needs at the time.

Expect the activity, with debrief, to take about an hour.

Below is a suggested way to carry out the activity, though it is certainly not the only use of the document. Experimentation, as always, is encouraged.

Introducing the Activity

As mentioned, we recommend introducing it as a critical thinking exercise. (Indeed, you could assign a critical thinking grade to this, if the students generate a document.)
Inform students that…

- They will have about 10-15 minutes to come up with an action plan, so they will need to work relatively quickly.
- They will need to present their plan to the rest of the class, and that they will have no more than 4 minutes to present.

During group discussion

As students are discussing, make sure to observe the conversations, and take note (to yourself) of how they are negotiating the group dynamic. Are they coming to decisions? How? Is one person dominating? Are any students "hanging back"? Is there any negotiating going on? Is there any conflict? How are they dealing with it? This kind of observation will be helpful to share during the debrief. If you see some particularly interesting interactions during the group processing, you might want to call up that group.

During Presentations

Students will begin to present, and you might let them go through their whole presentation. At the end, you can ask them a variety of questions about process, like,

"What are the names of all the people in your group?"
"How did you come to a decision about your final list?"
"What did (name of someone in the group) contribute to the list?"
"Did anyone in the group NOT speak?"
"Was there disagreement in your group? How did you deal with it?"
"Did someone take charge right away? What was the reaction of the rest of the group?"

… and so on. You might tailor some of the questions for observations you made during the group work time.

Gap Analysis

On the board, or on a ppt, you might have three columns for recording student response. The columns might look like so:

Characteristics of an ideal group.	Characteristics of the Survival groups you were just in	Characteristics of groups in our class, during projects

Hopefully, your penetrating questions during the presentation will create some good thoughts about what an ideal group might look like.

Once you have the columns filled out, there will be differences between the ideal and actual. Send the students back to groups, and have them brainstorm some strategies for bringing the actual closer to the ideal. You might phrase this, "Describe at least ___ strategies that we might use in the class to help groups in projects to come closer to what an ideal group looks like."

Students can work on that, and submit to a Discussion Forum, or present.

The whole list of strategies should be synthesized… and then they can become an integral part of the next group contract, OR, part of a template for contracts for the rest of the year in your class.

"Desert Survival" Team Building Exercise

It is 1:00 p.m. on a Saturday afternoon at the end of May. You and your teammates have just finished a two-day training in Casablanca, Morocco. You are all on board a chartered, twin-engine plane that is destined for Dakhla, Morocco, a small town on the coast of the North Atlantic Ocean, approximately 1000 miles from Casablanca. At the beginning of the flight the Captain came on the overhead speaker and invited you to sit back and relax during the two-hour flight. The first fifty minutes of the flight were fine. Around this time the pilot comes back on the speaker to let you know that you are currently flying over the Sahara Desert and that weather reports showed a temperature high of 115 degrees. Approximately one hour and ten minutes into the flight, you hear a loud blast and the plane nosedives. Within minutes you realize that the cabin is losing pressure. When you look outside the windows, you notice that is dessert below is growing larger as the plane rapidly descends toward the ground. You notice that the only things you can see out of your window are some large boulders and miles and miles of sand. The pilot comes on once again to let you know that the plane has blown an engine and is therefore, indisputably, going to crash and so all on board should prepare for a turbulent, possibly fatal, crash landing. Within minutes the planes crashes and smoke and flames fill the cabin. All surviving passengers and crew members scramble to exit the plane before it explodes. Seven minutes after the crash, the plane explodes in a fiery ball that reduces it to rubble. With the exception of the airplane's captain and one crew member, you, your teammates, one flight crew member, and the co-captain have all survived the crash. Now you must decide how to work together to survive the desert climate and terrain, get help, and hopefully make it out of the desert alive. On your way of the plane, in the few minutes before it exploded, you and your teammates were able to salvage the items in the list below. It is May and you and your teammates are dressed in business casual for the hot summer months of Africa. With only the clothes on your back and the items pulled from the wreckage, how will you survive?

Rank the items below in order of importance and develop an action plan to help you get out alive.

1 Book of matches
3 Airplane blankets
20 Feet of nylon rope
1 Sewing kit
2 50 kg Tanks of oxygen
20 Cans of soda
1 Life raft
1 Bottle opener
1 Magnetic compass
1 Single-blade pocketknife
15 Gallons of water
3 Signal flares
1 First aid kit
1 Snakebite kit
25 Mini bags of pretzels
55 Mini bags of peanuts
1 Safety razor blade
4 Airplane pillows

rEVOLUTIONary thinkers Group Contract

Group Member Name	Phone Number	Preferred E-mail

Part I: Displaying Core Values in our Group:

Trust: We trust each other. The following are three ways that we will show each other we are capable of trusting and being trusted:
I.

II.

III.

Responsibility: We take responsibility for both our individual contributions and the product as a whole. The following are three ways that we will show we are responsible:
I.

II.

III.

Respect: We show ourselves and others respect. The following are three ways that we will demonstrate respect:
I.

II.

III.

Integrity: We are people who do the right thing. The following are three ways that we will demonstrate our personal integrity:
I.

II.

III.

Perseverance: We do not give up, even when things are difficult. The following are three ways that we can demonstrate our commitment to follow through:
I.

II.

III.

Part II: Project Roles.

_______________ will be our Editor. He/She will take responsibility for ensuring the written part of our project is held to a consistent and high standard. This role requires attending a workshop on Science writing and ensuring all text on the poster is of high quality.

_______________will be our Designer. He/She will take responsibility for ensuring the visual and aesthetic part of our project is held to a consistent and high standard. This role requires attending a workshop on Scientific posters and ensuring that the layout and execution of the poster is of a high quality.

Part III: Group Consequences

We understand that our primary goal in class is to learn. If we do not hold our group members accountable to their commitments, we not only do an unfair share of work, but we also are allowing a group member to get by without learning. In order to avoid this, we will enforce our contract.

*The first time a group member fails to complete a task, they receive a warning.

*The second time a group member fails to complete a task, they receive a warning and the group must conference with the teacher.

*The third time a group member fails to complete a task, they are fired.

All warnings must be documented with the teacher and signed by the warned individual.

Part IV: Commitment

We agree to uphold ____________________ core values to the best of our ability. We also understand that we are responsible for the information contained in the rubric and the project calendar, and we will meet all due dates to the best of our ability.

_________________________________ _________________________________

_________________________________ _________________________________

The Big Race:

Dear Students,

We have had a lot of fun learning how to use these robots and maybe a little math along the way. Previously, we've had a race to tie, but we haven't yet had a race to win… until now. The rules of the race are simple:

1. Your Linkbot may not move for longer than six seconds.
2. The initial speed for the first second will be 10 degrees/second.
3. For the remaining seconds you must ***accelerate*** so the graph of your Linkbot's motion matches one of the three models: linear, exponential, ***or*** quadratic.
4. Your final speed shall be no greater than 200 degrees/second.
5. The car that travels the furthest during the 6 seconds will be the winner.

Sincerely,
Your Teacher

Know	Need to Know	

Warm-up: Linear vs Non-Linear

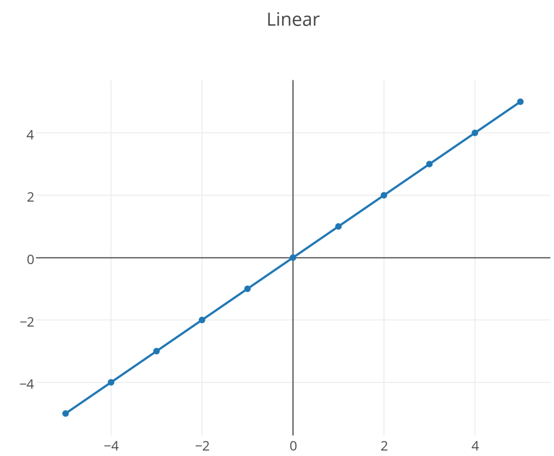
Name ______________________________

Date __________________ Period ________

Linear Equation : y = x

x	y=x	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		
5		

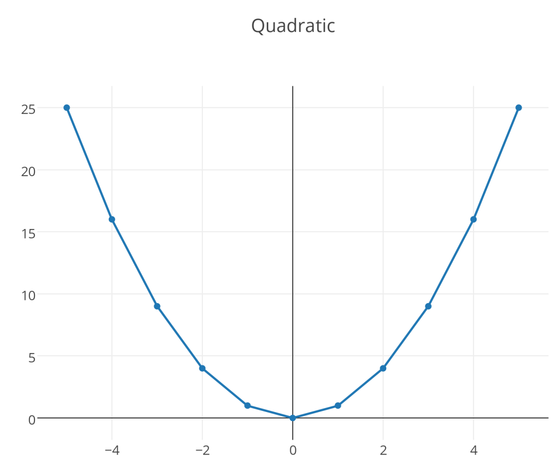
Linear Function f(x) = x



Quadratic Equation : $y = x^2$

x	$y = x^2$	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		

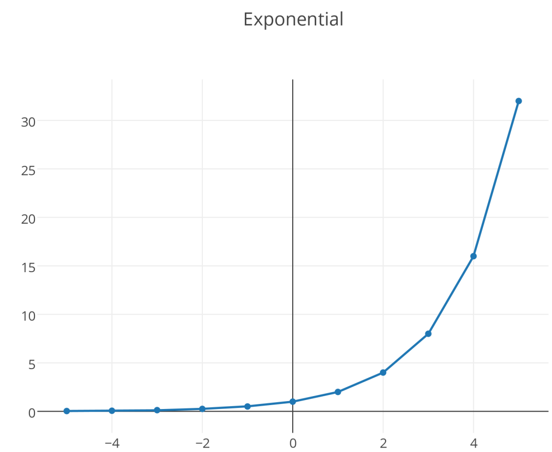
Quadratic Function : $f(x) = x^2$



Exponential Equation : $y = 2^x$

x	$y = 2^x$	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		
5		

Exponential Function : $f(x) = 2^x$

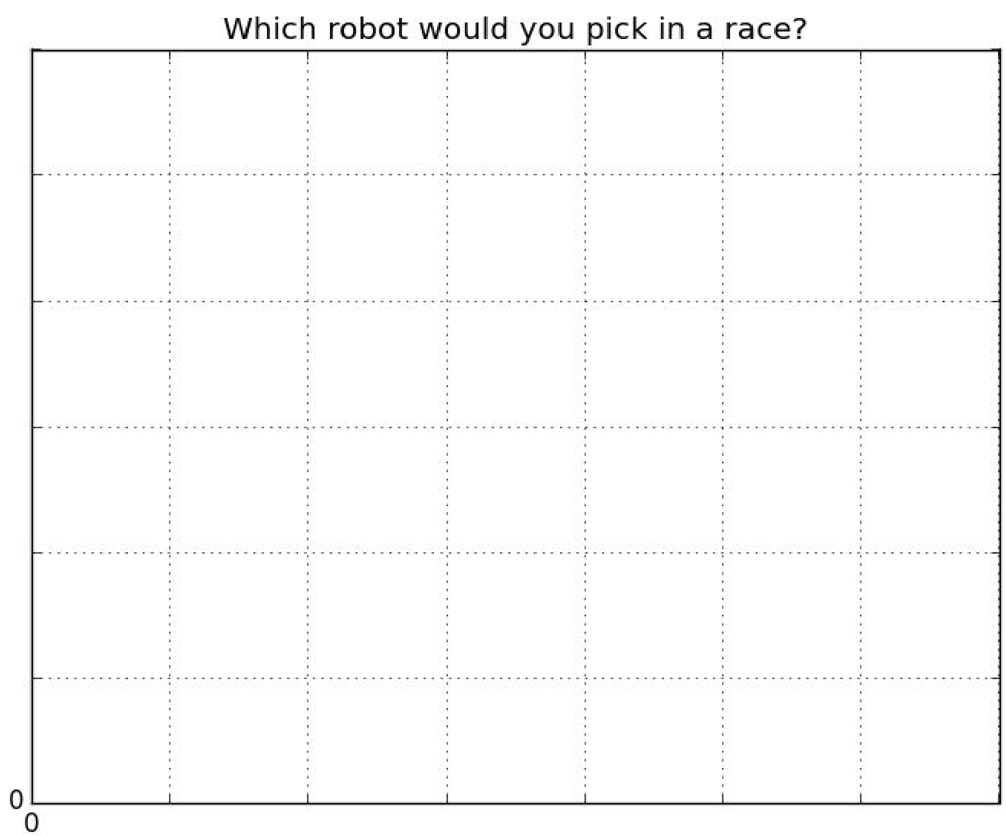


Function Lab: Part 1

Get together with another group (you will need four robots for this). Attach one of the robots to your computer and label the other three as follows: one should be labeled *Linear*, the next *Quadratic*, and the third *Exponential*. Once they are all lined up about six inches apart, run the program called functionLab.py and make sure to enter the correct Linkbot for each label.

As you watch the Linkbots move look for similarities and differences. Which one(s) start off slow and then get faster? Which one(s) move at a mostly constant speed? Which one would you like to have in a race?

Notes:



After the Linkbots have finished moving a graph will appear on your screen. Sketch the graph below (use a different color for each Linkbot).

Use the graph to fill in the table below for the bots:

Seconds	Average Speed (deg/s): Linear	Average Speed (deg/s): Quadratic	Average Speed (deg/s): Exponential
0-1			
1-2			
2-3			
3-4			
4-5			
5-6			

What do you notice about the speed of Linkbot whose graph was linear?
What do you notice about the speed of Linkbot whose graph was quadratic?
What do you notice about the speed of Linkbot whose graph was exponential?

Add a row for 6-7 seconds and predict what the average speed will be for each.

Which graph would you like your Linkbot to match? Why?

Function Lab: Part 2

Share your predictions for 6-7 seconds with your group, record them below:

Name:					Group Average
Linear					
Quadratic					
Exponential					

Use your Group Average and the graph to figure out where each bot will be at the end of the race to 7 seconds.

	Degrees at 6 seconds	Predicted degrees traveled from 6-7 seconds	Degrees predicted at 7 seconds
Linear			
Quadratic			
Exponential			

For each Linkbot put a point using the appropriate shape on your graph from part 1, does it fit with the existing points?

How far from the starting line will the point you put on your graph be?

Linear	
Quadratic	
Exponential	

Place a dot where you think each Linkbot will reach at the end of 7 seconds.

After 7 second run:

How far were your predictions from the actual resting place?
For your prediction that was the furthest away from the actual resting place, how would you adjust it? Does that change anything about how you were thinking about the different speeds?

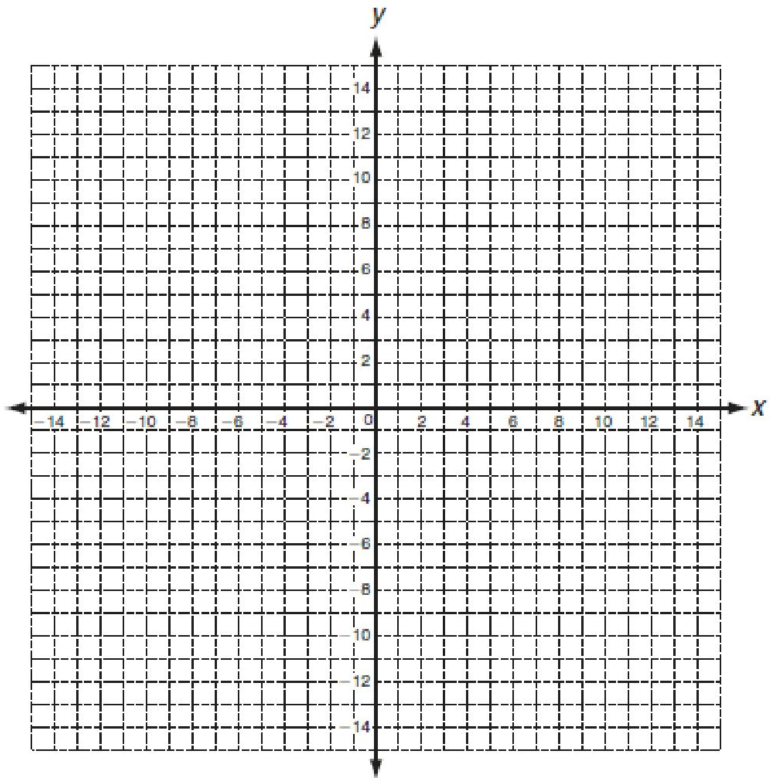
Which graph would you like your Linkbot to match? Why?

Linear Functions Warm-up

Complete the table for each linear function, and then graph the line.

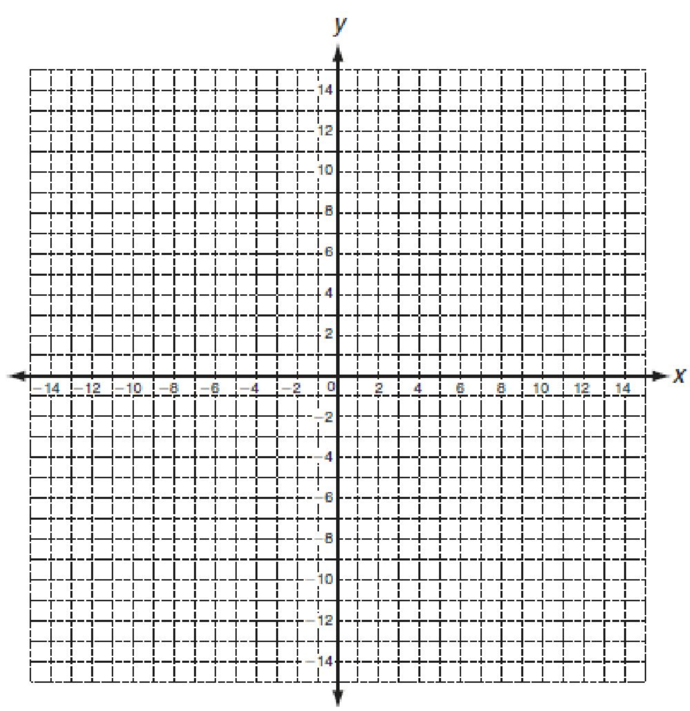
A.) $y = x$

x	y
8	
4	
2	
0	
-2	
-4	
-8	



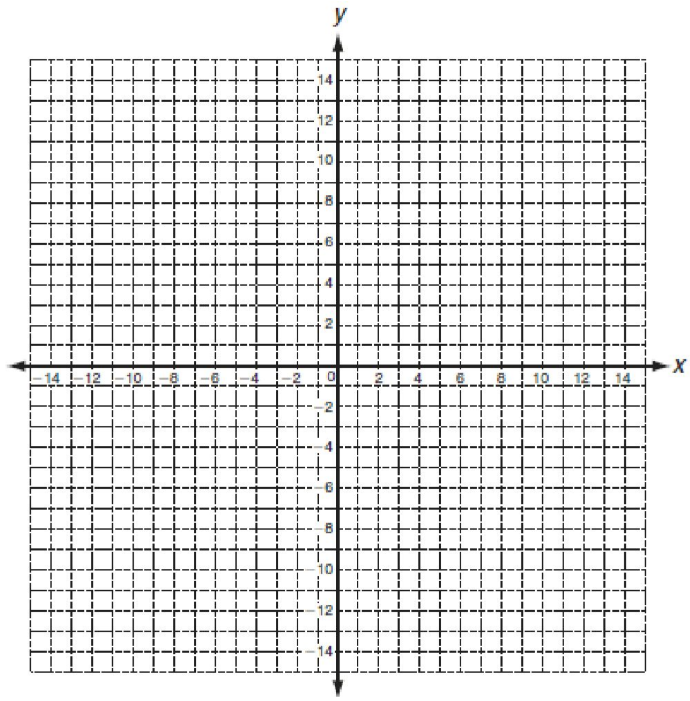
B.) $y = 3x - 4$

x	$3x - 4$	y
6		
4		
2		
0		
-1		
-2		
-3		



c.) $y = -2x + 3$

x		y
8		
4		
2		
0		
-2		
-4		
-6		



1. At what value does each graph cross the y-axis?

   Graph A: ____________ Graph B: ____________ Graph C: ___________

2. Do you see this “y-intercept” value in each corresponding equation?

3. If so, where?

4. As you move left to right on each of the graphs, how does the steepness of each line behave?

   Graph A: ____________ Graph B: ____________ Graph C: ___________

5. Which value on each equation do you think affects the “slope” of each line?

6. What is the slope of each graph?

   Graph A: ____________ Graph B: ____________ Graph C: ___________

7. Identify the slope and y-intercept of : $y = mx + b$.

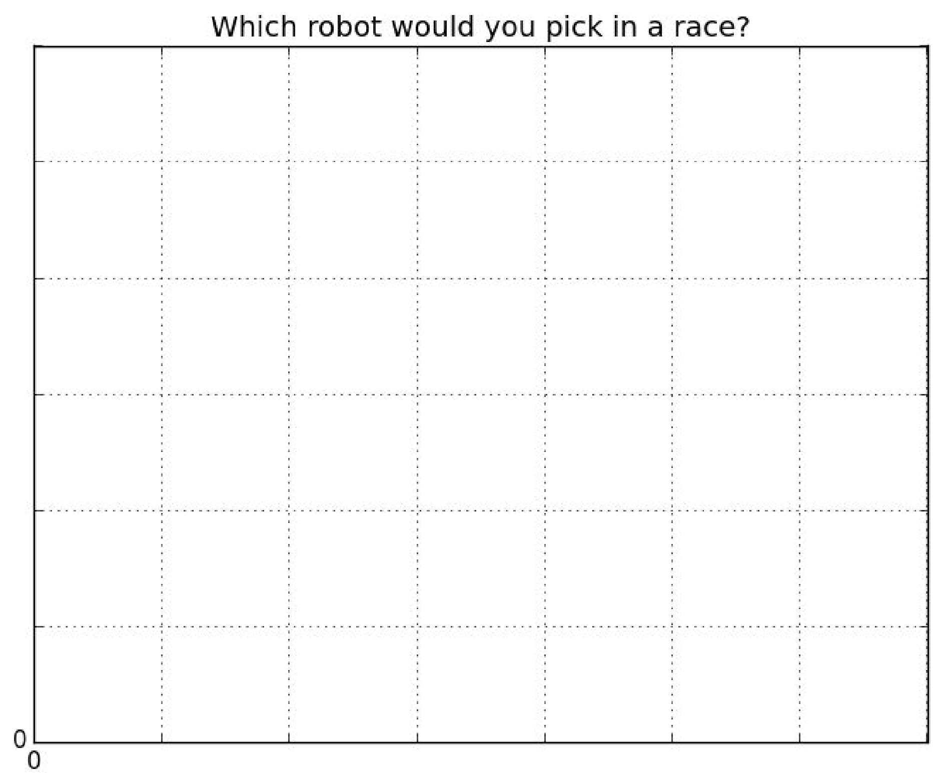
The Big Race Results

Function type: ____

Time (seconds)	Distance Travelled (cm)	Average Speed (degrees/sec)	Average Speed (cm/sec)
1			
2			
3			
4			
5			
6			

Total Distance Traveled: _______________

1. Graph the ordered pairs with “Time” as your independent variable and “Distance Travelled (cm)” as your dependent variable.



The Big Race Results

2. Describe the characteristics of the graph.

3. Write an equation of the graph.

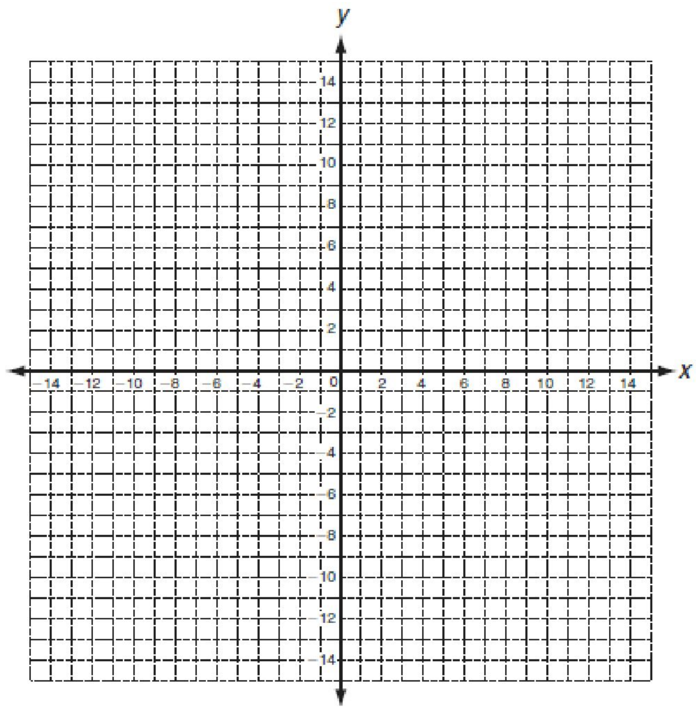
4. Save your results for comparison with different function graphs.

Quadratic Functions Warm-up

Complete the table for each quadratic function, and then graph the parabola.

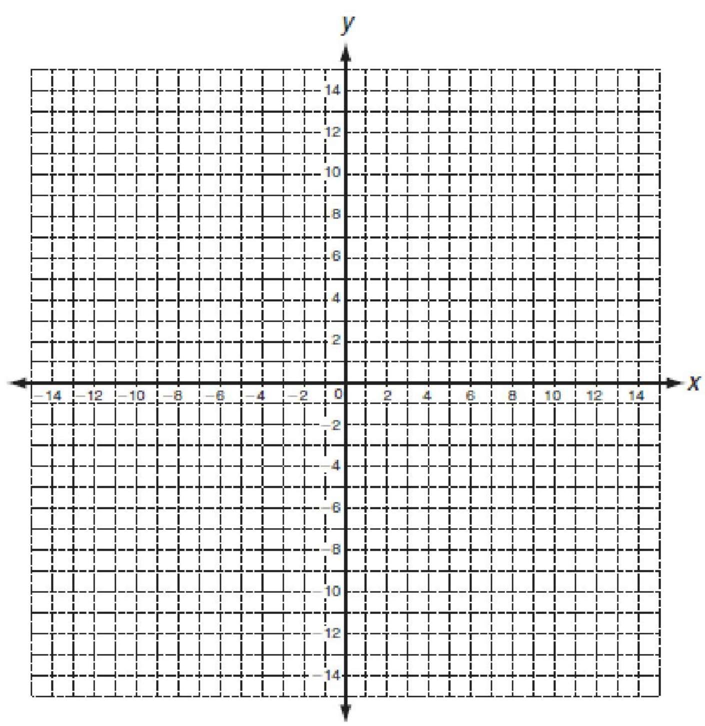
A.) $y = x^2$

x	x^2	y
3		
2		
1		
0		
-1		
-2		
-3		



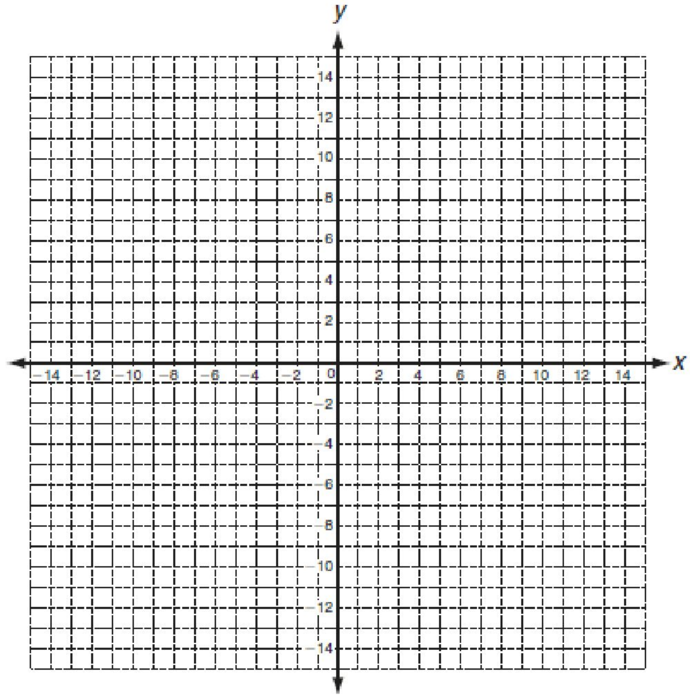
B.) $y = 2x^2 - 4$

x	$2x^2 - 4$	y
3		
2		
1		
0		
-1		
-2		
-3		



C.) $y = -\frac{1}{2}x^2 + 3$

x		y
6		
4		
2		
0		
-2		
-4		
-6		



1. At what value does each graph cross the y-axis?

   Graph A: ____________   Graph B: ____________   Graph C: ___________

2. Do you see this "y-intercept" value in each corresponding equation?

3. If so, where?

4. In which direction does each graph "open"?

   Graph A: ____________   Graph B: ____________   Graph C: ___________

5. Which value on each equation do you think determines the direction a graph opens?

6. What is the "leading coefficient" of each equation?

   Equation A: ____________   Equation B: ____________   Equation C: ___________

7. Identify the leading coefficient and y-intercept of : $y = ax^2 + bx + c$.

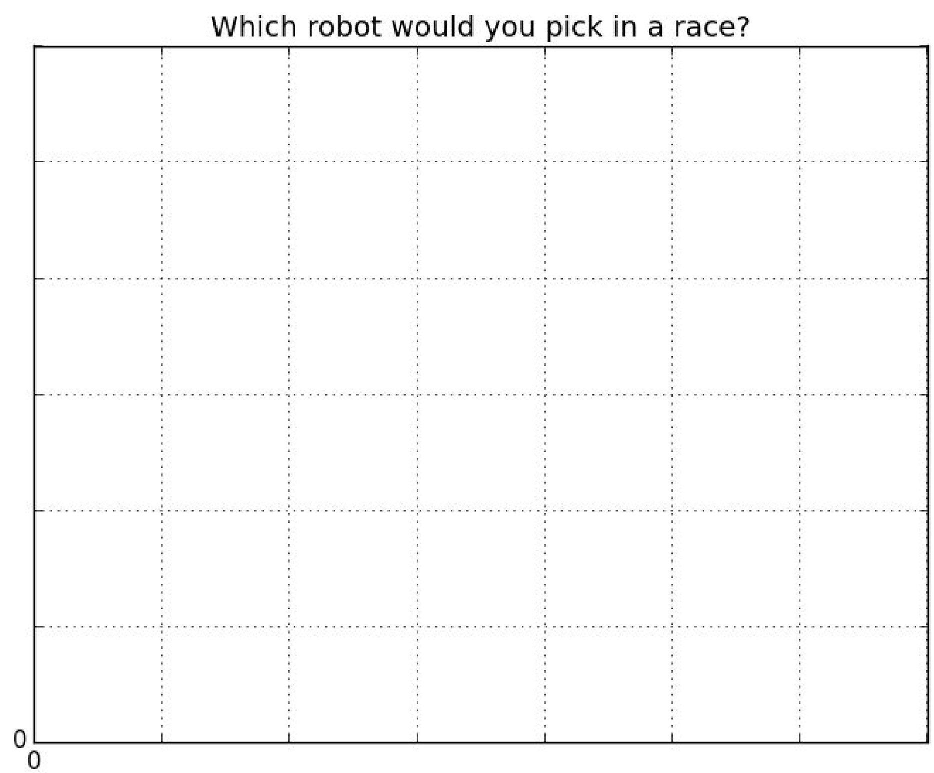
The Big Race Results

Function type: ____

Time (seconds)	Distance Travelled (cm)	Average Speed (degrees/sec)	Average Speed (cm/sec)
1			
2			
3			
4			
5			
6			

Total Distance Traveled: ________________

1. Graph the ordered pairs with “Time” as your independent variable and “Distance Travelled (cm)” as your dependent variable.



<u>The Big Race Results</u>

2. Describe the characteristics of the graph.

3. Write an equation of the graph.

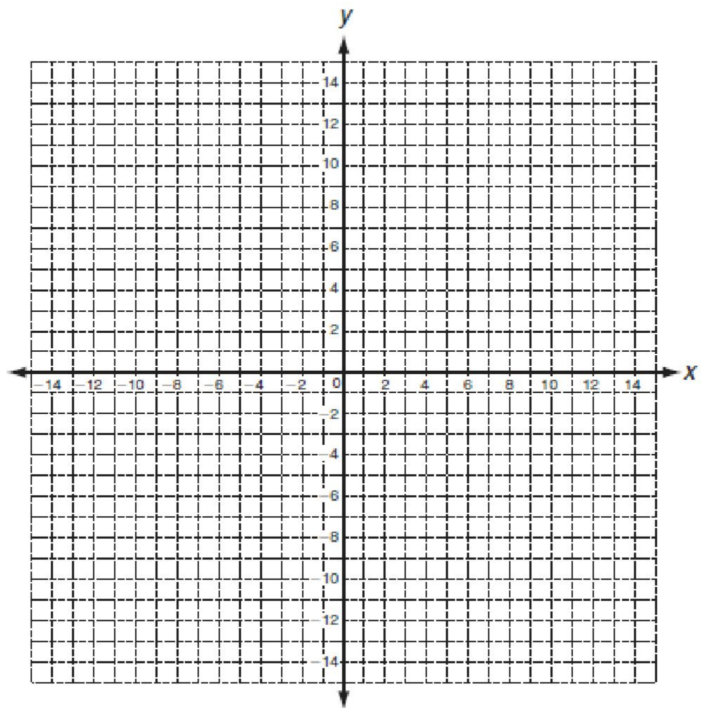
4. Save your results for comparison with different function graphs.

<u>Exponential Functions Warm-up</u>

Complete the table for each exponential function, and then graph the exponential curve.

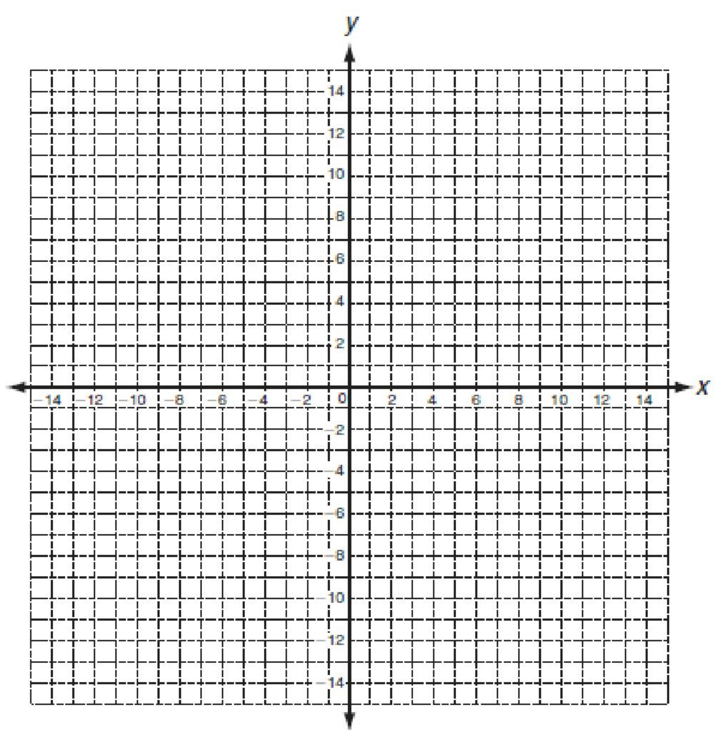
A.) $y = 2^x$

x	2^x	y
3		
2		
1		
0		
-1		
-2		
-3		



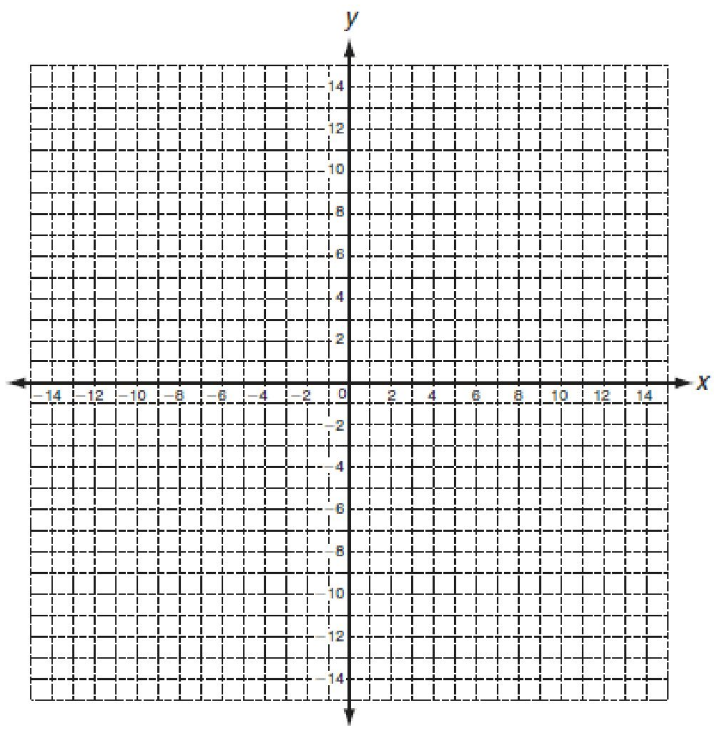
B.) $y = 2(2^x) - 4$

x	$2(2^x) - 4$	y
3		
2		
1		
0		
-1		
-2		
-3		



C.) $y=-\frac{1}{2}(2^x)+3$

x		y
5		
3		
1		
0		
-1		
-2		
-3		



1. What value does each graph appear to approach as it begins to “flatten out”?

   Graph A: ____________ Graph B: ____________ Graph C: ___________

2. Do you see this “asymptote” value in each corresponding equation?

3. If so, where?

4. In which direction does each graph “open”?

   Graph A: ____________ Graph B: ____________ Graph C: ___________

5. Which value on each equation do you think determines the direction a graph opens?

6. What is the “leading coefficient” of each equation?

   Equation A: ____________ Equation B: ____________ Equation C: ___________

7. Identify the leading coefficient and asymptote of : $y=a(b^x)+c$.

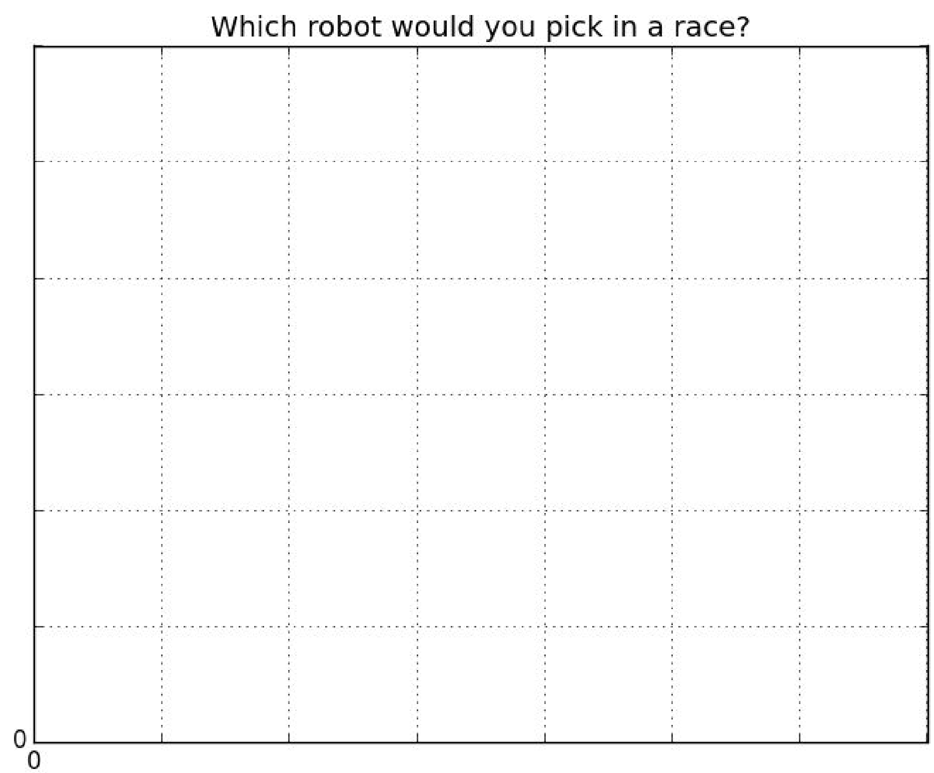
<u>The Big Race Results</u>

Function type: ____

Time (seconds)	Distance Travelled (cm)	Average Speed (degrees/sec)	Average Speed (cm/sec)
1			
2			
3			
4			
5			
6			

Total Distance Traveled: _______________

1. Graph the ordered pairs with “Time” as your independent variable and “Distance Travelled (cm)” as your dependent variable.



The Big Race Results

2. Describe the characteristics of the graph.

3. Write an equation of the graph.

4. Save your results for comparison with different function graphs.

Algebra 1

Name ______________________________

Date ____________________ Period ________

The Big Race Quiz
Comparing Equation/Function Types

Fill in the blank below to correctly label the equation. Then complete the table below the equation to correctly represent the data from the equation.

__________ Equation : $y = 2x+1$

x	y=x	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		
5		

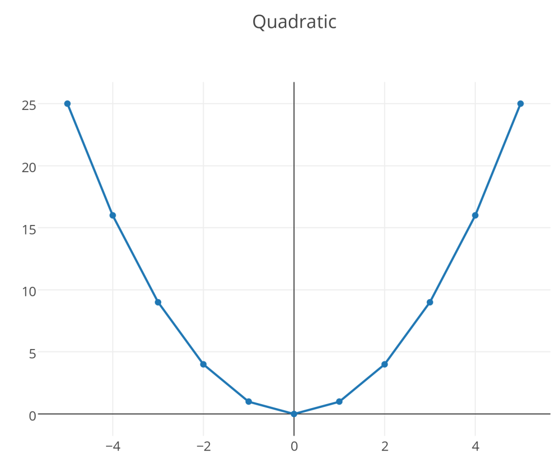
Fill in the data table below with the data generated by the equation below.

Quadratic Equation : $y = x^2$

x	$y = x^2$	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		

Fill in blanks to correctly represent the graph below. Then fill in the table below the graph with the correct data from the graph.

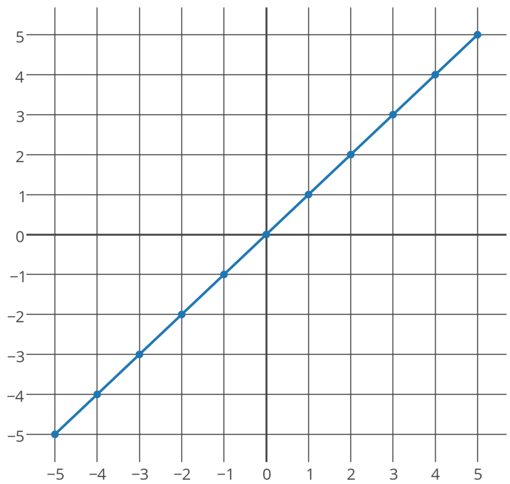
________ Function : f(x) = ____



x		y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		

Label the function type below based on the graph below. Then fill in the data table.

____________ Function $f(x) = x$

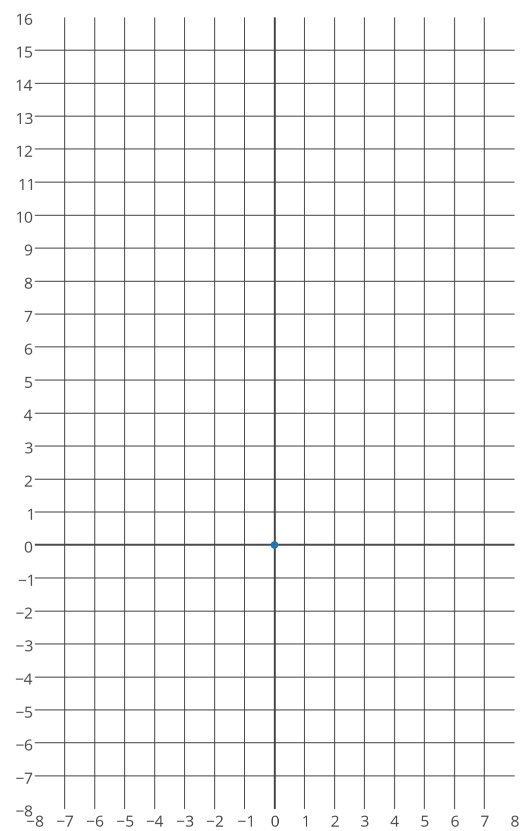


x		y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		

Label the equation type below. Then fill in the table and the graph based on the equation.

____________ Equation : $y = 2^x$

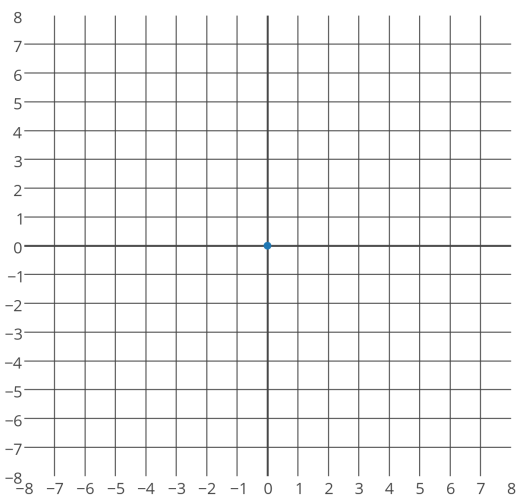
x	$y = 2^x$	y
-5		
-4		
-3		
-2		
-1		
0		
1		
2		
3		
4		
5		



Create your own function of any type then label the function, fill in the data table below and graph the function on the graph below.

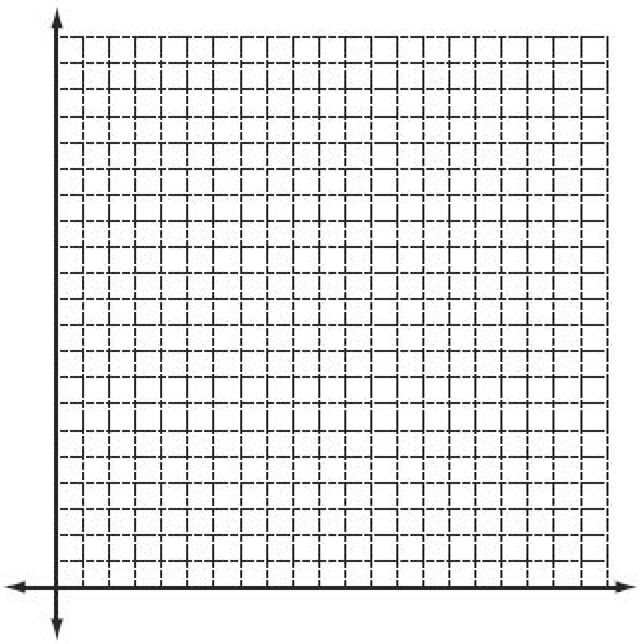
____________ Function _____________

x		y



Comparing Function Lab Results

Using the results from the previous labs for this project, graph *time vs. speed* of each type of movement (linear, quadratic and exponential) onto the same coordinate plane. Afterwards, answer the questions that follow.



What do you notice about the speed of Linkbot whose graph was linear?
What do you notice about the speed of Linkbot whose graph was quadratic?
What do you notice about the speed of Linkbot whose graph was exponential?

Add a row for 7 seconds and predict what the average speed will be for each.

Which graph would you like your Linkbot to match? Why?

Share your predictions for 7 seconds with other groups and record them below:

Name:					Group Average
Linear					
Quadratic					
Exponential					

Use your Group Average and the graph to figure out where each bot will be at the end of the race to 7 seconds.

	Degrees at 6 seconds	Predicted degrees traveled from 6-7 seconds	Degrees predicted at 7 seconds
Linear			
Quadratic			
Exponential			

For each Linkbot put a point using the appropriate shape on your graph from the beginning of this worksheet; does it fit with the existing points?

How far from the starting line will the point you put on your graph be?	
Linear	
Quadratic	
Exponential	

Place a dot where you think each Linkbot will reach at the end of 7 seconds.

After 7 second run:

How far were your predictions from the actual resting place?
For your prediction that was the furthest away from the actual resting place, how would you adjust it? Does that change anything about how you were thinking about the different speeds?

Which graph would you like your Linkbot to match? Why?

	RUBRIC The Big Race	STUDENT: ______________________________ EVALUATOR: _____________ DATE: _______

CRITERIA	APPROACHING PROFICIENT (Below Performance Standards)	PROFICIENT (Meets Standards)	ADVANCED (Demonstrates Exceptional Performance)
Construct and compare linear, quadratic and exponential models and solve problems. Alg. 1: F-LE 1 *20 pts*	Students are unable to distinguish the differences between linear and non-linear situations. Students choose an incorrect function type to model the situation.	Student can choose the correct function (linear or exponential) to model a situation.	**In addition to meeting the PROFICIENT criteria...** Students can correctly explain the reason for their choice of function.
	0 - - - - - - - - - - - - 8 - - - - - - - - - - - - 10	11 - - - - - - - - - - - - 13 - - - - - - - - - - - - 16	17 - - - - - - - - - - - -19 - - - - - - - - - - - - 20
Alg. 1: F-LE 1a *20 pts*	Students are unable to differentiate the patterns shown in the graphs and tables of different functions.	Students understand that linear functions change by equal amounts over equal intervals, and that exponential functions change by equal factors over equal intervals.	**In addition to meeting the PROFICIENT criteria ...** Students understand that 2nd level differences are the same for quadratic functions and that 1st level differences are constant for linear functions.
	0 - - - - - - - - - - - - 8 - - - - - - - - - - - - 16	17 - - - - - - - - - - - - 19 - - - - - - - - - - - - 21	23 - - - - - - - - - - - -24 - - - - - - - - - - - - 25
Alg. 1: F-LE 1b *20 pts*	Student does not use table ***and*** graph to determine correct function type (linear, exponential or quadratic).	Student uses table ***and*** graph to determine whether the data represents a linear and exponential (***or*** quadratic) function..	**In addition to meeting the PROFICIENT criteria ...** Student uses table ***and*** graph to determine whether the data represents a linear, exponential ***and*** quadratic function.
	0 - - - - - - - - - - - - 8 - - - - - - - - - - - - 16	17 - - - - - - - - - - - - 19 - - - - - - - - - - - - 21	23 - - - - - - - - - - - -24 - - - - - - - - - - - - 25
Alg. 1: F-LE 3 *20 pts*	Students are unable to recognize patterns in tables and graphs to distinguish differences in the behavior of functions..	Students use tables and graphs to observe that exponential functions eventually change at a greater rate than linear ***or*** quadratic functions.	**In addition to meeting the PROFICIENT criteria...** Students use tables and graphs to observe that exponential functions eventually change at a greater rate than linear ***and*** quadratic functions.
Project Presentation *20 pts*	Student's Linkbot does not accurately represent the linear and exponential (***or*** quadratic) graph (***or*** table).	Student's Linkbot accurately represents the linear and exponential (***or*** quadratic) graph (***or*** table).	**In addition to meeting the PROFICIENT criteria ...** Student's Linkbot accurately represents the linear and exponential (***and*** quadratic) graph (***and*** table).
	0 - - - - - - - - - - - - 8 - - - - - - - - - - - - 16	17 - - - - - - - - - - - - 19 - - - - - - - - - - - - 21	23 - - - - - - - - - - - -24 - - - - - - - - - - - - 25

COMMENTS: