Activity 2: Making Connections

Objective: The student will be able to:

- Write a function rule from a table.
- Plot points on a graph.
- Use a table or graph to solve equations.

Materials: Transparencies of activities, copies of activities, paper clips, plastic grocery sacks, CBRs (1 per group of 3)

Procedure:

1. We have been graphing data that has to do with distance and time and writing function rules for motion. Now we will look at different situations that can be represented with function rules and graphs.

2. Do Activity 2.1 together, Exercise 1 together. Explain that you input something in the function machine and a different number comes out. What happens to the input in the middle is called the process.
   - What is the input in the example? (40 students)
   - What is the process? ($100 + 15 \bullet 40$)
   - What does the process mean in the terms of the problem? (It cost $100 plus $15 for each of the 40 students.)
   - What is the $15 dollars for and who has to pay it? (The $15 is for a ticket to Ocean Universe and each student has to pay it.)
   - What is the $100? (The cost of renting the bus.)
   - What would the process be if the input is 10 students? ($100 + 15 \bullet 10$)

   Continue finding the process for the input values in the table. Then determine a function rule.
   - Look at the process column. What stays the same in all the processes? (All the processes have $100 + 15 \bullet$___.)
   - What is changing in the processes? (The number of students.)
   - What variable can we use for the number of students according to the table? (N)
   - What is the general process? ($100 + 15N$)

3. As a whole group, work through the questions on Activity 2.1, Exercise 1. With each new question give students a small amount of time to think about the problem. Then ask students what they think. Possible guiding questions follow.
   - What is the question in part *a* really asking? (Can 70 students go on the trip?)
   - Can 70 students go on the trip? (No because the bus can only seat 60 students.)

- What is part *b* really asking you to do? (Make a list of possible numbers of students that can go on the trip.)
- What is the largest number of students that can go on the trip? (60 students)
- What is the least number of students that can go on the trip? (This can lead to great discussion. At least one person has to go one the trip. Some students may add that one student is not a choir, so at least two people must go. Also, students may bring up the fact that if only a few students are going a car or van may be cheaper.)
- What do we know the input values must be? (Less than 60.)
- How can we write the process as a sentence? Start with "The total cost is." (The total cost is starting at $100 and adding $15 times the number of students.)
- How can we write our sentence as a function rule? ($T = 100 + 15N$)
- How can we use our calculator to check? (Enter the function rule in y= and create a table. It should match the one from Exercise 1.)
- If the choir can spend $775, where would that number go in our function rule: number of students or total cost? (The total cost is $775.)
- What equation can we write? ($775 = 100 + 15N$)
- How can we use our table to find the number of students that can go to Ocean Universe for $775? (From the table, one can tell the answer is between 40 and 50 students. Using guess and check with the process, one can determine that 45 students can go on the trip.)
- How can we use the calculator table to find the number of students that can go?

4. For Activity 2.1, Exercise 2, have several students plot points on the overhead. Then have students write a short description of the graph. Ask for volunteers to work each of the next problems on the overhead and explain. Exercise 2, Part *d* and Exercise 1, Part *d* are similar. The function rule for Exercise 2, Part *e* was written in Exercise 1, Part *c*.

5. In groups, have students complete Activity 2.2. If time does not allow, assign this activity for homework. It is very similar to Activity 2.1.

6. Hand out Activity 2.3. Assigning each group one of the three exercises to do is a good idea to save time. Also, if two groups get the same

exercise, they can collaborate. Have students work in their groups for about 15 minutes to complete the exercises. Teacher and tutors need to help students with the activities. Also, encourage and show students how to work as a team to work the problems. Then randomly choose groups that have not presented to present the problems. Again, make sure that each member of the team explains some part of the exercise. As they are presenting, other students can participate by copying the information for the exercises that they were not assigned.

7. Hand out Activity 2.4. Explain how to make the parachute. Demonstrate how to set up the CBR and drop the parachute directly above it. Estimate how long it takes the parachute to fall (about 1.5 seconds). Then set the CBR to collect data for that amount of time, drop the parachute again, and collect data. Ideas for helping the parachute to fall straight include not standing by an air vent, closing doors and windows, and standing in a chair and releasing the parachute instead of throwing it up. Also, open the bag to help it fall slower.

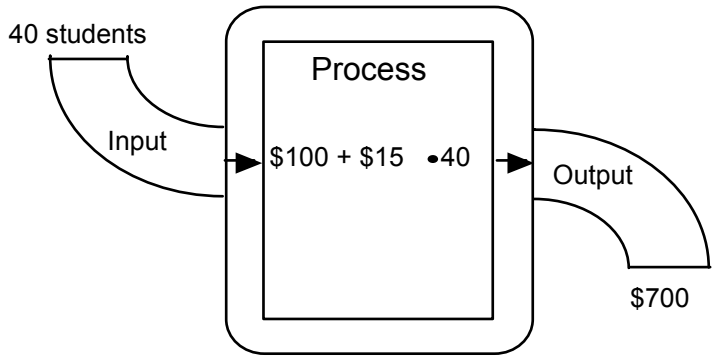
8. Have students predict what the graph will look like and draw it on Exercise 1. Then have them break into their teams and collect data. It will probably take several tries to get a good graph, but it can be done well. Students should complete the rest of the exercises in their group.

9. List all the function rules on the overhead or board. Ask the following questions:
   - Which group started its parachute the highest?
   - Which group started the lowest?
   - If we started all parachutes at the same height and raced to the ground, which group would win?
   - In real-life, we want parachutes to go slow to the ground so that people do not get hurt. If we started all parachutes at the same height, which group would get to the ground last?

10 . If time allows, complete Activity 2.5. Do the first exercise together. Then have students complete Exercise 2. This exercise could be assigned for homework or collected for assessment. Alternatively, have several groups share their scenarios, a group complete the table, another write a sentence and function rule, and other to answer the last three parts.

Extensions: Have students use a graphing calculator to generate tables and have a partner guess the rule.

1. The school choir is planning a trip to Ocean Universe. The bus costs $100 to rent and seats 60. Tickets to Ocean Universe cost $15 each. A function machine can be used to compute the total cost.



Use mental math to complete the table below.

Input	Process	Output
Number of Students		Total Cost
10		
20		
30		
40		
50		
N		

a. Can you have an input value of 70? Explain your reasoning.

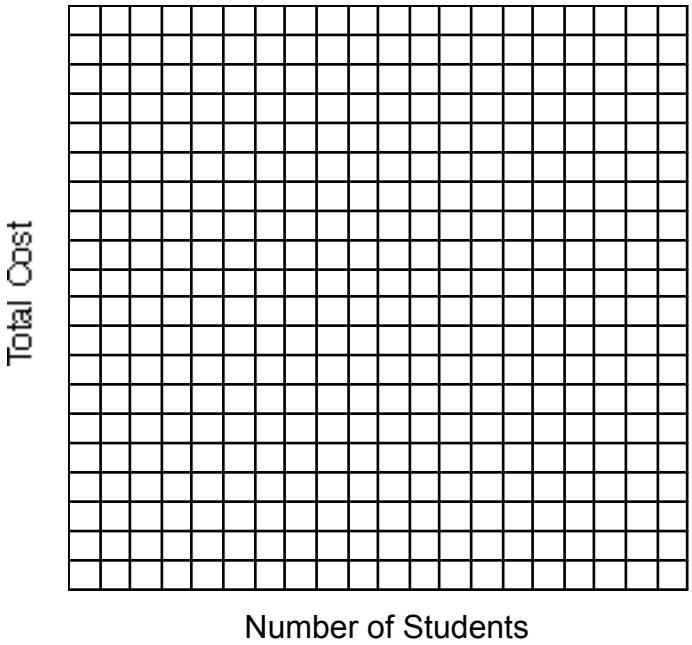
b. Make a list of input values that make sense in this situation.

c. Write a sentence and a function rule describing the total cost of the trip in terms of the number of students going. Use a calculator table to confirm your rule.

d. Write an equation for the following problem: The choir only raised $775 for the trip. How many people can go to Ocean Universe? Solve by guess and check.

e. Use a graphing calculator table created from your rule to find the solution for Part d.

2. Graph your data from Activity 2.1, Exercise 1 on the grid below.



a. Describe your graph.

b. Use your graph to determine the total cost for 40 students. Explain how you found your solution.

c. Use your graph to determine the number of students who can go on the trip for $1000. Explain how you found your solution.

d. Write an equation in one variable for the problem in Part c.

e. Label your graph with a rule relating the total cost to the number of students.

1. U. S. ONLINE charges $10 per month plus $0.25 per hour for Internet service. Your conscience says, "No more than one hour per day!" and you always listen to your conscience. Build a table to show possible monthly costs.

Input	**Process**	**Output**
Number of Hours		Monthy Cost

a. Identify the input and output variables and label them in your table.

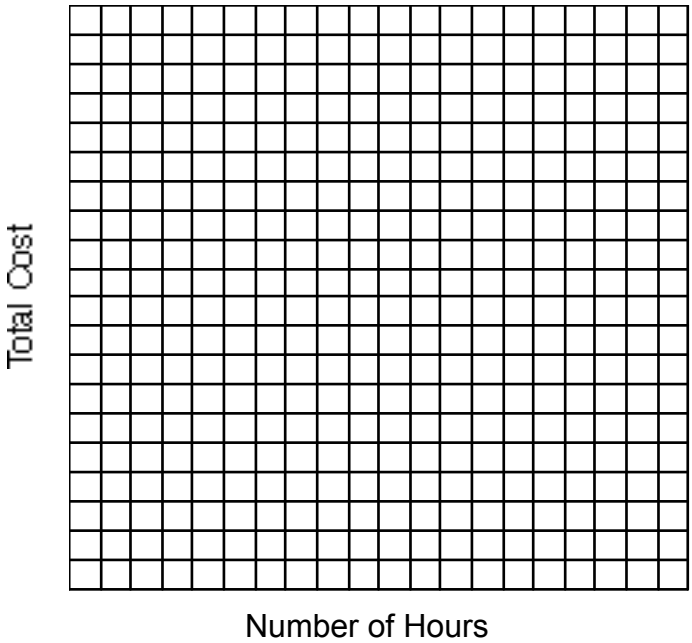
b. What input values make sense in this problem?

c. Write a sentence and a function rule describing the monthly cost in terms of the hours used. Use a calculator table to confirm your rule.

d. Write an equation for the following problem: Your Internet service bill is $15.75. For how many hours of use were you charged?

e. Use a graphing calculator table created from your rule to find the solution for Part d.

2. Graph your data from Activity 2.1, Exercise 2 on the grid below.



a. Describe your graph.

b. Use your graph to determine the cost for 15 hours. Explain how you found your solution.

c. Use your graph to determine the number of hours of service for a cost of $15. Explain how you found your solution.

d. Write an equation in one variable for the problem in Part c.

e. Label your graph with a rule relation the total cost to the number of hours.

1. Sam sells t-shirts on the beach. Complete the table by yourself to find the cost for different numbers of t-shirts. Then compare with your group.

Input	**Process**	**Output**
Number of T-shirts		Total Cost
10		75
20		150
30		
40		
50		
200		
270		
		750
		2250
N		T

a. Explain your strategy for completing the table and compare it with others' in your group.

b. Use the second column to show the process.

c. Write a sentence and a rule describing how the total cost is related to the number of t-shirts. Confirm your rule with your calculator.

2. WLT offers a different phone plan than its competitors. Complete the table by yourself to begin discovering their plan. Then compare with your group.

Input	**Process**	**Output**
Number of Hours		Cost of Phone Service
1		21
2		27
3		
4		
5		
12		
		75
		165
H		C

a. Explain your strategy for completing the table and compare it with others' in your group.

b. Use the second column to show the process.

c. Write a sentence and a rule describing the cost of the phone bill related to the number of hours. Confirm with your calculator.

Write an equation for the output value of:

d. 75

e. 165

3. Suppose a toy parachute is dropped from a height of 20 feet and falls at a rate of 2 feet per second. Complete the table by yourself. Then compare with your group.

Input	**Process**	**Output**
Time (seconds)		Height (feet)
0		20
T		H

a. Explain your strategy for completing the table and compare it with others' in your group.

b. Use the second column to show the process.

c. Write a sentence and a rule describing the height in relation to the time. Confirm your rule with your calculator.

Use a data collection device with a CBR and a plastic grocery sack to simulate a parachute drop.

- Attach a paper clip to the handles of the grocery sack as shown.

- Set the CBR on the floor facing up.
- Throw the parachute in the air directly over the CBR. Estimate the time, T, it takes the parachute to fall from its maximum height to the floor.
- Throw the parachute again; this time collect distance data with the CBR for T seconds. Start the data collection when the parachute is at its maximum height.
- Repeat if necessary.

1. What do you think the graph of the parachute's distance from the CBR over time will look like? Sketch your conjecture.

2. Sketch the graph you obtain of the parachute's distance from the CBR over time.

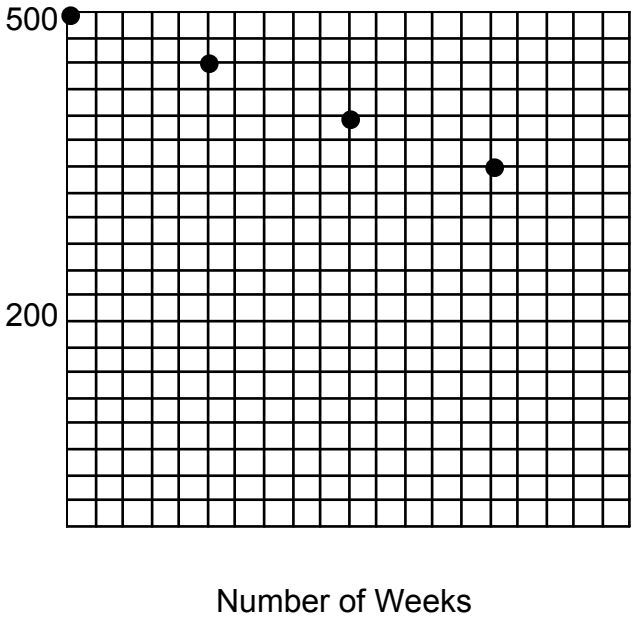
3. Where is the parachute at time 0?

4. Estimate the speed in feet per second.

5. Use your parachute's starting point at time zero and speed to fit the data with a rule that describes the relationship.

6. Refine your rule for a good fit, if necessary.

1. Record the data from the graph in the table. Label the input and output variables.



Input	Process	Output
W		A

a. Make up a scenario that the graph can represent.

b. Explain your strategy for completing the table and compare it with others' in your group.

c. Use the second column to show the process.

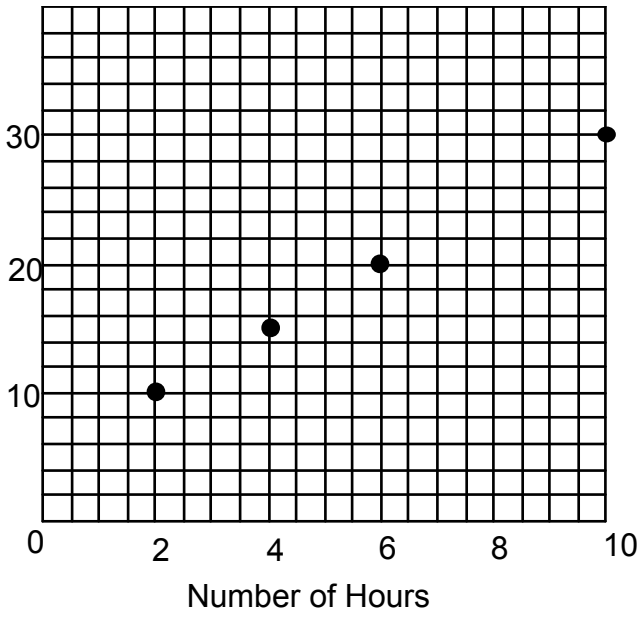
d. Write a sentence and a function rule describing the amount in terms of the number of weeks. Confirm your rule with your calculator.

e. Write an equation in one variable for each input value, where the input value is the solution.

f. Find the amount at 8 weeks.

g. Write and solve an equation for the problem: When is the amount 0?

2. Record the data from the graph in the table by yourself. Label the input and output variables.



Input	Process	Output
H		T

a. Make up a scenario that the graph can represent.

b. Explain your strategy for completing the table and compare it with others' in your group.

c. Use the second column to show the process.

d. Write a sentence and a function rule describing the total cost in relation to time. Confirm your rule with your calculator.

e. Write an equation in one variable for each input value, where the input value is the solution.

f. Find the cost for 12 hours.

g. Write and solve an equation for the problem: When is the amount $42.50?