Background Information: This lesson was adapted from a lesson study written by myself and four seventh grade teachers at my district. We were trying to find a concrete way to explain why some data does not represent functions. With some tweaking, the lesson became very effective and students demonstrated a strong understanding of this concept in subsequent assessments. Feel free to modify or break the lesson up into two lessons as there is a LOT of information here. Try to really pump up the class during the elevator simulation as this sets the tone for the rest of the lesson. Last, remember to have fun……your own enthusiasm is contagious!

Lesson Concept: Students will determine if a set of ordered pairs, coordinates, or a graph represent a function or a non-function.

5E	Teacher Does	Student Does
Prep	*Materials: Make 6 signs with student #'s 1-6 to be placed around students' necks during simulation. Copy, cut (and laminate) attached cards (one/student). Dice (two dice with different colors/one set per pair), copies of worksheet (one/student), Functions and Relations tns file uploaded onto each TI-Nspire.*	
Engage **20 min**	*What questions/activities would teachers do that will produce the stated goals?* **Teacher: The concept we are exploring today is how some relationships are more useful than others and how they are shown mathematically. We will begin by exploring this concept by doing a simulation of people riding on an elevator. I need 6 volunteers (place sign with student #'s around necks). Please refer to page 1.1 on your handheld to input the values needed for this simulation. The x-value will be the student number and the y-value will be the floor that this student gets off on. (Also record values on worksheet) <u>Rule</u>: once a student gets off of the elevator he/she cannot get back on and everyone exits at some point. All 6 students are on the elevator at the main floor. (place #'s 1-6 on your table). Explain that floor #1 is the main floor with purses, does anyone want to exit the elevator? (Place floor number next to names of student(s) that exit). The elevator door closes and we now go up to floor #2, Shoes, does anyone want to exit**	*What might students know or need to know about the lesson concept before they begin the lesson?* **Coordinate plane, x & y values, origin, how to graph, ordered pairs, relation between table and graph, 2 different types of tables.** **Students are either volunteers or observing and assisting class in how to act out scenarios. Students should be inputting data into handheld and on worksheet with correct input/output values. Asking questions as needed.**

	now? (Continue until you hit all 6 floors and everyone exits). Look at the t-chart, what do you notice about the numbers? Is there a pattern or any differences or anything interesting? **Now look at the t-chart for #2 (Refer to Page 2.1 on handheld). All 6 students are again on the elevator on the Main Floor. Can anyone tell me what happens at this floor? Now we go up to the second floor, what happens here? (Continue on to each floor until finished). What do you notice about the x values versus the y values? Can they be the same?** **Ask for a new group of volunteers. Explain that x can also be called the "input" and y can also be called the "output." Label on table and act out table #3 (Page 3.1). Does it matter that the input values are out of order? Why or why not? Can more than one person get off on the same floor? Where is this illustrated in the t-chart? Can one person get off of more than one floor? Why or why not? What would this look like on the t-chart?** **Look at table #4 (Page 4.2). Can someone guide the volunteers as to how to act out this scenario? Act out as a class.** **Turn to your partner and discuss table 5 (Page 5.2). What would this simulation look like? Can student #2 get off of floor 3 and floor 4 at the same time? Why? Can anyone make a statement about which tables are possible and which are not? Can someone give an example of what an impossible table might look like? (An input gives 2 different outputs). What is another term for a student? A floor number? Can we put this statement into mathematical language using our new terminology?**	

Explore **15 min**	*What possible activities/prompts might elicit the stated goal? How does this activity help students meet the stated goal and understand the concept?* **Teacher says: "Today we are going to be looking at relations and functions, which is the section in the book we will be studying today. Every situation we just examined is a relation but not all of them are considered functions. Please write the following definition of a function on the bottom of your worksheet: A function is a special type of useful relationship in which each input gives exactly one output. In other words, one x cannot give 2 different y's or one input cannot give 2 different outputs. Can someone explain this in terms of our elevator scenario? (one person cannot get off on 2 different floors). You may want to discuss that you still have a function if the same x and y are repeated.**	*What part of the concepts would students need to explore? How would students demonstrate/communicate thinking toward understanding the lesson concept?* **Students will communicate either verbally or in written form the clear definition of a relation and a function. Students will examine multiple representations of functions and determine if the information fits the definition of a function. Students will defend why the vertical-line test illustrates if a graph is or is not a function (follow-up lesson).**
Explain **20 min**	*What possible activities/prompts might elicit the stated goal? How does this activity enable students to explain their understanding and to engage in student-to-student interactions regarding their understanding of the lesson concept?* **Dice Game: Now we will play a dice game to help us explore relations and functions further. Refer students to Page 6.1 on handheld. Model game (teacher versus students) where teacher and class have one die of a different color. Instructions: Roll a die 4 times and record outcomes in columns titled "SampleGameX" and "SampleGameY." Teachers roll goes into x column and student roll goes into y column. I recommend that you "cheat" to make the function a non-function (i.e. roll same x value at least two times). You may want to**	*What would students be able to think, do, verbalize, draw, and/or write to indicate that they understand the lesson concept?* **Students will be able to identify if a set of ordered pairs, coordinates or graphs represent a function. Students will verbalize the difference between a non-function and a function. Students will use the vertical-line test to determine if a graph represents a function (explored more in follow-up lesson).** **Students will participate in dice game/discussions and complete quickwrite.**

	discuss that you still have a function if the same x and y are repeated. This will happen in some of the simulations and should be addressed prior to starting. Rule for student simulation: "Begin by deciding which student will be the domain value and which one will be the range value. Roll the dice die 4 times each and put values onto charts on Pages 6.2 through 6.6 (play 5 times). Apply your knowledge of functions to determine if the relation is a function or not. Discuss with your partner. Play game until teacher directs you to stop or your finish 5 trials." **Direct students to Page 6.7 on handheld and the worksheet. Ask students to complete Pages 6.7 through 6.11 with their partner. This investigation asks students to select a relation from their 5 trials that represents a function and explain what makes the data a function? They are asked to use "domain" and "range" in their explanation. What about a table that does not represent a function? Students are asked to explain what makes this relation a non-function? They should graph both trials' data on their worksheet and on their handheld. Page 6.11 asks students to draw a vertical line using the "parallel" menu key. You should them show them how to grab and drag the line across both functions (depending on their skill level with the Nspire). The idea is to get them to starting exploring the concept of the vertical line test. You may want to reserve this concept for the following lesson depending upon time and the level of understanding with your students. You can provide more/less guidance on this step depending on your students' needs.** **Students should then work through Pages 7.2 and 7.3 as a table group.**	

Extend **10 min.**	*What possible activities/prompts might elicit the stated goal?* **Pass out a card to each student at a table (these should be made from the attachment and laminated, if possible). These cards have varying representations of relations (tables (vertical and horizontal), graphs, ordered pairs, function form). Have students discuss in pairs or table groups if their card is or is not a function and why. This exercise can be a good intro for the next day's lesson on the vertical line test, if you are out of time. (Remember to collect cards)**	**Students have a card with data. Students are to share with their table group, partner, as to whether or not their data represents a function and why or why not.**
Evaluate **5 min.**	*Are the students expressing the desired learning outcome? What is the game plan if the response is not what was expected?* **Page 8.1 has a few suggestions for homework/extensions/extra credit. Use this list as you see most useful. Page 8.2 has a quick question that can be used for a ticket out the door or as homework. This page asks students to list two things that they learned about relations and functions today. (Discuss if time and collect worksheet if not being used for homework).**	**Recommendation: have students complete homework on the identification of functions and/or explain the difference between the two (you can use Page 8.1 for question ideas). Students can also be asked to give an explanation of the vertical line test and why it helps to identify functions.**