Grade Level	8	**Content Area**	Mathematics
Course Title (grades 9-12 Only)	NA		
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	Students understand how to construct scatter plots. Students understand how to interpret scatter plots for bivariate measurement data to investigate patterns of association between to quantities. Students can describe patterns such as clustering, positive or negative association, linear association, and non linear association.		
Alignment to Program of Instruction *Briefly outline methods of instruction found in this sequence of lessons that align to the Program of Instruction described in A.3.*	Students work both collaboratively and independently to achieve a thorough common core standard based understanding in order to apply mathematics knowledge to real world situations. Instruction encourages accuracy, precision and problem solving skills as students learn the basic principles of mathematics reasoning.		
Standard Number and Description *List the Number* and full description for the Required Standard or Science Performance Objective listed in section A.6.*	**8.SP.2** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.		
Materials/Resources Needed	Lesson 1: Smart Board, computers with internet access Lesson 2: Smart Board, graph paper		

* ***Standard Number****: For English Language Arts (Reading and Writing), use Grade, Strand, Standard (e.g., 3.RI.2). For K-8 Math, use Grade, Domain, Standard (e.g., 6.EE.7). For HS Math, use Conceptual Category-Domain, Standard (e.g., A-REI.6). For Science, use Grade, Strand, Concept, PO (e.g., 4.1.3.1).*

Lesson (add as needed)	Instructional Strategies **The teacher will:**	Student Activities **The students will:**
1	**Review:** Have students stand up next to their desks scattered throughout the room. Define the following: 1. The students' front right of the classroom is the origin (0,0) of a coordinate plane (Quadrant I). 2. The right wall represents the y-axis and the front wall represents the x-axis. 3. The students represent points scatter plotted on a graph (coordinate plane). Ask students the following review questions: 1. What does a scatter plot graph represent? 2. To make a scatter plot, graph the data as…? 3. You can use scatter plots to look for ….? 4. As one set of values increases on a scatter plot the other set tends to increase. What kind of correlation does this describe? Instruct students to work together to represent themselves as points on a scatter plot which show a positive correlation. Help assist students. 5. As one set of values increases, the other set tends to decrease. What kind of correlation does this describe? Instruct and assist students to represent themselves as points on a scatter plot which show a *negative correlation*. **6.** The values have no relationship. What kind of correlation does this describe? Instruct and assist students to represent themselves as points on a scatter plot which show *no correlation* around the room. **Vocabulary:** 1. Explain to students that two quantitative variables are represented by their respective values on the x and y axis (<u>bivariate data</u>). 2. Explain that clusters (patterns) of this data on scatter plots that show a positive or negative correlation suggest a <u>linear association</u>. 3. Explain that a <u>line of best fit</u> or <u>trend line</u> is a line that can be drawn to "fit" bivariate data.	**Review:** Create a human scatter plot. Discuss and respond: 1. A scatter plot represents the relationship between two sets of data. 2. Ordered pairs 3. Trends 4. Positive Correlation a. Arrange themselves starting in the front right of the room (close to origin) scattered towards the back left of the room. This will give students a good visual of a positive correlation scatter plot. 5. Negative Correlation: Arrange themselves starting in the back right of the room scattered towards the front left of the room. This will give the students a good visual of a negative correlation. 6. No Correlation: Arrange themselves randomly throughout the room. This will give the students a good visual of a no correlation. **Vocabulary:** Respond to teacher prompts, by repeating chorally the answers to questions that check for understanding for each of the vocabulary words. For example, clusters (patterns) of this data on scatter plots that show a positive or negative correlation suggest a (choral response) "linear association".

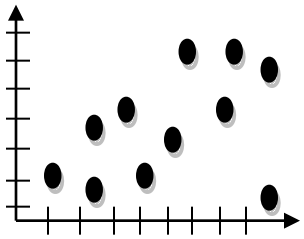
	4. Explain thatthe correlation coefficient is the number *r*, which indicates how well a set of data can be approximated by the line of best fit. $-1 \leq r \leq 1$ a. A perfect positive correlation is given the value 1. b. A perfect negative correlation is given the value -1. c. If there is no correlation the value is 0. **Introduction:** 1. Explain to students they will be using computers to complete an activity called "The Line of Best Fit". 2. Instruct students that they will virtually create a scatter plot, draw the line of best fit, and compare their line of best fit with a computer generated line of best fit. **Demonstration:** 1. Write the following URL on the board: http://www.shodor.org/interactive/activities/regression. Log in as teacher. 2. Create a scatter plot by plotting points of their choice. Note that students may enter each ordered pair in the data box beneath the graph and click on "Update Plot," or graph points on the grid by clicking their mouse. In this case, the values of the ordered pairs will appear in the data box. 3. Show students that after scatter plot is completed, they should create a line of best fit by clicking on the box "Fit your own line". 4. Remind students that a line of best fit should follow the line suggested by the points on the scatter plot. Some points will be above the line and some points will be below the line. 5. Demonstrate how to adjust the line by checking the dot "Move your fit line" and clicking on the green circles moving the cursor. 6. Encourage students to be sure line of best fit is accurate then demonstrate how to check the box "display line of best fit" and compare this computer generated line with theirs. 7. Instruct them to note the value of *r* and the equation of the line of best fit. 8. Suggest and show students how to check the circles "Add Points" and "Remove Points" to see the effect of additional data or the removal of outliers. 9. Demonstrate that by clicking on "Reset" students may create	**Demonstration:** Pay close attention to the demonstration the teacher provides as the demonstration will model the expectations and procedures necessary to complete the activity. Ask for clarification if necessary.

	another scatter plot. **Interaction:** Move around the room providing guidance, answering questions and assisting students who are carrying out this "Line of best fit" activity. **Independent Practice:** 1. Instruct students to write an explanation of how a scatter plot and line of best fit are related. 2. Instruct students to use the following words in their explanation: scatter plot, line of best fit, linear association, positive correlation, negative correlation, bivariate data, and correlation coefficient. 3. The explanation should be based on the results noted during the activity. 4. Instruct students that explanations will be discussed in class the following day.	**Interaction:** 1. Log on at their computers to the URL written on the white board. 2. Create a scatter plot by plotting points of their choice. Note that students may enter each ordered pair in the data box beneath the graph and click on "Update Plot", or graph points on the grid by clicking their mouse. 3. Complete scatter plot and create a line of best fit by clicking on the box "Fit your own line". 4. Adjust the line by checking the dot "Move your fit line" and clicking on the green circles moving the cursor. 5. Ensure the line of best fit appears accurate and then check the box "display line of best fit" and compare this computer generated line with their own. 6. Note the value of *r* (correlation coefficient) and the equation of the line of best fit. 7. Check the circles "Add Points" and "Remove Points" to see the effect of additional data or the removal of outliers. 10. Click on "Reset" to create another scatter plot. **Independent Practice:** Write an explanation of how a scatter plot and a line of best fit are related using the vocabulary provided by the teacher.
2	**Review:** 1. Arrange students' desks in a circle. 2. Ask students to take out their "Line of Best Fit" activity explanations they wrote for homework. Facilitate a discussion with the following questions. a. What type of line best models the relationship between bivariate data, a straight line or curved line? Answer: Curved	**Review:** Discuss explanations.

	b. Were any of your scatter plots so scattered that there was no correlation? What was the *r* value in this case? Answer: 0 c. What do we call this *r* value? Answer: No correlation d. Did any of you have data with an upward sloping line of best fit? What kind of correlation is this? What was your *r* value? Answer: Positive correlation, close to 1 e. Did any of you have a scatter plot with a downward sloping "line of best fit"? What kind of correlation is this? What was your *r* value? Answer: Negative correlation, close to -1 f. What do these positive of negative relationships suggest about clusters of data? Answer: linear association 3. Ask students to volunteer to share the explanations they wrote for homework. 4. Instruct students to provide feedback to classmates when/if explanations are either inaccurate or do not make sense. 5. Provide feedback when necessary.	
	Introduction: Explain that scatter plots will be displayed on the Smart Board. For each scatter plot displayed on the Smart Board students will be asked to complete the following on a piece of graph paper: (Instruct students to write down these questions). 1. Does the scatter plot show a relationship between bivariate data? 2. Can a straight line be used to model a relationship between bivariate data? Meaning is there a linear association? 3. Informally draw a "line of best fit" on your graph paper for each scatter plot presented, if applicable. 4. For each line of best fit, write down what you would expect the *r* value to be. 5. For each line of best fit, informally asses the model fit by judging the closeness of data points to the line by writing what type of correlation exists and how close the one would expect the *r* value to be to 1 or -1 for each scatter plot.	**Introduction:** Record and complete questions.
	Interaction: 1. Provide assistance to students who have questions. 2. Walk around the room, checking for understanding by reviewing student responses to scatter plots on projection screen. 3. Advance to each successive slide when students finish responses.	**Interaction:** Respond on graph paper to 10 sample scatter plots shown by teacher on the projection screen to the following prompts: 1. Does the scatter plot show a relationship between bivariate data? 2. Can a straight line be used to model a relationship between bivariate data? Meaning is there a linear association?

	Wrap Up: 1. Assign students to pairs. 2. Instruct students to share responses they made to the prompts associated with the projected scatter plots. 3. Instruct students to review partner's scatter plots and discuss any responses that are different and discuss why they are different and what the correct response should be. 4. Mediate any disputes or provide clarity when students are unable to determine correct response.	3. Informally draw a "line of best fit" on your graph paper for each scatter plot presented, if applicable. 4. For each line of best fit, write down what you would expect the *r* value to be. 5. For each line of best fit, informally asses the model fit by judging the closeness of data points to the line by writing what type of correlation exists and how close the one would expect the *r* value to be to 1 or -1 for each scatter plot. **Wrap Up:** 1. Work together to review each other's responses to scatter plot activity. 2. Discuss any responses that are different and discuss why they are different and what the correct response should be. 3. Ask teacher for clarity or to resolve any disputes

Summative Assessment Items:



1. Draw the line of fit for the scatter plot above.
2. What kind of relationship is modeled by the line of fit for the above scatter plot?
   A. No Correlation
   B. Negative Correlation
   C. Positive Correlation
   D. Binomial Variation

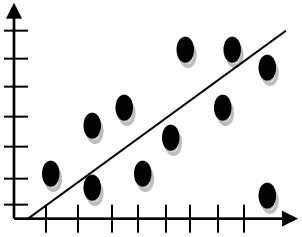
3. What is an *r* value and what would you expect the *r* value to be in the scatter plot above?
   A. correlation coefficient; 1
   B. correlation coefficient; 0
   C. correlation cofactor; -1
   D. correlation cofactor; 1

4. An assessment of the cluster shows the closeness of the data points to the line which suggests a _____ _____.

5. Draw your own scatter plot with data points and trend line representing an *r* value of -1.

Answer Key: Each correct answer is awarded 1 point, and no partial credit is available. A score of 4/5 demonstrates mastery.

1) The line of fit drawn should divide the bivariate data in half on the scatter plot and look similar to the following:



2) A
3) C
4) linear association
5) Student responses should look similar to the answer to #1 except the cluster should go down from the upper left to lower right on the graph.