Curriculum Sample Template
Max. 8 Pages

Grade Level	8	**Content Area**	Mathematics
Course Title (grades 9-12 Only)			
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	Students now have enough experience with coordinate geometry and linear functions 8.F.3, 8.F.4, 8.F.5 to plot bivariate data as points on a plane and to make use of the equation of a line in analyzing the relationship between two paired variables.		
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.*	This sample also demonstrates the three distinctive features of SySTEM Phoenix's Program of instruction: 1) Integration: Math and Science standards are taught in a mutually reinforcing manner 2) Problem-Based Learning: The standard is introduced to students within the context of a real-world problem that they continually hook their new knowledge into in order to create a viable solution or make an evaluative judgment 3) All final products are authentic documents that students will present to an audience of stakeholders.		
Standard Number and Description *List the Number* and full description for the required Standard or Science Performance Objective listed in 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	"Gapminder" www.gapminder.org "Scatter Plots and Correlation" http://www.regentsprep.org/Regents/math/ALGEBRA/AD4/scatter.htm Gizmos from www.explorelearning.com: "Line of Best Fit Using Least Squares Activity A and B", "Correlation" "Engineering Statistics Handbook" http://www.itl.nist.gov/div898/handbook/eda/section3/eda33q.htm "Scatter Plot" applet: National Library of Virtual Manipulatives http://nlvm.usu.edu/		

* ***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)	**Instruction**	**Student Activities**
1	***1. Essential Question:*** How can we use scatter plots to identify patterns? ***2. Launch/Introduction:*** **The Case:** You are an officer of the Phoenix Highway Patrol. Though you see fatal car accidents on a regular basis, you were perturbed to learn that motor vehicle crashes are the leading cause of death for U.S. teens. Upon further research, you found out that per mile driven, teen drivers ages 16 to 19 are three times more likely than drivers aged 20 and older to be in a fatal crash. Fortunately, you and your fellow officers teen motor vehicle crashes are preventable and proven strategies can improve the safety of young drivers on the road. Your task is to create a short video that will encourage young drivers to use a particular safe driving strategy. Your challenge is to collect and represent bivariate data that supports the effectiveness of the chosen strategy. ***4. Vocabulary:*** Student Glossary Graphic Organizer of Tier 2 academic) and Tier 3 (content) vocabulary. "Term, Definition, Example." Bivariate, linear association/correlation, positive association, negative association, scatter plot, trend line ***6. Debrief/Summarize:*** The teacher will pose questions about the fit of the best fit line and prompt students to discuss how a best fit line characterizes the data set. Together, the class will decide on a definition for the concept of line of best fit (a line that captures the essential nature of the trend). The teacher will ensure the following learning targets are formalized: *student can place a straight line on a scatter plot that closely fits the data points and 2) student can judge how well the trend line fits the data by looking at the closeness of the data points.*	3. ***PBL Casework:*** **Meet the Problem:** Students will be organized into collaborative working groups of four, which will stay consistent throughout the entire case. *S*tudents will examine the case and get familiar with the provided case material. **Know/Need to Know:** Students will identify information and ideas into a KWHLS (see Resources) chart. The group facilitator will prompt group members to **Define the Problem Statement.** Though the definition of the problem may evolve as the team progresses. ***5. Investigate/Explore:*** Students will go to "Gapminder" and explore the interactive data for car deaths v. income per person on an international comparison. Students will create a line of best fit to represent the relationship between both variables and discuss its implications. ***7. Differentiation/Additional Exploration:*** Given various scatter plots, students will use a piece of uncooked spaghetti to position a best fit line and justify their positioning. As well, using the "Line of Best Fit Using Least Squares Activity A and B" Gizmo, students will fit a line to the data in a scatter plot using their own judgment and then compare the least squares line of best fit. ***8. Reflection/Closure:*** When data is displayed with a scatter plot, it is often useful to attempt to represent that data with a straight line. What is this line called and what is its purpose? ***9. Formative Assessment:*** Given a table of data, students will graph each data point on a coordinate plane and determine a line of best fit. Students will then judge the closeness of this fit. ***10. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire

		skills/knowledge, share information, and generate possible solutions. The group may delegate tasks to individual group members.
2	***1. Introduction:*** Rather than writing a paragraph to explain the relationship between two things, the best fit line provides a quick, visual representation of the relationship. 3. Throughout the lab, the role of the teacher is facilitative. The teacher will actively observe groups, help students with group dynamic issues if needed, and ask probing questions. The teacher will also collect informal formative assessment data based on his/her observations. ***3. Summarize/Debrief:*** After students have collected lab data and constructed scatter plots to represent their data, a representative from each group will share their findings and explain their rationale for the positioning of the best fit line. As a facilitator, the teacher will guide the class to look for similar trends, make argument-based claims, and generalize the correlation. The teacher will ensure the following learning targets are formalized: *student can recognize that straight lines can be used on scatter plots to model the relationship between two quantitative variables.*	***2. Investigation/Exploration:*** In groups, students will conduct Lab #1 to investigate how the height of a ramp affects the displacement of an object? (velocity) Students will collect bivariate data from their observations. After displaying the data as a scatterplot, the group will use the spaghetti technique for line fitting. Students will describe how well the line fits the data. 4. In collaborative working groups, students will reflect on how their lab findings relate to the case. Students will construct an initial solution to the problem and identify the most important concepts and their relationships. The group may delegate individual group members to gather specific information for the group. ***6. Differentiation/Exploration:*** Using the "Correlation" Gizmo, students will explore the relationship between the correlation coefficient of a data set and its graph. **7. Reflection/Closure:** How does a best fit line help us understand how data is correlated? ***8. Formative Assessment:*** Given a scatterplot with three lines, students will choose the best fit line for the data and justify their decision. ***8. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions. The group may delegate tasks to individual group members.
3	***1. Introduction:*** 3. Throughout the lab, the role of the teacher is facilitative. The teacher will actively observe groups, help students with group	***2. Investigation/Exploration:*** In groups, students will conduct Lab #2 to investigate how the heaviness of the car affects the displacement of an object? (weight) Students will conduct this lab to collect bivariate data from their observations. Students will describe how well the line

	dynamic issues if needed, and ask probing questions. ***4. Summarize/Debrief:*** After students have collected lab data, constructed scatter plots to represent their data, and decided on a line of best fit with the lowest mean absolute deviation, a representative from each group will share their findings. *Students will construct viable arguments and critique the reasoning of others.* As a facilitator, the teacher will guide the students to define and identify data outliers. At first, students will predict the effect these extreme values may have on the positioning of the best fit line. Then, the teacher will model how the linear regression function on a graphing utility will show different lines depending on the inclusion/exclusion of outliers. The teacher will ensure the following learning targets are formalized: *student can test how one or more outliers might have tremendous influence on the positioning of the line.* **6.** Throughout casework time, the role of the teacher is facilitative. The teacher will actively observe groups, help students with group dynamic issues if needed, ask probing questions and/or direct towards further resources.	fits the data by calculating the mean absolute deviation, found by averaging the measures of the distance of each ordered pair from the line. ***5. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions. 7. ***Differentiation/Exploration:*** Students will read an excerpt from the "Engineering Statistics Handbook" on scatter plots, to explore further information about scatter plots and the effects of outliers. ***8. Closure:*** In a scatterplot, what does the term outlier mean? How do outliers affect the best fit line? ***9. Formative Assessment:*** Given a data set, students will create a scatterplot and a best fit line including the outliers and another best fit line excluding outliers.
4	***2. Debrief/Summarize:*** The teacher will guide the class in a whole group discussion; students will present their interpretation of the graphical presentation and discuss the relationship the data describes. As a facilitator, the teacher will probe students at the whole class level to look for similar trends, make argument-based claims, and construct generalizations. *Students will look for and make use of structure.* The teacher will ensure the following learning targets are formalized: *1) student can identify a correlation (trend) and use it to justify predictions about data not represented on the scatter plot.* ***5. Conferencing/Feedback:*** As students continue their casework, the teacher may observe or participate in group dialogue. The teacher will conference with each group to ask	***1. Investigation/Exploration:*** Using Illustrative Mathematics "Birds' Eggs" problem (41), students will glean contextual information about birds eggs from a collection of data organized into a scatterplot. ***3. Differentiation/Further Exploration:*** Using the "Scatter Plot" applet, students will plot multiple data points based on hands-on measurements (height v. hand-span) in two dimensions and determine the correlation. ***4. PBL Case:*** **Resolve:** Student groups will **determine the best fit solution** to the case and draft their report. Students will send their draft to an officer of the Phoenix Highway Patrol for feedback. ***6. Closure/Self-Assessment:*** Individually, each student will self-assess

	probing questions and discuss components of the rubric for the PBL Case product. The teacher will record level of mastery of the standard demonstrated by the product thus far (adequate, proficient, expert)	their learning through a written summary which details how their individual contributions furthered the group's effort in addition to a reflection of learning. Students will provide evidence of their efforts.
5	***Group Conferencing/Feedback:*** Throughout the lab, the role of the teacher is facilitative. The teacher will conference with each group asking leading questions about the video, the results expected, and the connection to dangerous driving. Teacher will provide feedback and assist students in setting scaffolded learning goals.	***1. Summative Assessment:*** Students will take summative assessment. ***2. PBL Case:*** **Resolve:** Students will continue to refine their report and presentation based on the feedback received. 4. ***Closure/Group-assessment:*** Groups will meet for group self-assessment and score their presentation on final rubric. Each score be supported using the claim-evidence-reason framework.
6	2. The presentation cycle for each group will include: a) Group solution presentation, b) Open forum clarifying questions , c) Open forum probing questions, d) Community member feedback ***4. PBL Case: Resolve:*** After all presentations are finished, teacher will facilitate a **debrief of the problem**.	***1. PBL Case:*** **Resolve:** Student groups will **present the solution** to the case. 3. As groups present, all audience members, teachers, students, and community members will write down key points and questions. All participants will have the opportunity to ask follow up questions after each presentation. ***5. Closure:*** After group debrief, students will incorporate synthesis of learning experience into individual self-assessment.

Summative Assessment Items: *Attach here.* For each summative assessment item, include an answer key or scoring rubric describing how points are to be awarded.

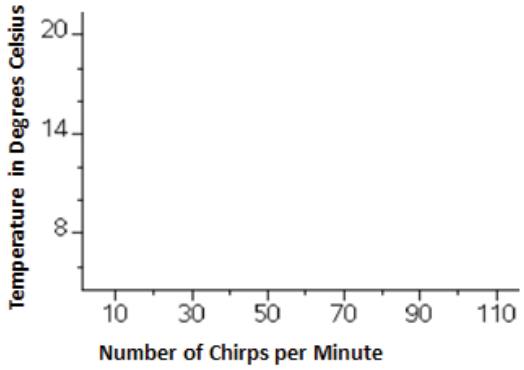
Type I:

Crickets are known to chirp faster when the temperature is higher. Here are some measurements made at different temperatures.

Temperature Based on Chirps

Number of Chirps Per Minute	Temperature in Degrees Celsius
11	6
29	8
47	10
75	15
107	20

1. Graph the following informaiton on the scatter plot below.



2. Draw a trend line and describe the closeness of its fit.

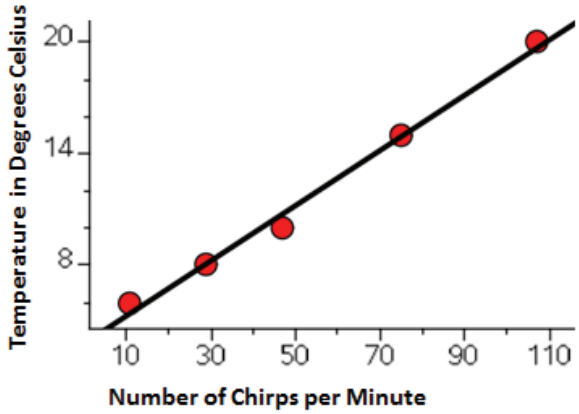
SOLUTION

Scoring: This item represents a level 2 mastery of the standard. To achieve this level, students must answer 80% or more of the questions correctly. The student must demonstrate:

Student can sketch a line though the "center" of the cloud of the points that captures the essential nature of the trend.

Student can judge how well the line "fits" the cloud of points by examining how closely the points are packed around the line

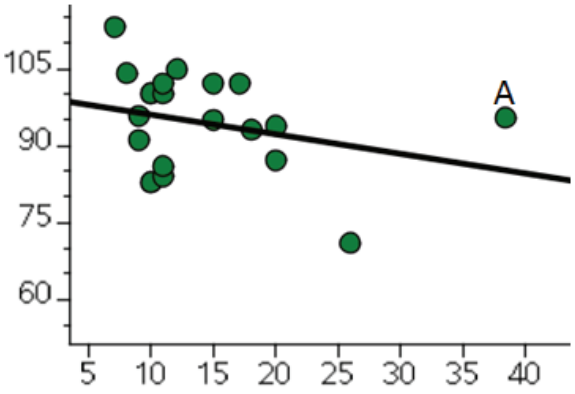
1.



2. Student describes positioning the line in the middle of the cloud of data. As well, student describes how the fit of the line is judged by how closely points are packed aroudn the line. In this case, the line captures the data very well because all points are either very close or on the line.

Type II:

Use the scatter plot to answer the questions below.



1. Describe how well the line of best fit captures the data.

3. Plot the line of best fit without point *A*. How did the elimination of this point affect the line of best fit?

4. If the *x*-axis is labeled "Age" and the *y*-axis is labeled "Score", what relationship between the two variables does the best fit line represent?

SOLUTION

Scoring: This item represents a level 3 mastery of the standard. To achieve this level, students must answer 80% or more of the questions correctly. The student must demonstrate:

Student can test how one or more outliers might have tremendous influence on the positioning of the line.

1. The line of best fit does not capture the data very well because most data points are not on or near the line.

2. The elimination of point *A* would have a large effect on the line of best fit because it is an extreme point (outlier) that does not exhibit the negative correlation trend represented by the rest of the data.

3. The relationship shows a negative correlation. Overall, as age increases, score decreases.

Type III:

Write a short essay in IMRAD form answer the following question: *What is the nature of obesity in the United States and how will it affect the future of America?* Use the table and info graphic to provide evidence for your argument. The essay will be scored based on the criteria addressed in the attached rubric.

Prevalence of Obesity Amongst U.S. adults aged 20-74

Year	Percentage of Population Identified as Obese
1994	22.9
1999	30.5
2001	30.5
2003	32.2
2005	34.3
2007	33.7
2009	35.7

Data Source: National Center for Health Statistics

RUBRIC:[1]

Essay Component	Level 2 (Adequate)	Level 3 (Proficient)	Level 4 (Expert)
Introduction			
Methods **Research**	Student can sketch a line though the "center" of the cloud of the points that captures the essential nature of the trend.		
Analysis	Student can judge how well the line "fits" the cloud of points by examining how closely the points are packed around the line.	Student can test how one or more outliers might have tremendous influence on the positioning of the line.	
Discussion			Student applies relationship exhibited from data to real world situation.

[1] Each criterion corresponds to a particular level of mastery on the standard. The rubric is cumulative, meaning that students must show mastery of both level 2 and level 3 criteria to score "Proficient" on the standard. Grey blocks indicate criterion not relevant to standard 8.SP.2