Curriculum Sample Template
Max. 8 Pages

Grade Level	7	**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 recognize that it is difficult to gather statistics on an entire population. Students understand how to obtain a random sample and understand that a random sample can be representative of the total population and will generate valid results. Students use this information to draw inferences from data. A random sample must be used in conjunction with the population to get accuracy. For example, a random sample of elementary students cannot be used to give a survey about the prom**.**		
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.*	7.SP.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.		
Materials/Resources Needed	"Dog DNA" http://teach.genetics.utah.edu/content/begin/traits/traitsrecipe.pdf "Determine an Appropriate Sample Size" http://toolkit.pellinstitute.org/evaluation-guide/collect-data/determine-appropriate-sample-size/ "Gone Fishing" http://www.ehow.com/list_6547961_population-sampling-activities-middle-school.html		

* ***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 might the sample of a survey affect the results of a survey? ***2. Launch/Introduction:*** **The Case:** You are a doctor at a local children's hospital. You overhear two groups of parents having a excited discussion about new advances in scientific knowledge of the human genome and the possibility to modify and change genes. The ability of parents to one day "design" their baby could well be possible in the near future. You recognize the developing technologies of genetic alteration open what could result in so-called "designer babies." As a doctor, you are not sure how to advise your patients' families. Knowing that this technology could potentially irreversibly alter the human species, you wonder: should parents be allowed to create their babies? Your task is to present the topic to a group of parents and ... Use both research and data analysis to answer the question: **Should parents be allowed to create their babies?**[1] Your challenge is to conduct independent research one inherited characteristic as a case study. Your team will design a surveying process to collect data on both the frequency of the characteristic within the actual population and the desire for the characteristic within the population. ***4. Vocabulary:*** Student Glossary Graphic Organizer of Tier 2 academic) and Tier 3 (content) vocabulary. "Term, Definition, Example." Multiple samples, simulated samples, predict and gauge, variation, random samples, inference, prediction, data, event, population, sampling error. ***6. Debrief/Summarize:*** The teacher will use questions to guide a discussion about the appropriate sample size based on students'	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. Each group will then identify one inherited trait to investigate. 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:*** Using the "Neighborhood Poll" Gizmo, students will conduct a phone poll of citizens in a small neighborhood to determine their response to a yes-or-no question and use the results to estimate the sentiment of the entire population. Students will *model with mathematics* and investigate how the error of this estimate becomes smaller as more people are polled. The facilitator will ensure students observe the following: ***7. Differentiation/Additional Exploration:*** Students will read the article "Determine an Appropriate Sample Size", which describes four questions researchers should consider when determining a representative sample size. ***8. Reflection/Closure:*** How can one determine an appropriate sample size when asking a statistical question about a defined population? ***Formative Assessment:*** Given the following scenario, students will determine an appropriate sample size and justify their answer. "A school has 800 students: 214 seventh graders, 107 eighth graders, 145 ninth graders, 126 tenth graders, and 108 eleventh graders. A sample of 100 students is to be taken. How many

[1] http://www.cnn.com/2008/TECH/science/10/30/designer.babies/

	experience with the Gizmo. By posing other scenarios with different population sizes, the teacher will ensure the following learning target is generalized: 1) *a larger sample allows for a more accurate examination of whatever is being tested and 2) student can identify an appropriate sample size.*	students in each year should be tested?" ***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	2. Teacher will guide a discussion about student observations and graph the data from each group as a dot plot. The teacher will ask probing questions about the distribution of the data, particularly about its center and spread. As well, students will be asked to consider the sample size and determine how a bigger or smaller sample size would affect the distribution of data. The concepts of sample and population will be defined. ***4. Debrief/Summarize:*** The teacher will guide the class in a whole group discussion; students will present their observations. *Students will look for and make use of structure.* Through comparison, students will understand the impact of sample size has on statistical measures. The teacher will ensure the following learning targets are formalized: *student can describe the variation in estimates or predictions based on multiple samples of the same data.* 9. Throughout the PBL casework, the role of the teacher is facilitative. The teacher will actively conference with groups, make observations, help students with group dynamic issues if needed, ask probing questions and/or direct towards further resources. 10. Teacher will assign students the task of administering the "If You Could Choose" inventory to two more people and draw their characteristics on two more index cards. This will increase the population for the following day's sampling activity.	***1. Stimulus:*** Students will individually fill in the "Inventory of My Traits" survey, which asks students to select those traits that they personally exhibit. Then, students will complete the "If You Could Choose" inventory of inherited traits. Students will draw a picture of a person with all of the traits on a 3 x 5 inch index card. Each group will construct a frequency table for each trait and represent the data as a bar graph. ***3. Investigate/Explore:*** Students will use the "Dog DNA" activity to create a population of dogs with various attributes. In groups, students will use data on an attribute for the entire population and then draw samples of different sizes from that population. Each time they draw a sample, students will record a statistic about the attribute, such as the mean. Students will compare the mean of the sample with the mean of the population. They will then repeat this process varying the sample size (3, 5, 10) and notice the difference between the population mean and the sample mean when the sample size is kept constant and when it is changed. ***5. Reflection/Closure:*** What causes sampling error in a statistical study? ***7. Formative Assessment:*** Given a large bank of data, students will generate multiple samples of the same size and describe the variation of these estimates. Students will then compare/contrast the mean of the samples to the actual population. ***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	***2. Presentation/Direct Instruction:*** The teacher will present on how inherited traits are genetically determined and the existence of dominant and recessive traits. ***3. Debrief/Summarize:*** The teacher will guide the class to share their observations and graph the data from each group as a dot plot. The teacher will define the concept of statistical inference and ask probing questions about what inferences can be draw about various populations (class, school, family, community, Phoenix, Arizona, etc.) based on the data collected. *Students will construct viable arguments and critique the reasoning of others* as they analyze and interpret the data to make inferences about unknown characteristics of the specified population. The teacher will ensure the following learning target is formalized: *student can make inferences about a population based on a sample.* 5. Throughout the PBL casework, the role of the teacher is facilitative. The teacher will actively conference with groups, make observations, help students with group dynamic issues if needed, ask probing questions and/or direct towards further resources. 8. ***Debrief/Summarize:*** By obtaining multiple samples of the same size for a given populaiton, students have observed variability and differences in estimates of measures of central tendency. The teacher will guide groups to share their observations. The teacher will ensure the following learning target is formalized: *student can generate multiple samples (or simulated samples) of the same size to determine the variation in estimates or predictions by comparing and contrasting data samples.*	***1. Explore/Investigate:*** Students will use the additional data collected from the previous night's homework to create a revised dot plot. Students will discuss how an increase in population size affected the data and the appropriate sample size needed to represent the population. Students will also debate the randomness of the data collection process. ***4. 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. ***6. Investigate/Explore:*** Through the "Introduction to Capture-Recapture" activity, students will simulate the release and capture population sampling technique by capturing, tagging and counting the fish population in a pond using pretzels and goldfish. Students will *model with mathematics* and consider the following: how the actual percentage of tagged fish compared to the estimate and how this process is a technique to estimate the size of a population. ***7. Differentiation/Additional Exploration:*** **U**sing "The Great Fish Pond" application, students will run a guided digital simulation of the capture-recapture technique. ***8. Formative Assessment:*** Given data from a capture and release scenario, students will determine the variation in estimates of the population size and make inferences based on the sample.
4	2. Teacher will review the product expectations/rubric for the PBL case.	***1. Stimulus:*** Using class data about eye-color and handedness, students will define the population and draw inferences about these two characteristics. Students will then compare/contrast class

	3. 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 probing questions and discuss components of the rubric. The teacher will record level of mastery of the standard demonstrated by the product thus far (adequate, proficient, expert)	data to national data about these two characteristics and discuss variation . ***3. PBL Case:*** **Resolve:** Student groups will **determine the best fit solution** to the case and draft their report. Students will send their draft to a local doctor for feedback. ***4. Closure/Self-Assessment:*** Individually, each student will self-assess 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	3. Throughout the revision/completion process, 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.	***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 must be supported with clear evidence.
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 ***3. 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. 2. 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. ***4. 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:

1. Sample size defines the number of people or animals participating in the study, or how many repetitions of the experiment should take place in order to obtain substantial findings to help answer research questions.

Consider the following study:

Laura performs a study of transportation behaviors to find out what percentage of college students in Phoenix, Arizona take the bus to campus. Laura decides to conduct a survey at the front gates of Phoenix College, which has a population of 20,000 students. Her study includes a sample size of 10 people and those 10 people all walk, bicycle or drive to school. Laura infers that college students in Phoenix do not take the bus.

1. What are some issues with the design of Laura's study? Describe how each of these design issues could be avoided or minimized.

2. Describe and defend an appropriate sample size for this study.

SOLUTION

1. Laura's sample size is too small to represent the population of college students. As well, her sample may be biased since all survey participants were selected from the same site. To minimize the issue of underrepresentation and sample bias, Laura should increase her sample size and be sure to conduct her survey at multiple locations or at a location not correlated to mode of transportation (i.e. a classroom). She could also use different mediums such as in person, Facebook and mailed letters to conduct her survey.

2. Student answers will vary as appropriate sample sizes depend on the context of the survey (time/resources available and the level of accuracy needed).

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 identify an appropriate sample size.

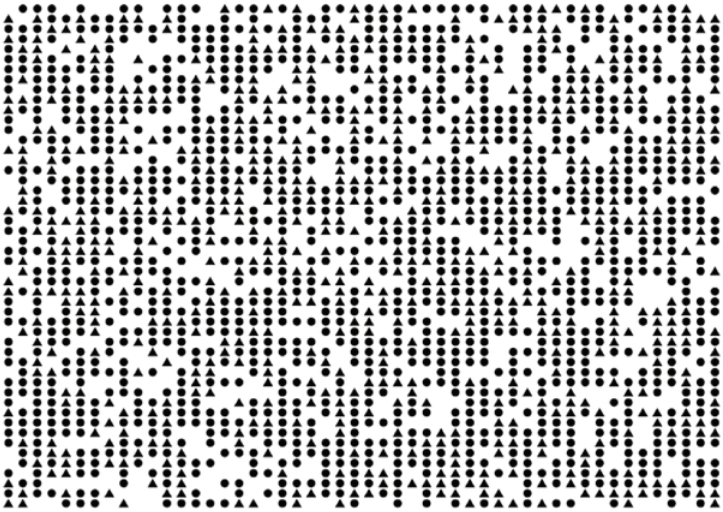
Type II:

1. Students asked 10 of their peers their favorite music. The results are shown below:
   Students 1: 4 Pop, 6 Country,
   Student 2: 1 Pop, 9 Country,
   Student 3: 6 Pop, 4 Country.

What would student 1 say about the proportion of students who prefer Pop? If, in fact,75% of the student body prefers Pop, what is the error in each student's estimate?

2. Given the first name of all students in your grade. Predict the most common name in the U.S. for 7th graders. How good an estimate do you think your sample provides? Explain your reasoning.

3. The diagram on the right some trees in a tree farm. The circles show old trees and the triangles show young trees. Tom wants to know how many trees there are of each type, but says it would take too long counting them all, one-by-one.



A. What method could he use to estimate the number of trees of each type? Provide a step-by-step explanation of your method.

B. Collect 5 random same size samples. Record the data from each sample below.

C. Estimate the number of:
(a) Old trees
(b) Young trees

SOLUTION

1. Student 1 would say 40% (4/10) students prefer Pop. If 75% of the student body actually prefers Pop, then the error estimate for each student would be as follows: Student 1: 35%, Student 2: 65%, and Student 3: 15%.

2. Answers may vary. Students should pick a common name amongst their classmates and then discuss why or why not the sample used to pick the name is representative of the population of all 7th graders in the U.S.

3. Though answers may vary, students will determine a sample of the population.
A. One method could be to divide the diagram into a 10 x 10 grid. Count and record the number of old and young trees in this square. Another method could be for students to close their eyes and mark ten spots with a highlighter and record the results.
B. Students will record the data from 5 samples.
C. Students will take the mean of the 5 samples and consider the ratio of sample to population to estimate the number of old and young trees.

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 make inferences about a population based on a sample.

Student can describe the variation in estimates or predictions based on multiple samples of the same data.

Type III:

You just received your scores on the PARCC exam, but would like to compare your scores to those of the student body. Use the Excel file titled "PARCC 2014" to answer the following questions:

1. What is the population's means score?

2. Use the *Data Analysis* tool in Excel to display the entire data set's histogram.

3. Use the *Sampling* function to generate 10 random samples of sizes 100, 10, and 5.Calculate the mean for each random sample and display the data in the table below.

Sample Mean PARCC Score

Sample Size / Sample #	100	10	5
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

4. Describe the variation amongst the means for each sample size. Which sample size demonstrates the most variation? Which demonstrates the least?

5. How does sample size affect the accuracy of a statistical study?

SOLUTION

Student answers may vary based on samples, however, students should note that the mean for the random samples of size 100 have less variation and are closer to the population mean of 489.34 than when sample of size 10 or 5 random samples were taken.

Scoring: This item represents a level 4 mastery of the standard. To achieve this level, students must answer 80% or more of the questions correctly. The student must demonstrate:

Student can generate multiple samples (or simulated samples) of the same size to determine the variation in estimates or predictions by comparing and contrasting data samples.