Grade Level	7	**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 conduct a survey. Students understand what makes a random sample representative of a population. Students have learned why it is necessary to use random sampling when analyzing a large population.		
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.*	**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.		
Materials/Resources Needed	Lesson 1: about 150 different-colored cubes such as Snap Cubes, math linking cubes or centimeter cubes, an opaque container (or a clear container wrapped in paper) large enough to hold all the cubes Lesson 2: dry erase markers, 5 burlap bags, 50 pencil top erasers of 3 different colors, 100 jelly beans of 3 different colors, 150 small dots of 4 different colors, 100 coins of 3 different denominations, 50 golf balls from 3 different makers		

* ***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:** Call on students to respond to the following questions regarding prior knowledge. 1. What makes a random sample representative of the population? 2. Should it be a diverse representation? 3. Is a smaller sample or larger sample better to reduce variability of the results? 4. What makes random samples the best samples? 5. Should random sample items be chosen by chance? 6. Should random sample items have the same probability of being selected for the sample? 7. Why is it necessary to use random sampling when analyzing a large population?	**Review:** Answer review questions.
	Vocabulary: Explain to students that an <u>inference</u> is the act of passing from statistical sample data to generalizations (predictions or inferences) usually with calculated degrees of certainty. For example, a bathtub is filled with coins and covered to obstruct view. 100 coins are pulled from the bathtub. 82 of them are dimes. One could make an inference that the bathtub contains mostly dimes, "with a calculated degree of certainty." Conversely, if 34 were pennies, 33 were dimes and 33 are nickels, one cannot infer that there are more pennies than any other type of coin in the bathtub because the difference between the different types of coins is so small and does not provide a "degree of certainty." Ask students questions to check for understanding of the vocab term inference and the requirement of a degree of certainty. Ask students for synonyms.	**Vocabulary:** Ask clarifying questions about vocabulary word "inference". Respond to questions on how inferences require a degree of certainty based on significant difference amongst data from the sample. Students provide synonyms for the term inference. Ie) Prediction, generalization, inductive reasoning
	Introduction: 1. Present a wrapped container to students and inform students that different-colored cubes are in the container and that I know how many of each color there are. Explain that ALL the cubes represent the population. 2. Tell students they will be paired with a partner and that as a pair they will select 15 cubes from the container (without looking inside). The selected cubes represent the sample. 3. Inform students that they will be counting and recording the	

	numbers and colors of the cubes they selected and then returning the cubes to the container. 4. Tell students the container will be shaken and the next group will select their 15 cubes and that this process will continue until all pairs have selected and recorded the numbers and colors of the cubes they selected. 5. Instruct students that after they have selected and recorded their results, they are to analyze their data and make predictions (inferences) about the numbers of colored cubes in the container. Tell students the total number of cubes in the container and the total number of different colored cubes will be presented at the end for a discussion related to their predictions and inferences. **Demonstration:** 1. Model selecting different colored cubes from container without looking inside. 2. Count and record colors and numbers of cubes selected. 3. Place cubes back into the container. 4. Remind students they will be analyzing their data and making predictions or inferences about the numbers of different-colored cubes in the container. **Warm Up:** 1. Pass wrapped container around to students. 2. Ask students to shake container and make prediction of how many cubes are in the container. 3. Ask them if it is possible to infer, at this point, the colors of the cubes in the container (obviously it is not).	**Warm Up:** 1. Pass container around to classmates. 2. Predict how many cubes are in the container. 3. Infer, if possible, the colors of the cubes in the container. **Interaction:** 1. Select 15 colored cubes from the container without looking inside. 2. Count and record the numbers and colors of the cubes they selected. For example, they might have picked 4 red, 6 blue, and 5 white. Students return cubes to the container. 3. Analyze their data and make predictions (inferences) about the numbers of different-colored cubes in the container. For example, if a pair of students selected 4 white cubes, 7 red cubes, and 3 blue cubes, they may conclude that half of the cubes in the container are red. They may also conclude (infer) that there are only three different-colored cubes in the container. 4. Write their random sample data on the board as well as their inferences.

	Wrap Up: 1. Ask students to write their random sample data results on the board along with their inferences. 2. Ask students to enter into a discussion on whose inferences are believed to be most accurate and whose might need improvement, if any. 3. Reveal to students the total number of cubes in the container and the numbers of each different-colored cube. 4. Discuss how and why the inferences of the students may have varied. **Independent Practice**: Instruct students to write a summary describing this experiment in terms of population and random samples and how the student inferences written on the board varied (or did not vary).	5. Discuss inferences made by classmates relative to their own inferences and who might be more accurate. 6. Write a summary describing the experiment in terms of population and random samples. **Wrap Up:** 1. Write random sample data results (15 cubes and color types) on board with inferences. 2. Discuss whose inferences are believed to be most accurate and whose might need improvement, if any. **Independent Practice**: Write a summary describing this experiment in terms of population and random samples and how the student inferences written on the board varied (or did not vary).
2	**Review:** 1. Arrange students' desks in a circle. Ask students to take out their summaries they wrote for homework. 2. Facilitate a discussion with the following questions from student summary homework assignment. 3. Ask students to gauge the variations of the inferences. 4. Were the inferences varied? Why or why not? 5. Was the random sample size of cubes chosen (15 cubes) large enough? 6. If the random sample was larger, (say 30 cubes) would the results have likely been more or less similar to the actual population (150 cubes)? 7. If the sample size was smaller (5 cubes) what would happen to the variability of the inferences? **Introduction:** 1. Explain to class that there are 5 burlap bags with different objects inside them on 5 desks around the room. a. Bag 1: 50 pencil top erasers with 5 different colors b. Bag 2: 100 jelly beans of 3 different colors c. Bag 3: 150 small plastic dots of 4 different colors d. Bag 4: 100 coins of 3 different denominations (pennies, nickels,	**Review:** Students sit at desks in a circle will raise their hand and respond when called on to answer review questions in response to summaries written for homework. **Introduction:** Ask teacher clarifying questions about expectations for activity being explained or respond to questions that check for understanding posed to students by teacher to ensure expectations are understood.

	dimes) e. Bag 5: 50 golf balls from 3 different makers 2. Explain to students that teacher knows actual numbers of each color, denomination of maker of each object in each bag. 3. Organize students into 5 different groups. 4. Place 1 group at each desk and instruct each group to pull 20 objects (random sample) from each bag (whole bag of objects represents population). 5. Instruct students to categorize the data from their random sample based on number of colors, denominations, or makers. 6. After random samples have been taken from all bags, instruct students within each group to work together to analyze their data and make inferences as a group about the total number of each color, denomination or maker of objects in each bag. **Demonstration:** 1. Use a sample burlap bag with 100 paper clips of 3 different colors. 2. Draw random sample of 20 paper clips and write down how many of each color selected. 3. Make two inferences based on the data. 4. Share the inferences with students so that students have had this activity modeled for them. **Interaction:** Provide assistance to groups by answering questions and making sure each group rotates to all burlap sacks.	**Demonstration:** Students ask any questions necessary to ensure clarity. **Interaction:** 1. In groups, move around the room taking random samples from five stations. 2. Pull random samples of objects from burlap bags and write down data according to numbers of colors. 3. Analyze data gathered to make two inferences about numbers of colors in each bag. 4. Write group inferences on the board (one student each group). 5. Students will return to their desks in a circle to discuss results (inferences).

	Wrap Up: 1. Facilitate a discussion of the results of the inferences made by groups on the board. 2. Ask the following questions to guide discussion: a. Is their variance amongst the inferences made? b. Why are the variances between group inferences slight or great? (Variance should only be slight as sample sizes are large enough to show adequate representations of population, barring an anomaly). c. How could your group make inferences even more accurate? (Select a larger random sample.) 3. Share actual numbers of each color, denomination and maker for each object from each burlap bag. d. How close are inferences to actual? e. What would make a group's inferences more accurate to the actual?	**Wrap Up:** Respond to teacher facilitated questions.

Summative Assessment Items:

1. An inference is most similar to a/an _____.
   A. statement that is proven
   B. wild guess
   C. prediction based on evidence
   D. emotion
2. A random sample of 300 fish caught in a lake yields the follow data:
   Trout-125
   Whitefish-130
   Walley-45
   Which inference is most valid?
   A. There are more trout and whitefish in the lake than walleye.
   B. There are close to 2,000 fish in the lake.
   C. Walleye swim at deeper depths.
   D. Trout are the largest fish in the lake.

3. Why is it not necessarily accurate to infer from the fish data in the above question that whitefish are the most common fish in the lake.
    A. Because whitefish are not the most numerous.
    B. Because walleye are likely more numerous.
    C. The difference between the number of whitefish and walleye is not significantly large enough.
    D. The difference between the number of whitefish and trout is not significantly large enough.
4. Multiple samples of the same size will help gauge _____ in predictions or estimates.
    A. percentages
    B. variances
    C. times
    D. populations
5. Inferences made from the fish data would most likely improve in their accuracy if _____
    A. the random sample size was smaller.
    B. there were more different types of fish included in the random sample.
    C. the random sample size was larger.
    D. the lake was larger.

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

1. C
2. A
3. C
4. B
5. C