1. If we wish to compare the average PSAT scores of boys and girls taking AP* Statistics at this high school, which would be the best way to gather these data?
   A) census         B) SRS         C) stratified sample
   D) observational study       E) experiment

2. A factory has 20 assembly lines producing a popular toy. To inspect a representative sample of 100 toys, quality control staff randomly selected 5 toys from each line’s output. Was this a simple random sample?
   A) Yes, because the toys were selected at random.
   B) Yes, because each toy produced had an equal chance to be selected.
   C) Yes, because a stratified sample is a type of simple random sample.
   D) No, because not all combinations of 100 toys could have been chosen.
   E) No, because toys do not come off the assembly line at random.

3. Which is true about sampling?
   I. An attempt to take a census will always result in less bias than sampling.
   II. Sampling error is usually reduced when the sample size is larger.
   III. Sampling error is the result of random variations and is always present.
   A) I only        B) II only       C) III only        D) II and III       E) all three

4. The owner of a car dealership planned to develop strategies to increase sales. He hoped to learn the reasons why many people who visit his car lot do not eventually buy a car from him. For one month he asked his sales staff to keep a list of the names and addresses of everyone who came in to test drive a car. At the end of the month he sent surveys to the people who did not buy the car, asking them why. About one third of them returned the survey, with 44% of those indicating that they found a lower price elsewhere. Which is true?
   I. The population of interest is all potential car buyers.
   II. This survey design suffered from non-response bias.
   III. Because it comes from a sample 44% is a parameter, not a statistic.
   A) I only        B) II only       C) I and II only       D) II and III only      E) I, II, and III

5. Does regular exercise decrease the risk of cancer? A researcher finds 200 women over 50 who exercise regularly, pairs each with a woman who has a similar medical history but does not exercise, then follows the subjects for 10 years to see which group develops more cancer. This is a
   A) survey       B) retrospective study       C) prospective study
   D) randomized experiment       E) matched experiment

6. Which is important in designing a good experiment?
   I. Randomization in assigning subjects to treatments.
   II. Control of potentially confounding variables.
   III. Replication of the experiment on a sufficient number of subjects.
   A) I only       B) I and II       C) I and III       D) II and III       E) all three

7. Can watching a movie temporarily raise your pulse rate? Researchers have 50 volunteers check their pulse rates. Then they watch an action film, after which they take check their pulse rates once more. Which aspect of experimentation is present in this research?
   A) a placebo       B) blinding       C) randomization
   D) a control group       E) none of these

8. In an experiment the primary purpose of blocking is to reduce
9. To check the effect of cold temperatures on the battery’s ability to start a car researchers purchased a battery from Sears and one from NAPA. They disabled a car so it would not start, put the car in a warm garage, and installed the Sears battery. They tried to start the car repeatedly, keeping track of the total time that elapsed before the battery could no longer turn the engine over. Then they moved the car outdoors where the temperature was below zero. After the car had chilled there for several hours the researchers installed the NAPA battery and repeated the test. Is this a good experimental design?
   A. Yes
   B. No, because the car and the batteries were not chosen at random.
   C. No, because they should have tested other brands of batteries, too.
   D. No, because they should have tested more temperatures.
   E. No, because temperature is confounded by brand.

10. Twenty dogs and 20 cats were subjects in an experiment to test the effectiveness of a new flea control chemical. Ten of the dogs were randomly assigned to an experimental group that wore a collar containing the chemical, while the others wore a similar collar without the chemical. The same was done with the cats. After 30 days veterinarians were asked to inspect the animals for fleas and evidence of flea bites. This experiment is…
   A) completely randomized with one factor: the type of collar
   B) completely randomized with one factor: the species of animal
   C) randomized block, blocked by species
   D) randomized block, blocked by type of collar
   E) completely randomized with two factors

11. Public opinion A member of the City Council has proposed a resolution opposing construction of a new state prison there. The council members decide they want to assess public opinion before they vote on this resolution. Below are some of the methods that are proposed to sample local residents to determine the level of public support for the resolution. Match each with one of the listed sampling techniques.
   a) Place an announcement in the newspaper asking people to call their council representatives to register their opinions. Council members will tally the calls they receive.
   b) Have each council member survey 50 friends, neighbors, or co-workers.
   c) Have the Board of Elections assign each voter a number, 400 of them using a random number table.
   d) Go to a downtown street corner, a grocery store, and a mall; interview 100 typical shoppers at each location.
   e) Randomly pick 50 voters from each election district.
   f) Call every 500th person in the phone book.
   g) Randomly pick several city blocks, then randomly pick 10 residents from each block.
   h) Randomly select several city blocks; interview all the adults living on each block.

12. Telephone poll The City Council decides to conduct a telephone poll. Pollsters ask a carefully chosen random sample of adults this question: “Do you favor the construction of a new prison to deal with the high level of violent crime in our State?” In what way might the proportion of “Yes” answers fail to accurately reflect true public opinion? Explain briefly. What kind of bias is this?
13. **M&Ms** The Mars candy company starts a marketing campaign that puts a plastic game piece in each bag of M&Ms. 25% of the pieces show the letter “M”, 10% show the symbol “&”, and the rest just say “Try again”. When you collect a set of three symbols “M”, “&”, and “M” you can turn them in for a free bag of candy. About how many bags will a consumer have to buy to get a free one? Use a simulation to find out.
   a. Explain how you will use the random numbers listed below to conduct your simulation.

   b. Carefully label your simulation for 2 trials.

<table>
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<td>4 8 3 2 4 7 7 9 2 8 3 1 2 4 9 6 4 7 1 0 0 2 2 9 5</td>
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   c. State your conclusion.

14. **Preservative** Leather furniture used in public places can fade, crack, and deteriorate rapidly. An airport manager wants to see if a leather preservative spray can make the furniture look good longer. He buys eight new leather chairs and places them in the waiting area, four near the south-facing windows and the other four set back from the windows as shown. He assigned the chairs randomly to these spots.
   a. Use the random numbers given to decide which chairs to spray. Explain your method clearly.
      3 2 2 1 9 0 0 5 9 7 8 6 3 7 4

   b. Briefly explain why your assignment strategy is important in helping the manager assess the effectiveness of the leather preservative.
15. **Candy packaging** Marketing researchers wonder if the color and type of a candy’s packaging may influence sales of the candy. They manufacture test packages for chocolate mints in three colors (white, green, and silver) and three types (box, bag, and roll). Suspecting that sales may depend on a combination of package color and type, the researchers prepare nine different packages, then market them for several weeks in convenience stores in various locations. In this experiment.

   a. what are the experimental units? ____________________  
   b. how many factors are there? _______  
   c. how many treatments are there? _______  
   d. what is the response variable? ____________________

16. **Aggressiveness** A recent study evaluated elementary age children for aggressiveness. This study found that the children who played video games were more likely to engage in aggressive or violent play at school. The researchers said the difference was statistically significant.

   a. Briefly explain what “statistically significant” means in this context.

   b. The news media reported that this study proved that playing computer games causes children to be aggressive or violent. Briefly explain why this conclusion is not justified.

   c. But perhaps it is true. We wonder if playing computer games can lead to aggressive or violent behavior in elementary school children. We find 50 young children whose families volunteer to participate in our research. Design an appropriate experiment. (You need not explain how to randomize.)
1. Which of these is not an advantage of using a stratified sample instead of a simple random sample?
   A) the stratified random sample allows you to get information about each stratum
   B) the stratified sample reduces bias
   C) the stratified sample reduces sample to sample variability
   D) the stratified sample allows you to get more reliable estimates using the same sample size
   E) the stratified sample eliminates the need for randomization

2. The principal of a small elementary school wants to select a simple random sample of 24 students. The school has 12 classrooms with 18 students in each class. She decides to randomly select two students from each classroom. Is this a simple random sample?
   A) No, because not all combinations of 24 students could have been chosen.
   B) No, because each student did not have an equal chance of being selected.
   C) Yes, because a stratified sample is a type of simple random sample.
   D) Yes, because the students were selected at random.
   E) Yes, because each student had an equal chance to be selected.

3. Which is true about randomized experiments?
   I. Randomization reduces the effects of confounding variables.
   II. Random assignment of treatments allows results to be generalized to the larger population.
   III. Blocking can be used to reduce the within-treatment variability.
   A) I only B) II only C) III only D) I and III E) all three

4. A school district administrator sent a survey to all teachers in the district. Only 30% of the teachers responded to the survey. Which of the following is true?
   I. The people that did not respond are likely to be similar to those that did so he should use them as the sample.
   II. This survey design suffered from non-response bias.
   III. Because he sent the survey to everyone, this is a census and the results can be applied to the whole population.
   A) I only B) II only C) I and II only D) II and III only E) I, II, and III

5. Does Procellera® Antimicrobial Wound Dressing help injuries heal faster? Researchers checked records of 38 patients who had been treated for acute or chronic wounds between 2010 and 2012. They found that those who had been treated with Procellera® healed almost twice as fast. This is a
   A) survey B) retrospective study C) prospective study
   D) randomized experiment E) matched experiment

6. A company has tried to improve the effectiveness of its dishwashing detergent and wants to see if it works better than the original formula. They use 6 identical new dishwashers and load them identically with dirty dishes. Three packs of each of the two types of detergent are used, and they are randomly assigned to one of the six dishwashers. After the load is run, they rate each load for overall cleanliness. Which of the following is true?
   A) The explanatory variable is the different dishwashers.
   B) The response variable is the type of detergent.
   C) Because each brand is used in three dishwashers, replication is used properly.
   D) A control group with no detergent at all is needed.
   E) Blinding is impossible in this experiment because they must be able to see the dishes.

7. In an experiment the primary purpose of blocking is to
   A) reduce the within-treatment variation. B) reduce the between-treatment variation.
   C) reduce bias. D) eliminate confounding variables.
   E) eliminate the need for random assignment of treatments.
8. A Columbia University study linked soda consumption to behavior problems in children. Researchers examined data from a previous study that followed 2929 mother-child pairs. One survey asked about behaviors of the child and also about soda consumption. They found that the more soda the kids drank, the more behavior problems they had. What aspect of a well-designed experiment is absent from this study?
A) a placebo  B) blinding  C) randomization  
D) a control group  E) all of these

9. It was discovered that a larger proportion of children who slept with nightlights later developed nearsightedness, compared to children who did not sleep with nightlights. The headlines read, “Leaving a light on for your children causes nearsightedness!” Later it was pointed out that nearsighted people have more trouble seeing in the dark and are more likely to leave lights on at night for their kids. And those same nearsighted parents are likely to have nearsighted kids. This is an example of
A) a lurking variable.  B) bias.  C) a control group.  
D) a placebo  E) a randomized block design.

10. In order to see which variety of apple tree produces more fruit, a farmer sets up an experiment. He has three plots of land with different soil and natural water availability. Each plot has room for eight trees. The farmer randomly selects four locations in each plot for the first variety of tree and the other four get the second variety. This experiment is…
A) completely randomized with one factor: the plot of land  
B) completely randomized with one factor: the variety of tree  
C) randomized block, blocked by plot of land  
D) randomized block, blocked by variety of tree  
E) completely randomized with two factors

11. **Announcements.** A high school in Wisconsin stopped having announcements read to students over the intercom system, choosing to have announcements displayed on television monitors located throughout the building. To see how students feel about the new system the principal wants to conduct a survey. Explain how to select a sample of about 500 students using each sampling method below:
a. Simple random sample

b. Stratified random sample with grade levels as strata

c. Cluster sample with classrooms as clusters
12. **Survey.** A local news station wants to know what percentage of people favor investing in new public light-rail system for the city. They conduct a survey, calling homes between 10:00 a.m. and 3:00 p.m. Explain why this sampling plan is biased.

13. **UFOs.** A National Geographic survey in 2012 found that 36% of Americans believe in aliens. (The outer-space kind, not visitors from foreign countries!) If you were to randomly select 10 Americans, what is the average number of believers you’d expect in your sample? Conduct a simulation to find out!
   a. Explain how you will use the random numbers listed below to conduct your simulation.
   b. Carefully label your simulation for 2 trials.

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   c. State your conclusion.

14. **Doors** When trying to reduce energy costs for a home, one strategy is to install high quality doors. A consumer service wants to test two brands (A and B) of doors to see which is more effective at preventing loss of heat. They have four doors of each brand they will install in a small cabin built for this purpose. The cabin has places for four doors on the north wall and four on the south wall. The inside of the cabin will be heated, and monitors will be placed outside each door to measure the amount of heat loss.

   a. Use the random numbers given to decide which doors to put in which position. Explain your method clearly.

   5 9 7 9 6  8 9 8 3 2  5 7 4 1 3

   b. Briefly explain why your assignment strategy is important in helping the manager assess the effectiveness of the doors.

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15. **Gun control** Two friends who strongly disagree on whether there should be stricter regulation of guns in this country want to conduct a poll of the students in their school to see which side most students agree with. Each came back with a different version of the question they want to ask.

Version 1: *Do you think the government should respect our 2nd Amendment rights and allow law-abiding citizens to own guns?*

Version 2: *In the wake of recent mass shootings, should laws be passed to keep guns out of the hands of people with a history of violence?*

a. Which version would make it seem like people oppose stricter gun regulation? What kind of bias is this?

b. Is the version you did not pick in part a less biased?

c. Is it reasonable for a person to respond ‘yes’ to both questions?

16. **Political math** A recent study by Yale professors found that people’s ability to do mathematics computations got worse when the result went against the person’s political ideology. This was based on a randomized experiment in which people were given the same basic computation, but some were given the question in a politically neutral context and others were given the same computation in a context in which the correct answer went against their political ideology. The difference between the proportion of people who got the question wrong in a ‘neutral’ context and those who got the question wrong in a ‘political’ context was reported to be “statistically significant.”

a. Briefly explain what “statistically significant” means in this context.

b. Would it be appropriate for the news media to report that the political context caused the poor computational results? Explain.