Name_____Period_____Assignment #_____

Testing Crystal Power

Imagine you are James Randi. How would you test the claims of the crystal energy healer?

1. What is the problem or question?

2. What is the hypothesis?

3. What treatments should be considered?

4. What are sources of error?

5. How can we control for the sources of error?

6. How will we collect data?

7. What is the probability of getting 10 right in a row by chance? **SHOW YOUR WORK!**

LAWS OF PROBABILITY

If A and B are mutually exclusive, then P (A or B) = P(A) + P(B)

If A and B are independent, then P (A and B) = P(A) x P(B)

8. Is the probability of getting 9 out of 10 equal to the probability of getting 9 in a row correct?

9. Explain your answer to the last question.

We will be simulating a test of crystal power using a coin-flip model. We will be using James Randi's rational that if crystals have power, a person ought to be able to detect whether or not a substance is a crystal without seeing it.

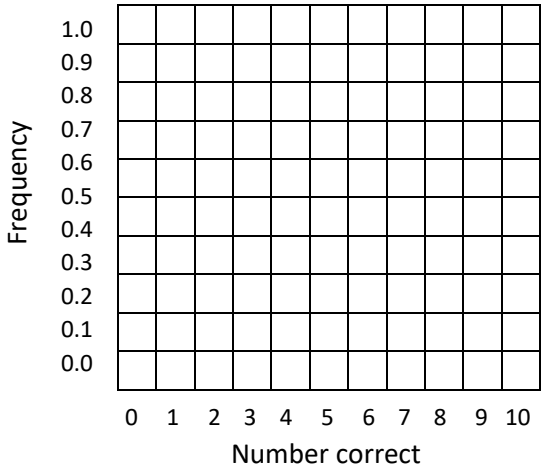
10. Sketch your prediction of the frequency distribution of the combinations of correct identifications of the crystal (heads) you would expect by chance alone for 10 attempts.

, etc.

11. What frequency would you expect to get 5 out of 10 correct by chance over multiple trials?

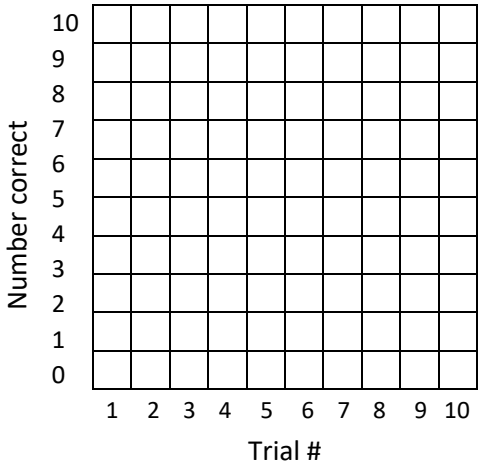
12. What number of correct responses out of 10 do you think would indicate that someone was able to detect the claimed energy of a crystal?

13. Sketch the predicted frequency distribution for number correct by chance for class data



Data Collection

14. Count the number of heads (correct responses) out of ten coins flipped (this is one trial)
15. Record as a single column bar like the one on the board



16. Write the number correct for the trial on a the provided small pink square of paper
17. Repeat steps 1-3 9 more times
18. Tape pink papers on the board
19. Calculate the mean number correct for your ten trials, write the mean on the provided small white square of paper and give to your teacher

STATISTICAL ANALYSIS AND PROBABILITY	
Standard Error	Mean
$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$ ***NOTE:*** *For the purposes of the AP Exam, students will not be asked to manipulate or derive this equation; however, they must know the underlying concepts and applications.*	$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$
Standard Deviation	Chi-Square
$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$ ***NOTE:*** *For the purposes of the AP Exam, students will not be asked to manipulate or derive this equation; however, they must know the underlying concepts and applications.*	$\chi^2 = \sum \frac{(o-e)^2}{e}$

s = sample standard deviation (i.e., the sample based estimate of the standard deviation of the population)
$\bar{x}$ = mean
n = size of the sample
o = observed individuals with observed genotype
e = expected individuals with observed genotype

Degrees of freedom equals the number of distinct possible outcomes minus one.

Show your work

$\bar{X}$=

20. Calculate the standard deviation of your 10 trials

Show your work

s =

21. Calculate the standard error of your 10 trials

Show your work

SE=

22. Fill in the table below

Trial	Number Correct	χ^2 p-value
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Class	p-value
0	0.00157
1	0.01141
2	0.05778
3	0.20590
4	0.52709
5	1.00000
6	0.52709
7	0.20590
8	0.05778
9	0.01141
10	0.00157

23. Create a box and whiskers plot of your data and the data of 3 of your classmates. **SHOW YOUR WORK!**

Rank	Sample
1	
2	
3	
4	
5	
6	
7	
8	
9	
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11	
12	
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14	
15	
16	
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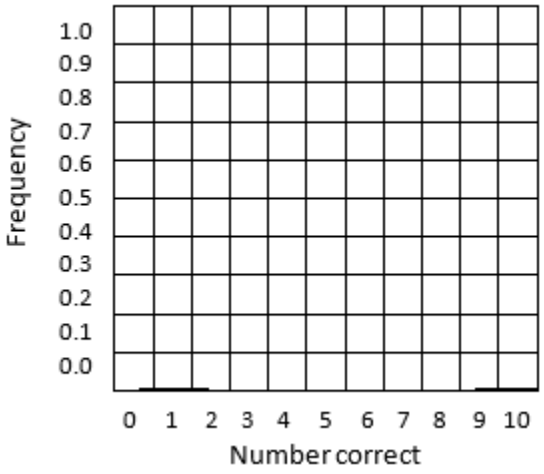
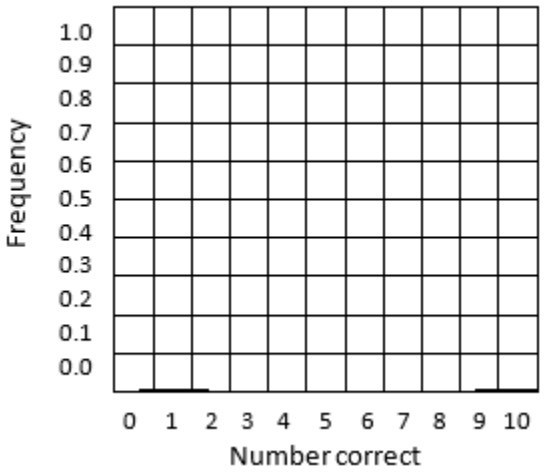
24. Sketch and label the class sample data



25. Sketch the frequency distribution of the class means



Analysis

26. What kind of distribution does the class data look like?

27. How does your prediction of the class data compare to the actual class data?

28. How does the distribution of means of the class compare to the distribution of samples for the class?

29. How does the standard error of your mean compare to the standard deviation of the means of the class compare?

30. Explain what the p-value is

31. Justify why sample size is important. A Justification has 3 components: 1) Scientific knowledge and/or theory; 2) Data from your analysis related to the knowledge; and 3) An explanation of HOW the data supports the theory or knowledge.

32. Is it practical under most circumstances to conduct multiple trials like we did in this activity?

33. Explain your answer to the question above.

34. Justify what the results of your experiment tell you about why some might believe they have evidence for crystal power. A Justification has 3 components: 1) Scientific knowledge and/or theory; 2) Data from your analysis related to the knowledge; and 3) An explanation of HOW the data supports the theory or knowledge.