Kisses are great!

When you flip a coin, it is equally likely to land on "heads" or "tails." Do plain Hershey's Kisses behave the same way? In this activity, you will toss a Hershey's Kiss several times and observe whether it comes to rest on its side (S) or on its base (B). The question you are trying to answer is: **What proportion of the time does a tossed Hershey's Kiss settle on its base?**

1. Before you begin, make a guess about what will happen. If you could toss your Hershey's Kiss over and over and over, what proportion of all tosses do you think would settle on the base? p = _______

2. Toss your Hershey's Kiss 50 times. Record the results of each toss S or B) in a table like the one shown. In the third column, calculate the proportion of base landings you have obtained so far.

Toss	Outcome	Cumulative proportion of B's
1	B	1/1 = 1.00
2	S	1/2 = 0.50
3	S	1/3 = 0.33
4	B	2/4 = 0.50
.	.	.
.	.	.
.	.	.

3. Make a scatterplot with the number of tosses on the horizontal axis and the cumulative proportion of B's on the vertical axis. Connect consecutive points with a line segment. Does the overall proportion of B's seem to be approaching a single value?

4. **SRS**: Your 50 tosses can be thought as a simple random sample from the population of all possible tosses of your Hershey's Kiss. The parameter *p* is the (unknown) population proportion of tosses that would land on the base. What is your best estimate for *p*? It's $\hat{p}$, the proportion of B's in your sample of 50 tosses. Record your value of $\hat{p}$ = ____ How does it compare to the conjecture you made in Step 1?

5. If you tossed your Hershey's Kiss 50 more times (don't do it!), would you expect to get the same value of $\hat{p}$? In Chapter 7, we learned that the values of $\hat{p}$ in repeated samples could be described by a sampling distribution. The mean of the sampling distribution $\mu_{\hat{p}}$ is equal to the population proportion *p*. How far will your sample proportion $\hat{p}$ be from the true value *p*? If the sampling distribution is approximately Normal, then the 68-95-99.7 rule tells us that about 95% of all $\hat{p}$-values will be within ____ standard deviations of *p*.

6. **Normality**: The sampling distribution of $\hat{p}$ will be approximately Normal if _______ and _______ are true. Verify the Normality condition is satisfied for your sample.

7. 10% Condition: 50 is less than _____ of the population of Hershey's Kiss tosses. Estimate the standard deviation of the sampling distribution (standard error) by computing $\sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ using your value of $\hat{p}$. This is the formula we developed in Chapter 7 but with *p* replaced by $\hat{p}$.

9. Construct the interval $\hat{p} \pm 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ based on your sample of 50 tosses and write it as an interval (______, _____) This is the *confidence interval for p (the true proportion of Hershey kisses landing on their base).*

10. Draw your confidence interval above the number line on the board. Your classmates will do the same. Do most of the intervals overlap? If so, what values are contained in all of the overlapping intervals?

11. About 95% of the time, the sample proportion $\hat{p}$ of base-landing tosses will be within two standard deviations of the actual population proportion of base-landing tosses of a Hershey's Kiss.

12. There is no way to know whether the confidence interval you constructed in Step 9 actually "catches" the true proportion p of times that your Hershey's Kiss will land on its base. What we can say is that the method you used in Step 9 will succeed in capturing the unknown population parameter about 95% of the time. The interval gives a range of plausible values for the population proportion p, the true proportion of tosses that would land on the base. Since intervals constructed in this manner will include the true proportion about 95% of the time in repeated sampling, are called 95% confidence intervals.