Hemifacial microsomia (HFM) is a term used to describe a specific type of abnormality in the development to the skull, jaw, or the ear before birth. A study published in the Journal of Craniofacial Surgery studied the effect of HFM on the left-handedness rate. Researchers were able to identify 86 people for this study each of whom had HFM. It was determined that 22 of the study participants were left-handed.

<u>Research Question</u>: Does HFM increase the rate of left-handedness compared to the rate in the general population?

| Number in Study with HFM that were Left-Handed	Left-Handedness Rate in the General Population	HFM Condition
22 out of 86	10%	

Source: Rogers, Gary F.; Sullivan, Stephen R.; Mulliken, John B.; Greene, Arin K.; Oh, Albert K.(2009). "Increased Prevalence of Left-Handedness in Hemifacial Microsomia" *Journal of Craniofacial Surgery*. March 2009.

1. Identify the following quantities on the number line below for the investigation of the research question stated above. (5 pts)

- Smallest possible value
- Largest possible value
- Location of pyramid
- Outcome from study
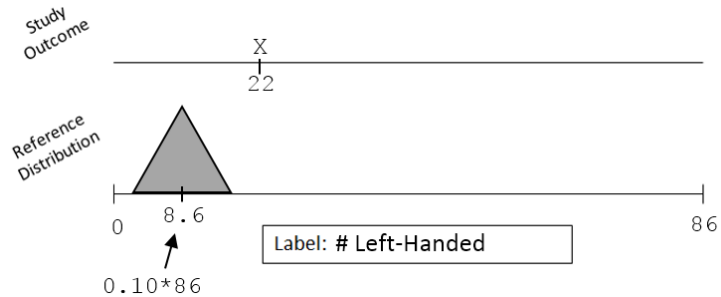
2. Next, provide details for the setup of a simulation in Tinkerplots that would allow us obtain a total of 1000 simulated outcomes to investigate the research question stated above. (3 pts)
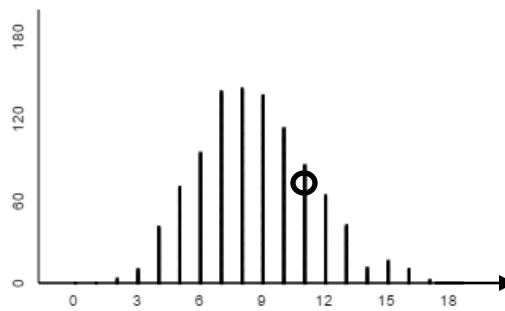
Identify the following
- Probability of heads
- Number of tosses
- Number of repetitions

Probability of heads: 0.10
Number of tosses: 86
Number of repetitions: 1000

The following graph provides the outcomes for the 1000 repeated iterations of the simulation.

3. Which of the following statements is most correct regarding the reference distribution? (3 pts)
    a. The dots on this reference distribution were constructed under the assumption that people with HFM have the same left-handedness rate as the general population.
    b. The dots on this reference distribution were constructed under the assumption that people with HFM have a greater prevalence of left-handedness because of the abnormality that developed before birth.
    c. The dots on this reference distribution were constructed under the assumption that people with HFM have a greater prevalence of left-handedness than the general population.

4. Circle a single dot on the above dotplot. Complete this sentence to explain what this single dot represents. (3 pts).

    For this particular simulated outcome, there were <u>11</u> out of a possible <u>86</u> left-handed people with HFM. This dot was generated under the assumption that <u>the left-handedness rate</u> <u>for those with HFM is the same as the general population.</u>

5. The number of people in this study that were left-handed was 22. After referring to the simulated outcomes above, do you believe 22 provides enough evidence to support the research question? Explain your reasoning. (3 pts)

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    Yes, 22 does provide enough sufficient evidence to say that left-
    handedness rate for those with HFM is higher than the general
    population. 22 is an outlier on the upper-end of our reference
    distribution which represents the pattern if the rate were the
    same as the general population.
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6. The exact left-handedness rate in the general population varies somewhat depending on the reference used. A value of 10% was reported in the above article, but others suggested that the left-handedness rate in the general population may be as high as 15%. Suppose a second simulation is conducted using the 15% instead of the 10% rate. Are we *more* or *less* likely to say 22 is an outlier in this second simulation? Explain. (3 pts)

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    If the rate in the general population were to increase to 15%
    (instead of 10%), then the reference distribution would shift
    up a little bit.  If the reference distribution were to shift
    up, then 22 would be *less* of an outlier. Thus, we'd be less
    likely to say that 22 is an outlier.
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