Logistic Growth

In logistic growth, the population has a maximum known as "capacity" determined by food or habitat. The relative sizes of population and capacity are measured by the ratio, called "saturation". As the population grows, the growth rate should slow relative to the saturation. We use the following relationship:

Saturation = (Current Population)/(Capacity)
Change in Population = (Current Population)(Base Growth Rate)(1-Saturation)

1. Build a spreadsheet model for logistic growth. Be sure to include a column for "Change in Population" so that we can follow how change varies in addition to total population. In your initial model, start with the following values:

- Initial population = 1000
- Base growth rate = 0.1 (10%)
- Capacity = 50000

Graph the population over the first 100 time periods.

Additional Questions (please use a separate tab to answer each question)

2. Introduce scroll bars for initial population, base growth rate and capacity. Explore how the graph changes as these vary.
[Note that scroll bars output integers, which is not convenient for us in this case. For instance, we might want base growth rate to vary between 0.01 and 0.20 in steps of 0.01. Use an extra reference cell to overcome this problem.]

3. For change in population, instead use the formula:

Change in Population = (Current Population)(Base Growth Rate)(1-Saturation)^k

and Introduce a scroll bar for the power parameter k, which varies from 0 to 2.

[Note that for small k, (1-Saturation) may be negative, causing problems with roots of negatives. Use the absolute value function ABS(number) to avoid errors. We want population to shrink when it exceeds capacity, so introduce a way to make sure change is negative when Saturation>1 (an IF statement perhaps?).]

4. Introduce into the model an oscillating variation in capacity.
[For example, Capacity = (Base Capacity) + Variation*sin(Time*PI()/4), where Variation is a new constant. Plot capacity on the same graph as population to observe how they affect each other.]

5. Often environmental limits aren't understood until it's too late. After period 5, use the population 5 periods earlier to determine the change in the current time period.
[Notice the effect that this causes, and investigate how the long-term result is influenced by the base growth rate. Use normal logistic growth for the first 5 periods.]