Vocab:

* Survivorship Curve – a graph showing the proportion of a population surviving to a particular age.
* Exponential Growth Curve – a graph that shows a population growing very rapidly with few (if any) limiting factors and a large amount (or unlimited) of resources
* J Curve – The type of graph seen during exponential growth.
* Logistic Growth Curve – a graph that shows a population that initially grows rapidly, but levels off its growth due to limiting factors.
* S Curve – The type of graph seen during logistic growth.
* Carrying Capacity – The number of organisms within a population that can be contained within an ecosystem
* Limiting Factor – Biotic or abiotic forces that reduce population size

**Population Dynamics**

1. Most people agree that house cats are cute. However, the statistics on cats are quite surprising. Take a look at the statistics on cats and see if you can answer the math problem below.

* A pair of cats will generally have four kittens in a litter.
* Cats generally have the same number of male and female kittens.
* Cats can have around two litters per year.
* Cats are generally mature after around 6 months

Let’s say you started with one male and one female cat. Assuming that all of the cats followed the rules that are listed above, how many cats would you have after 4 years?

**Work Space**

0 Months = 2 Mature + 4 Kittens (Immature) = 6 total cats

6 Months = 6 Mature + 12 Kittens (Immature) = 18 total cats

12 Months = 18 Mature + 36 Kittens (Immature) = 54 total cats

18 Months = 54 Mature + 108 Kittens (Immature) = 162 total cats

24 Months = 162 Mature + 324 Kittens (Immature) = 486 total cats

30 Months = 486 Mature + 972 Kittens (Immature) = 1458 total cats

36 Months = 1458 Mature + 2916 Kittens (Immature) = 4374 total cats

42 Months = 4374 Mature + 8748 Kittens (Immature) = 13122 total cats

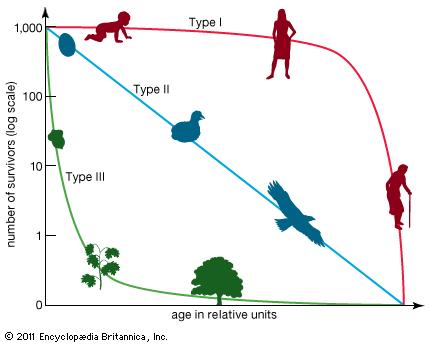
48 Months = 13122 Mature + 26244 Kittens (immature) = 39366 total cats

As you see there would be a very large number of cats after a very brief period of time. List four major reasons why the United States is not overrun with billions of cats.

There are limiting factors on the cats. The limiting factors include biotic factors such as access to food, access to shelter and disease. The limiting factors also include abiotic factors such as limited space and access to water.

1. A **survivorship curve** is a basic graph that shows the proportion of a population surviving to a particular age. This is important to know because many different species have many different survival strategies.

Look at the survivorship curve below. Identify how the lives of the following species will be different.



The three different organisms, tree, bird and human, have large differences in the amount of organisms that survive to maturity. Identify two different types of species below that relate to each of the curves above.

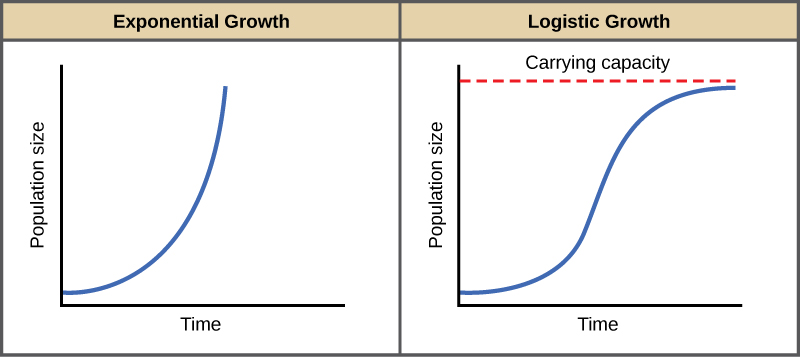
Organisms that relate to the tree (Type III)– This would include any organism that produces large amounts of offspring but does not have many of them survive to maturity. Often these types of organisms show little parental care. Animals that fit this category are turtles, squid, fish, tapeworms and more. Most plants also fit in this category.

Organisms that relate to the bird (Type II)– This would include any organism that produces moderate amounts of offspring and have a moderate number of them live to maturity. Often this strategy requires paternal care. Animals that fit this category are ducks, squirrels and many types of lizards. Not many plants fit this category.

Organisms that relate to the human (Type I) – This would include any organism that produces low amounts of offspring and have a large amount of their offspring survive to maturity. This strategy requires parental care. Animals that fit this category are bears, chimpanzees, deer and lions. Most plans do not fit in this category.

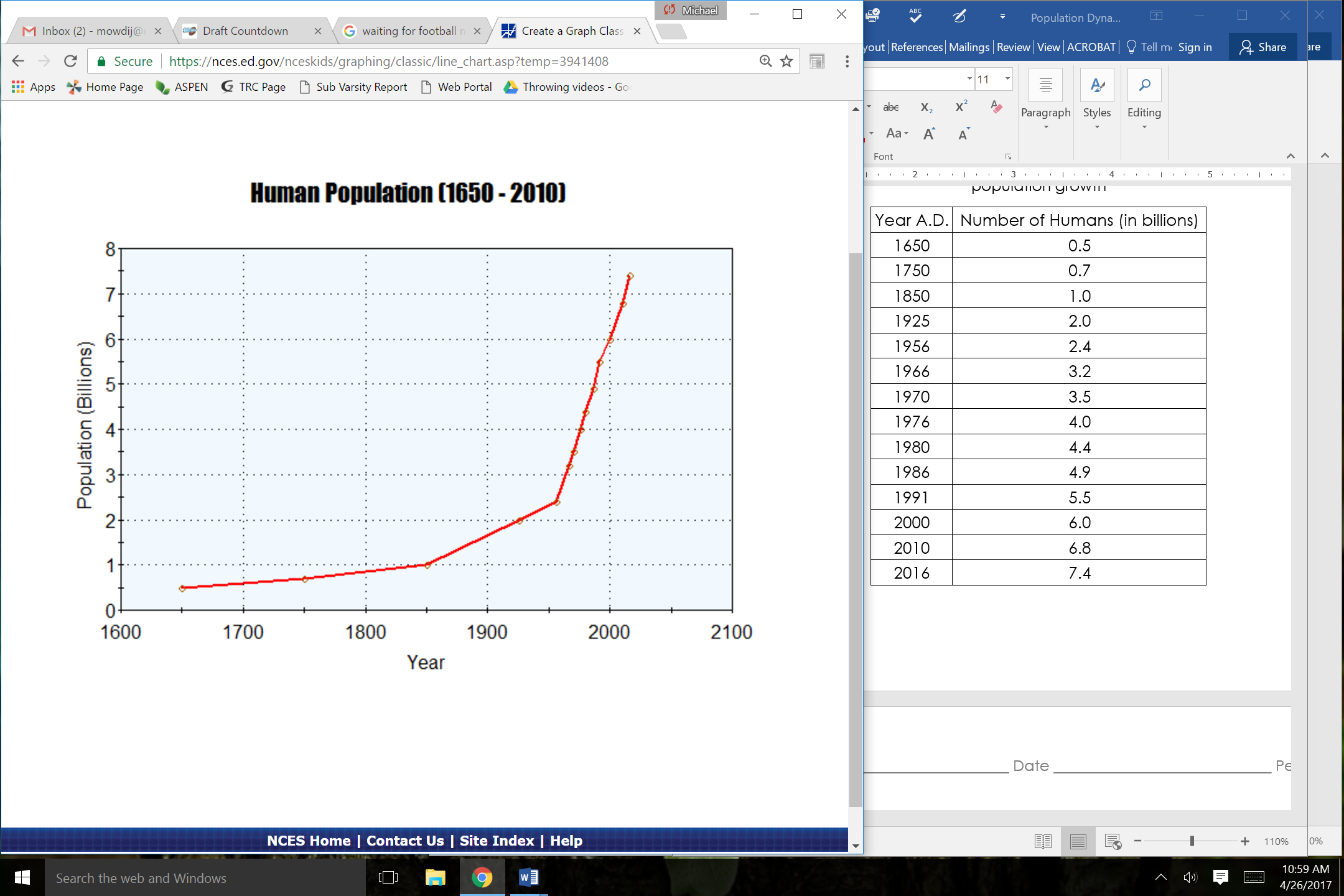
1. Based on how populations grow over time, they can have different types of growth. One method of growth is **exponential growth**. This is when a population grows very rapidly. It is normally seen when a population discovered a new ecosystem that has few predators and a large (or even unlimited) amount of resources. Bacteria that discover a new habitat often show exponential growth.

The graph for exponential growth is often called a **J – Curve** and can be seen below.



Use the information below to graph your own exponential growth curve of human population growth

|  |  |
| --- | --- |
| Year A.D. | Number of Humans (in billions) |
| 1650 | 0.5 |
| 1750 | 0.7 |
| 1850 | 1.0 |
| 1925 | 2.0 |
| 1956 | 2.4 |
| 1966 | 3.2 |
| 1970 | 3.5 |
| 1976 | 4.0 |
| 1980 | 4.4 |
| 1986 | 4.9 |
| 1991 | 5.5 |
| 2000 | 6.0 |
| 2010 | 6.8 |
| 2016 | 7.4 |



Looking at the above graph, answer the following questions about human population.

1. What type of growth are humans currently following? Why?

They are following exponential growth. This is because there are relatively few predators and few limits on resources available to humans.

1. What does this graph tell us about the resources (currently) available to humans?

Most humans have not yet met a limit on their resources.

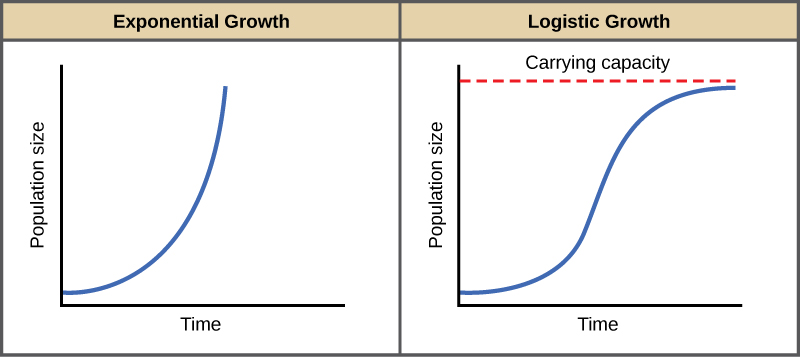
1. If you were to predict human population in the year 2050, how many humans would you expect to find on earth? How did you come to that conclusion?

Anywhere in the 8.5 to 10 billion range.

1. Another method of growth is **logarithmic growth**. This is when a population grows very rapidly, however it caps off. It is normally seen when a population is limited by an outside factor. An example of this would be the number of wild foxes in New Jersey. Their population has remained relatively stable for several years.

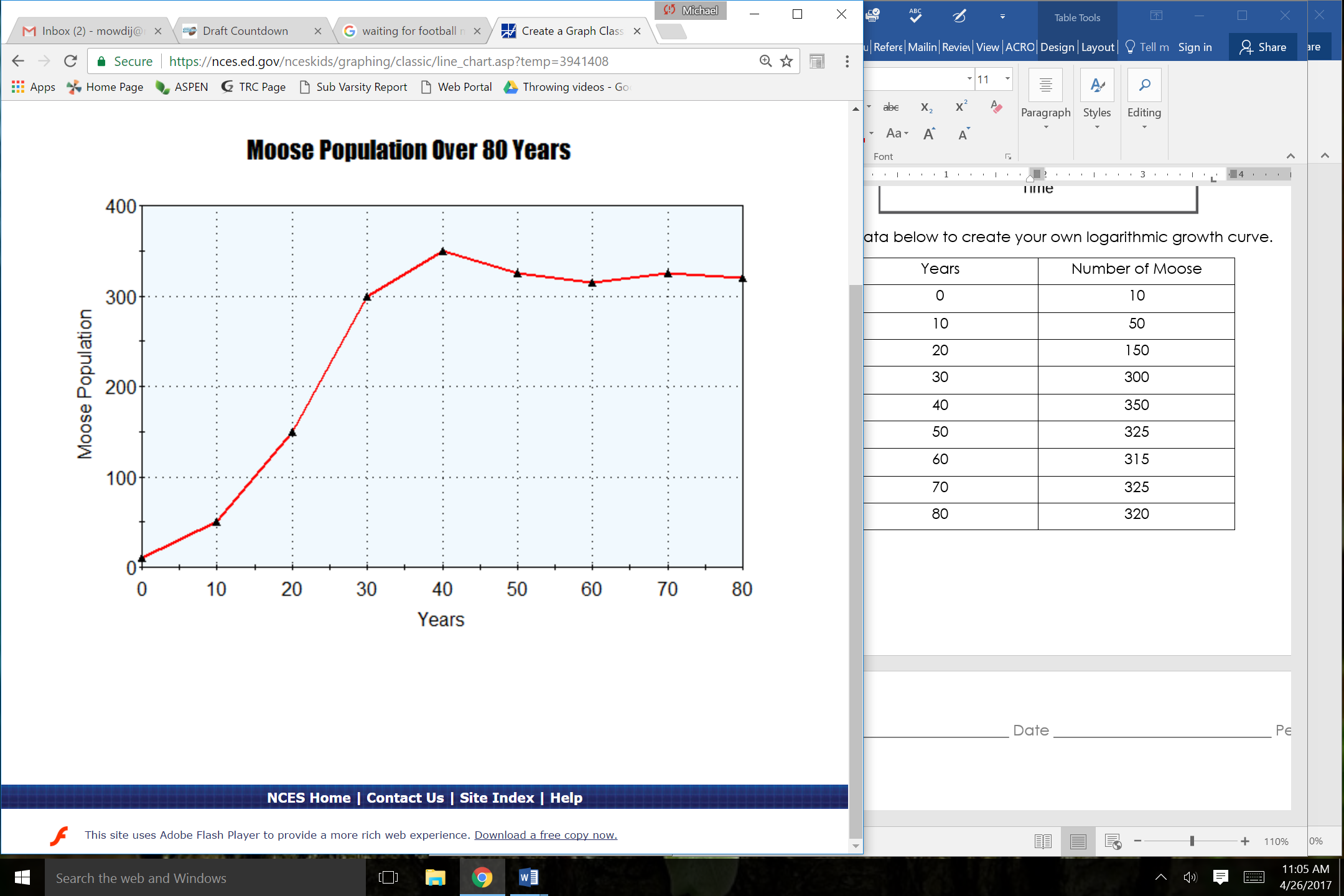
The graph for exponential growth is often called an **S – Curve** and can be seen below.

The point of an S-Curve where a population levels off is called the **carrying capacity**. This is the number of organisms that an environment can support. The carrying capacity is normally limited by several **limiting factors**. Limiting factors such as disease, lack of food, predators and old age will keep a population from expanding beyond a certain size.



Use the sample of data below to create your own logarithmic growth curve.

|  |  |
| --- | --- |
| Years | Number of Moose |
| 0 | 10 |
| 10 | 50 |
| 20 | 150 |
| 30 | 300 |
| 40 | 350 |
| 50 | 325 |
| 60 | 315 |
| 70 | 325 |
| 80 | 320 |



Looking at the above graph, answer the following questions about this example’s moose population.

1. What is the carrying capacity of the moose population?

Anywhere between 315 and 325 moose. This depends upon the year.

1. Is carrying capacity rigid at one number? Can it change from year to year? Why might it change from year to year?

The carrying capacity can fluctuate based on the conditions of the ecosystem during that given year. Some years may be more favorable and may support more moose, while other years may be less favorable and may support less moose. It all depends on the limiting factors of growth.

1. What are two different biotic factors that may limit the moose population?

Predators, disease, access to food, shelter, places to live, competition for food

* Key note – Other answers may be given. As long as they qualify as biotic factors, encourage new ideas!

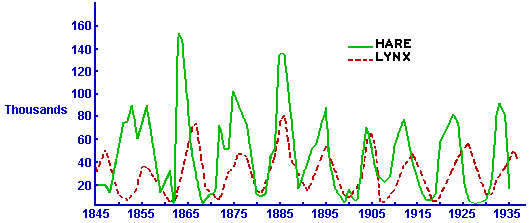
1. What are two different abiotic factors that may limit the moose population?

Access to water, access to shelter, access to inorganic nutrients,

* Key note – Other answers may be given. As long as they qualify as abiotic factors, encourage new ideas!

1. Populations do not always grow or decline by themselves. Often populations chance with the ecosystem.

One situation that helps us understand the basics of dynamic populations is the situation of the snow shoe hair and the lynx. These are two organisms that live in relative isolation in the northern parts of Canada. Take a look at a graph of their populations below.



Use the space below to describe three different patterns that you see from the graph above.

1. The hare population and the lynx population are prone to large increase or decreases based on the ecosystem.
2. When the hare population rises, the lynx population rises shortly after.
3. When the lynx population drastically rises the hare population falls shortly after.
4. When the hare population falls, the lynx population falls shortly after.
5. When the lynx population falls, the hare population rises shortly after.
6. Large increases in the hare population lead to large increases in the lynx population
7. Small increases in the hare population lead to small increases in the lynx population.

* Key Note – Students can come up with almost any answer, as long as it is relevant to the graph.

With your observations, write a paragraph that describes why the populations of the snowshoe hair and the lynx are intertwined. Be sure to highlight now the two population’s success or failure are linked.

Major Points -

* Interdependence shown from the lynx and hare.
* Correlation between the numbers of lynx and hare.
* Cycle of rising and falling populations.
* Sharp increases in a population when one population falls
* Key Note – Students can come up with almost any answer, as long as it is relevant to the graph.