
COMPETENCY 3:
POPULATION
GROWTH

Content Standards:

The learners demonstrate an understanding of:

1. the influence of biodiversity on the stability of ecosystems;
2. an ecosystem as being capable of supporting a limited number of organisms.

Competency:

Explain the relationship between population growth and carrying capacity. **S10LT- IIIi -42** .

Objectives:

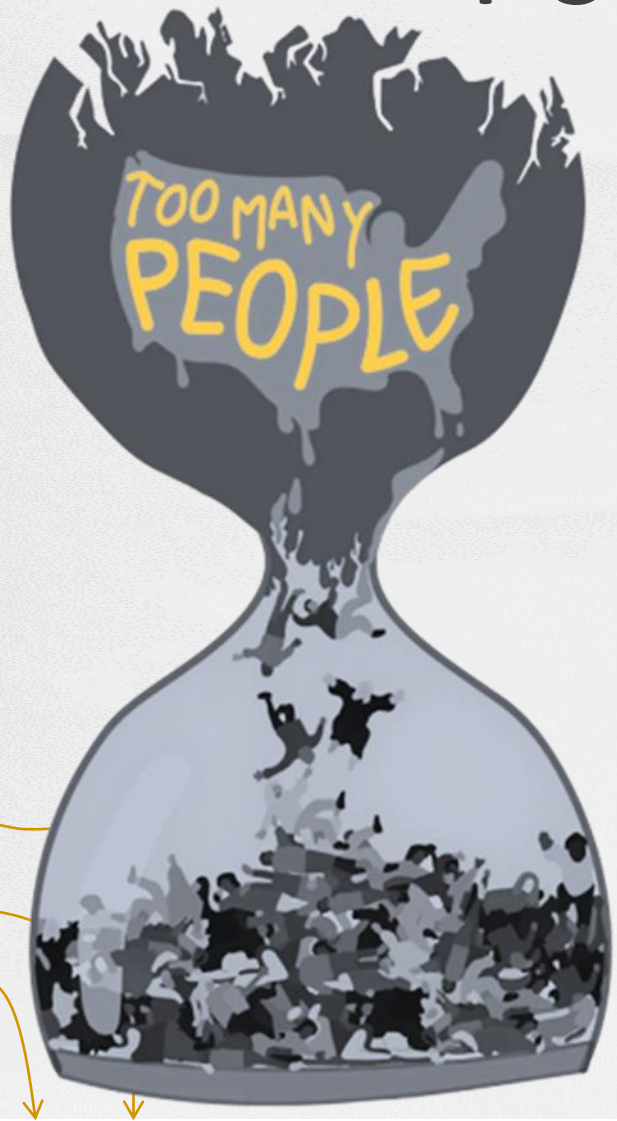
At the end of the material the student will be able to:

1. define the population growth and carrying capacity;
2. compare and contrast different factors that can affect the size and carrying capacity of a population; and
3. relate the population growth to carrying capacity.

The Ups and Downs of Population Growth

A ***population*** is a group of organisms of the same species that live in a certain area. Ecologists regularly monitor the number of organisms in many populations. They also need to know why the number of organisms is decreasing. Populations that are growing or diminishing can be indicators of potential problems in the organisms' environment, and such conditions alarm the ecologists if something is wrong.

The Ups and Downs of Population Growth



Essential Questions:

- But why do they do this?
- Why should we care if the number of organisms in an area is increasing or decreasing?
- But it is not enough to simply know if the number of organisms in an area is increasing or decreasing?
- Why is a population's size increasing or decreasing?

The Ups and Downs of Population Growth

Many factors can cause a population's size to change. But first, we must understand the basic reasons behind why a population increases or decreases.

Any population, whether it be that of humans, animals, the mold growing on bread, or the bacteria living in your intestines, will grow if more organisms are being developed as GMO (Genetically Modified Organisms), or born than are dying.

The Ups and Downs of Population Growth

The number of births in a population is called the ***birth rate (natality).***

The number of organisms that are dying in a population is called the ***death rate (mortality).***

The Ups and Downs of Population Growth

> If the birth rate is greater than the death rate, the population will grow.
> If the death rate is greater than the birth rate, then the population will decrease.

A population of organisms cannot grow forever, at some point, its growth will be limited, or stopped, and the death rate will be greater than the birth rate.

The Ups and Downs of Population Growth

A population's growth is limited by two general factors: ***density-independent factors*** and ***density-dependent factors***.

Population density

: the number of organisms per unit area.

If a population's density is very high, that means there are a lot of organisms crowded into a certain area.

If a population's density is low, that means there are very few organisms in an area.

The Ups and Downs of Population Growth

Density-independent Factors

If the population's density does not directly influence changes in population growth

Density-independent limiting factors that can stop a population from growing can be such things as:

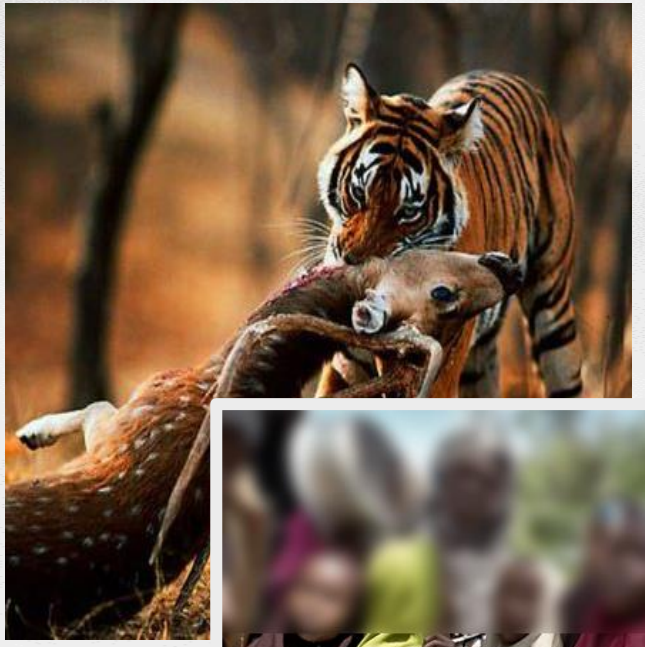
- **Natural disasters**
- **Temperature**
- **Sunlight**
- **Activities of humans in the environment**

The Ups and Downs of Population Growth

Density-dependent Factors

A factor that regulates a population's growth and is influenced by population density

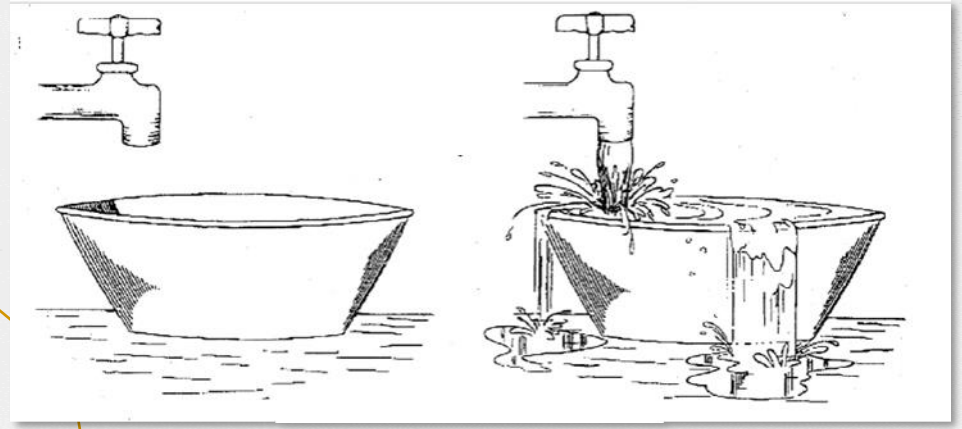
Density-dependent limiting factors come into play when a population reaches a certain number of organisms. For example, when a population reaches a certain size, there won't be enough resources such as food, water, and shelter for all of the organisms.

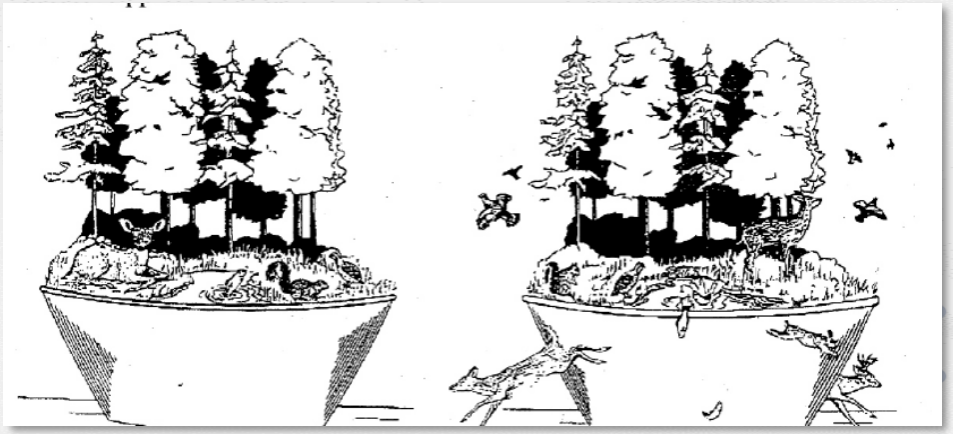


The Ups and Downs of Population Growth

Density-dependent Factors

This could cause the population to stop growing when it reaches the maximum number of organisms that can be supported or carried by the environment. This number is known as the ***population's carrying capacity*** in a particular environment.

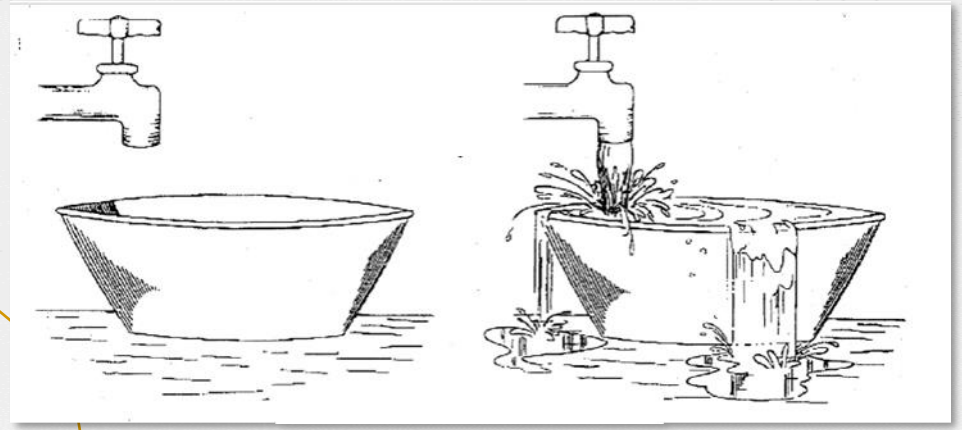


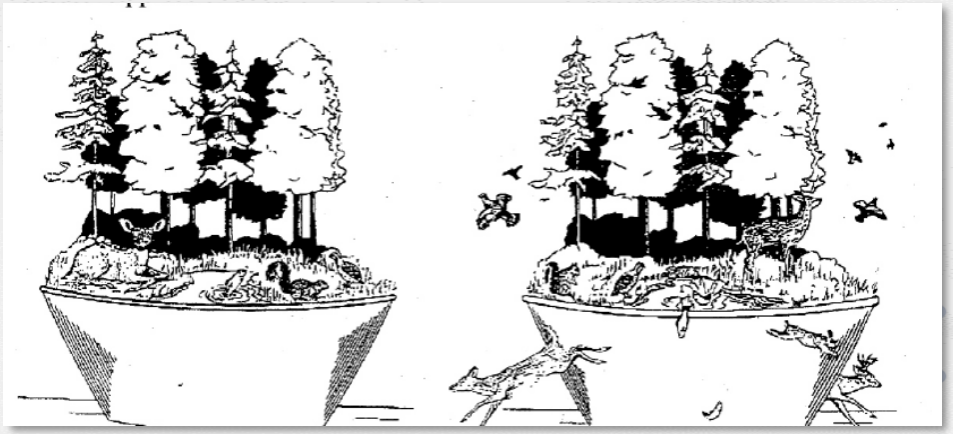


The Ups and Downs of Population Growth

Density-dependent Factors

Each population of organisms has a different carrying capacity, depending on the number of resources available in the area in which it lives.



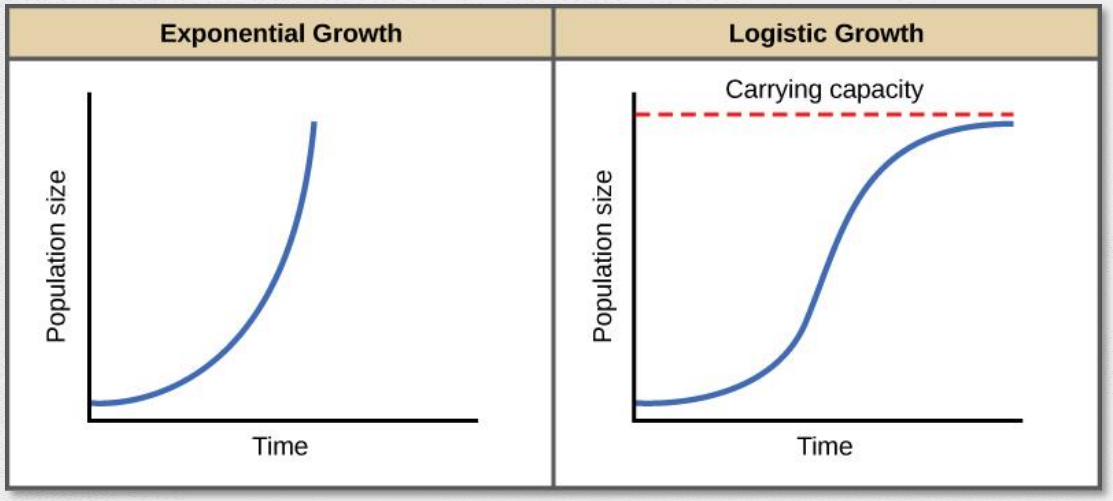


The Ups and Downs of Population Growth

Before a population reaches its carrying capacity, it experiences a period of rapid growth. This period of growth is called ***exponential population growth.***

During this period, there are plenty of resources available for all organisms, so more births are recorded than deaths in organisms.

The Ups and Downs of Population Growth



When resources are unlimited, populations exhibit **exponential growth**, resulting in a *J-shaped curve*.

When resources are limited, populations exhibit **logistic growth**. In logistic growth, population expansion decreases as resources become scarce, and it levels off when the carrying capacity of the environment is reached, resulting in an *S-shaped curve*.

Station 1

Objective:

Explain the relationship between population growth and carrying capacity.

Materials:

i. Oh Deer Card game set (Please print all the cards: Oh Deer cards, Habitat cards, and Deer Chips)
ii. 2–4 students (per group)
iii. Dealer (optional)

Procedure:

a. Each player gets 1 of each habitat card (food, water, shelter) and 5 Deer Chips to start
b. Mix the “Oh Deer” cards and place them face down in the center of the playing area (this game can be done online)
c. Set the Deer Chips aside in a pile or a bag
d. If there is no dealer, determine the order of play: Players can flip a coin or roll a number cube to determine who goes first, second, third, etc.

e. Play: Before each round, every player will select one of their habitat cards (food, water, or shelter) and place it face down in front of them. The card that they select will be what their deer will be looking for in that round. Once everyone has selected their habitat card, an “Oh Deer” card should be flipped from the stack for everyone to see. If a player’s habitat card matches the “Oh Deer” card, they get a new Deer Chip. If their habitat card does not match the flipped card, they lose a deer.

f. Winning: The game continues for 6 rounds. Whoever has the most Deer Chips at the end of the game wins.

g. If there is a dealer, simply have one player or an adult select the “Oh Deer” card for each round.

h. With an adult or educator as the dealer: have the dealer set the deck (without telling the players) so that one of the habitat cards comes up multiple times

Guide Questions:

1. Are you able to collect many Deer Chips at the end of the game? How?
2. What have you noticed about the population of deers when it comes to their food, water, and shelter?
3. What happens if deer become too numerous?
4. What will happen to the population of deers if there are natural disasters?
5. Examine the flow of the game, does it show the relationship of the population growth to carrying capacity? Explain briefly.

Station 2

In this activity you will study the effects of environmental stresses (loss of habitation, predation, etc.) on the size of a Tilapia population in Box Lake. You will keep track of this population using pictures and graphs.

Rules to Box Lake:

1. Tilapia often eat smaller fish for their survival. There is enough food in each Square of Box Lake to keep one Tilapia alive. Therefore, only one Tilapia can occupy a square within Box Lake at a time.

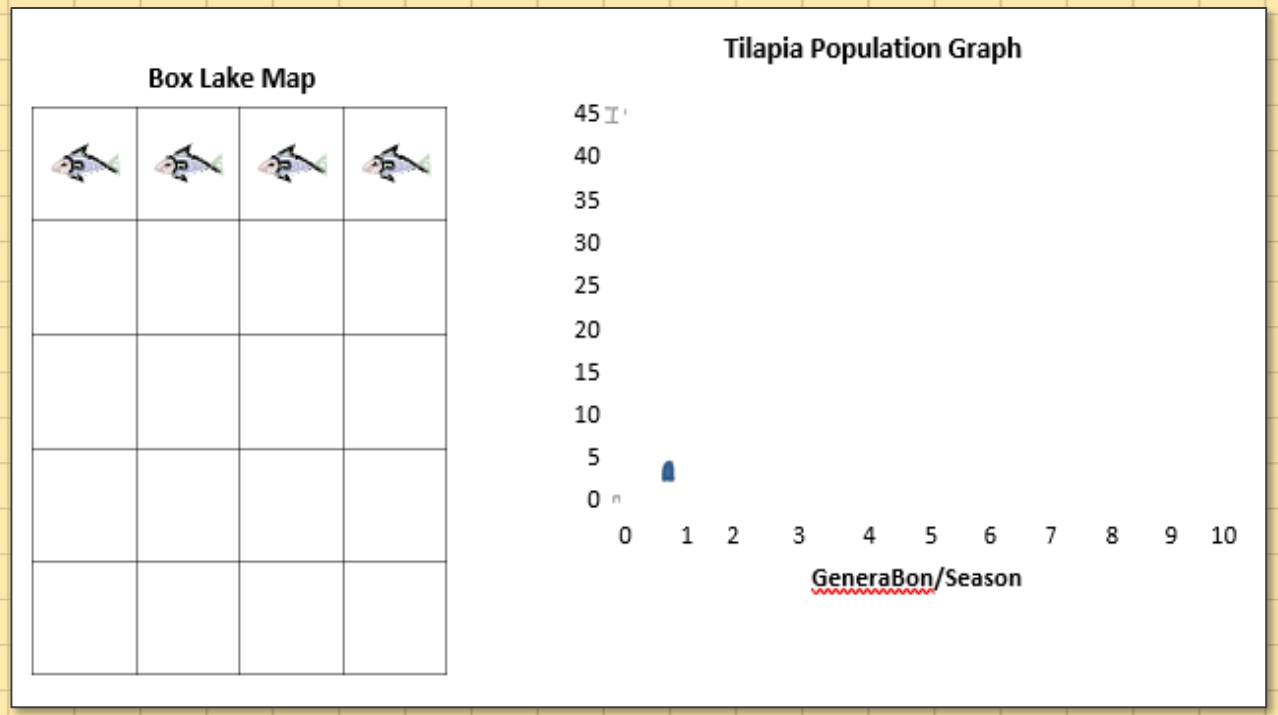
2. For every two Tilapia, one new offspring will survive predators (birds, fisherman, etc.) each generation or season. Add a new Tilapia each generation.

3. If all of the squares are filled in Box Lake with Tilapia during a generation, there will not be enough perch to eat and no additional Tilapia will survive.

4. If all of the squares are filled with Tilapia at the start of the generation or season, the small fish population will start to decline. Two Tilapia will starve and need to be removed from Box Lake. No additional offspring will survive.

Scenario 1: Normal Conditions

Generation 1 in this scenario has 4 Tilapia in it. Follow the rules to Box Lake above. For each generation, draw additional Tilapia on the Box Lake Map. For example, since there are 4 Tilapia, 2 offspring would be added. The total number of Musky will now equal 6. On the Tilapia Population Graph, record 5 Tilapia for Generation 2. Continue for 10 generations.



Scenario 1: Normal Conditions

1. Does the Tilapia population continue to increase over time? Why?

2. The maximum number of organisms that an environment can support without ruining the environment is called the "Carrying Capacity."

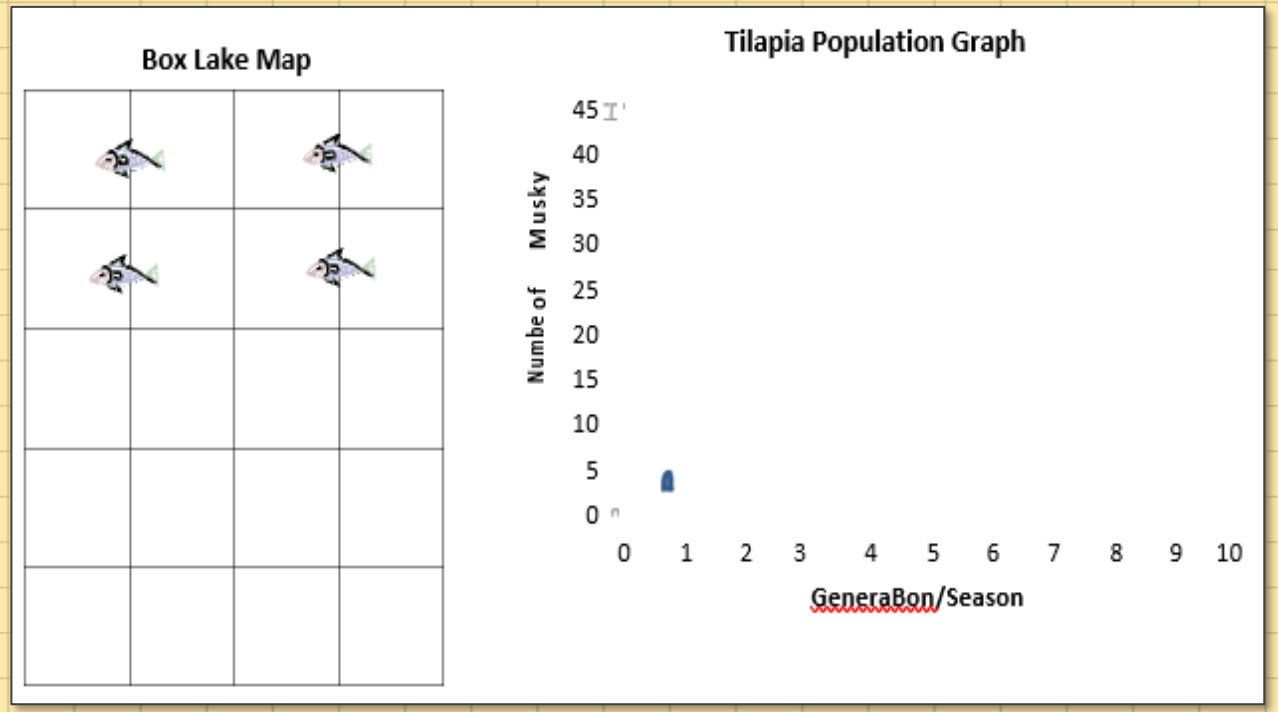
    a) The carrying capacity for Musky in Box Lake is about 19 Tilapia. Draw a line across your graph at 19 Tilapia and label it "Carrying Capacity.“

    b) Describe how you can determine the carrying capacity of an organism by just looking at a Population vs. Time graph.

3. Populations tend to fluctuate naturally around the carrying capacity. Why do you think populations fluctuate?

Scenario 2: Invasive Species

Thai Catfish species have been introduced into Box Lake. Thai Catfish and trout compete to eat enough zooplankton to survive. This competition over resources leads to a decrease in zooplankton and trout populations. Follow the rules to Box Lake to complete the Map and the Graph only this time there can only be one Tilapia for every 2 squares due to the decrease in trout. Complete 10 generations



Scenario 2: Invasive Species

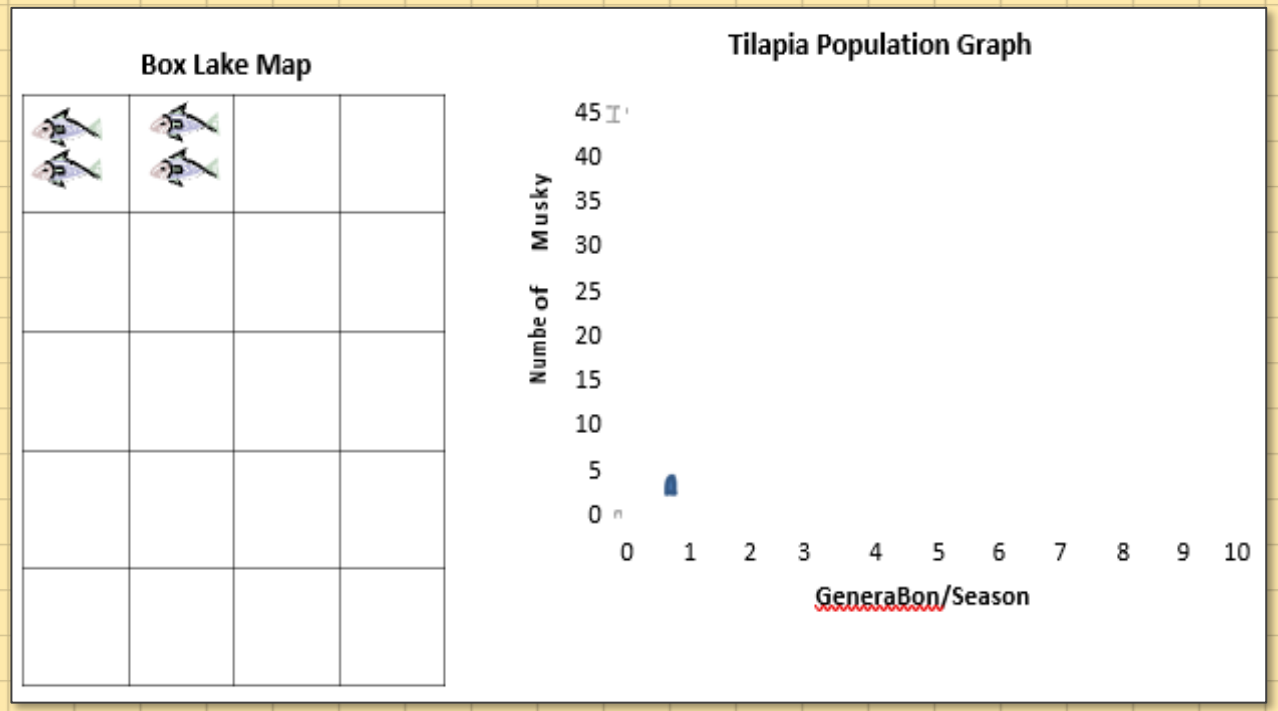
1. What is the new carrying capacity for Tilapia after Thai Catfish have been introduced? Support your answer using evidence from your population graph.

2. Why did the carrying capacity of Tilapia lower in this scenario than in scenario 1?

3. Brainstorm two other scenarios or changes to the Box Lake environment that would also lower the carrying capacity of Tilapia.

Scenario 3: Fishing Regulation Change

The minimum length needed to keep a trout caught through fishing has increased to 13" at Box Lake. This means more trout survive from generation to generation, providing more food for Tilapia. Follow the Rules to Box Lake to complete the Map and Graph only this time two Tilapia can fit in a square due to the increase in trout population.



Scenario 3: Fishing Regulation Change

7. What is the new carrying capacity after the fishing regulation change? Support your answer using evidence from your population graph.

8. Why was the carrying capacity of Tilapia higher in this scenario than in scenario 1?

9. Brainstorm two other scenarios or changes to the Box Lake environment that would also increase the carrying capacity of Tilapia

10. Viral Hemorrhagic Septicemia (VHS) is a deadly fish virus that infects many fish species including Tilapia and trout. While most of the infected fish die, some survive and produce antibodies to help protect them from future exposure to the virus. Sketch a Tilapia Population graph for this scenario. Make sure it is obvious if the carrying capacity is lower, higher, or the same as the normal carrying capacity at Box Lake. Explain your reasoning behind your graph.

Assessment

Competency 2
Describe the feedback mechanisms involved in regulating processes in the female reproductive system (e.g., menstrual cycle) **S10LT – IIIc -35.**

Direction: Choose the letter of the correct answer.

26. Which of the following describes a group of organisms of the same species that live in a certain area?
    a. Population
    b. Community
    c. Biodiversity
    d. Society

27. What refers to the number of organisms per unit area?
    a. Exponential population growth
    b. Logistic population growth
    c. Population density
    d. Community growth

28. Who is responsible for regular monitoring of the number of organisms in many populations?
    a. Census
    b. Anthropologists
    c. Environmentalists
    d. Ecologists

29. An increase in the number of organisms in the population depends on the following:
    I. Emigrate
    II. Immigrate
    III. Natality
    IV. Mortality

    a. I and III
    b. II and III
    c. I and IV
    d. II and IV

30. What does it indicate if the birth rate is greater than the death rate?
    a. The population is growing
    b. The population is decreasing
    c. The population is constant
    d. None of the above

31. What factor regulates a population's growth and is influenced by population density?
    a. Density-dependent limiting factor
    b. Density-independent limiting factor
    c. Exponential population growth
    d. Logistic population growth

32. Which of the following factors described in population density does not directly influence changes in population growth like natural disasters, human activities, etc.?
    a. Exponential population growth
    b. Logistic population growth
    c. Density-dependent limiting factor
    d. Density-independent limiting factor

33. Which of the following refers to the maximum number of organisms that can be supported or carried by the environment?
    a. Logistic population growth
    b. Density-independent limiting factor
    c. Population's Carrying capacity
    d. Density-dependent limiting factor

34. What does it imply if the population's density is very high?
    a. There are a lot of organisms crowded into a certain area
    b. There are few organisms living in a certain area
    c. There is a little to no organisms present in a particular area
    d. None of the above

35. In which period explains that plenty of resources are available for all organisms and what happens before a population reaches its maximum number of organisms?
    a. Carrying capacity
    b. Exponential population growth
    c. Population density
    d. Logistic population growth

36. Which period of growth implies that population expansion decreases and results in an S-shaped curve?
    a. Logistic growth
    b. Exponential growth
    c. Population growth
    d. Population density

37. Why should we care if the number of organisms in an area is increasing or decreasing?
    a. Populations that are growing or diminishing can be indicators of potential problems in the organisms' environment.
    b. To monitor the population density and report to the authority.
    c. It conveys an alarming condition and resolves what is going wrong in the population growth.
    d. The act of knowing the status of a population in an area depicts indirect help to the authority.

38. Which is NOT a factor in population size increasing or decreasing?
    a. More organisms are being developed
    b. Birth rate or natality
    c. Mortality rate or mortality
    d. Family planning

39. What do you think will happen if the human population reaches its carrying capacity?
    a. In a certain way, when a population reaches its maximum number of organisms, there will be a scarcity of resources; thus, leading to population growth to stop.
    b. Population density decreases due to the emigration of people to look for pretentious life.
    c. Nothing will happen. People tend to decrease their number and they can provide enough resources from the environment they live in.
    d. A better resolution for this is to report it to the authority and complain about resources.

40. Which of the following BEST describes the relationship between population growth and carrying capacity?
    a. A population of monkeys has enough food as their number increases
    b. Nick and his mother fill up their storage room that will be sustainable for a month
    c. A group of tigers and lions consumed two prey that is good for one 1-week
    d. Charlie's family of 3 has insupportable sources

COMPETENCY 3