SCIENTIST IN RESIDENCE PROGRAM

Science Unit: *Plants and Animals Through the Stages of Ecological Life*
Lesson 4: *Populations – The Survival of the Fittest (Part 1)*

School year:	2007/2008
Developed for:	Mount Pleasant Elementary School, Vancouver School District
Developed by:	Luana Avila (scientist), Connie McGregor and Maureen McDonnell (teachers)
Grade level:	Presented to grades 6 - 7; appropriate for grades 4 – 7 with age appropriate modifications.
Duration of lesson:	1 hour and 20 minutes (revise as needed)

Objectives

1. Learn that organisms live in populations
2. Learn that diversity is essential for population survival

Background Information

All organisms live in populations. Populations are composed of organisms of the same species that live in close proximity. An obvious example is human populations, no human alone could reproduce, and thus living in proximity to other people allows us to reproduce and ensures the *Homo sapiens* species is perpetuated. The drive to grow and reproduce is more pronounced in other animals and plants. Scientists believe that reproduction in a key aspect of any organism's life cycle. The idea is that one wants to pass to the next generation its own genes, in a way eternally preserving one's lineage. However, in a population not all organisms will be able to reproduce. Many will not survive to reproductive age, or will not be able to reproduce for lack of attracting a mate or incompetent sexual gametes. This process is what Darwin called Natural Selection. The 'unfit' organisms will drop out of the population and only 'fit' ones will pass their genes to the next generation. 'Fitness' however, is based on current environment conditions. For example, animals with genes that cause them to have a heavy fur will be best suited for cold environments, if one year is unusually warm, that organism will not be as successful at surviving the warm weather as another animal with a lighter fur coat. In short, fitness depends on the adaptability of the organism to its present environmental condition.

Vocabulary

<u>Word:</u>	<u>Brief definition.</u>
Population	A group of organisms of a species that interbreed and live in the same place at the same time
Diversity	A wide variety of characteristics present in a single population
Trait	Alternate forms of a given characteristic, ie furry versus furless
Mutation	A permanent and transmissible change in the genetic material of an organism
Natural selection	A natural process resulting in the evolution of organisms best adapted to the environment.
Clones	Organisms that reproduce by creating exact genetic copies of itself, creating a clonal population
Fitness	The ability of an organism to suit its environment and reproduce.

Generation The average interval of time between the birth of parents and the birth of their offspring.

Materials

- Pictures of animal and plant populations (obtain online)
- Containers for the beans
- 1 pound of kidney beans
- 1 pound of white beans

In the Classroom

Introductory Discussion

Can anyone tell me the topic we have been exploring with these lessons?

What have we learned about animals and plants? Cells→organism→ what is this next level?

What do think a population is?

What is the relationship between cells, organisms and populations?

What are some examples of populations?

Ask for 4 volunteers to form a population with 2 different traits: wearing both shoes or wearing no shoes. Ask students to stand in front of the class.

Ask the class – what is similar between all these organisms? (all kids, all humans, all students)

what is different? (wearing shoes or not)

Introduce the vocabulary – trait (foot capable of wearing a shoes or incapable of wearing a shoes)

Give examples of other traits: hair colour, hair type, eye colour, ear lobe attachment…

Ask for another 4 volunteers – line 1st four volunteers behind new volunteers. Explain that the line behind are the parents and the line in front are the babies.

Which babies do you think will be able to wear shoes?

Introduce the idea of inheritance

Draw smaller empty circles and filled circles. Explain that filled circles represent organisms that can wear shoes and empty circles are organisms that cannot wear shoes. Explain that in some years all organisms need to cross a glass field to reproduce, and the only way to get across is to walk through it. In years when there is no glass, the shoeless organisms can run faster that the shoed organisms and find the best nests.

On a glass year, which organisms do you think are most likely to get across? Why?

What do you think that will do to the population numbers of the next generation?
(explain the word generation)

After ten 'glass' generations, how many shoeless and shoed organisms do you expect to find?

What about after 10 'no glass' generations?

Today we are going to model what might happen to a population under different environment conditions. We are going to use red and white beans to represent the organisms of each trait. We are going to test whether a diverse population, one that contains organisms of more than one trait can survive better than a clonal population, one that has organisms of only one trait.

What is your hypothesis?

Science Activity: Modeling Population Diversity

Setup 6 tables with different 'bean population' ratios (see the table below)

Explain the diversity game

On each table we have a 'model' population that is composed of two types of beans: white and kidney beans. Each type of bean represents a trait. On your worksheet you should write your group number and the number of beans of each type. This is your initial population ratio.

After everyone has written their initial population ratio, I will announce to the class this generation's environment. Organisms that are well adapted to survive this environment will live and organisms that are not adapted will die. When I announce the environment you will remove half of those organisms that are not well adapted to that weather.

After those organisms are removed, the ones left in the bowl, the survivors will reproduce. Count the total number of beans of each type and add half that number (rounding down if necessary) to the population. The total number of beans in the bowl after the first round is your generation 1. I will then announce the new environmental conditions and we will re-start the cycle.

Table	Population Ratio		
	Red bean	White bean	Ratio (%)
1	16	0	100:0
2	12	4	75:25
3	8	8	50:50
4	0	16	0:100
5	4	12	25:75
6	8	8	50:50

Do the first round together with the students. Write on the board the traits represented by each bean type and the environment condition in which each bean thrives.

Example:	**Bean type**	**Trait**	**Loves**	**Hates**
	Red	Furry	Cold	Hot
	White	Furless	Hot	Cold

Write the steps of the game on the board:

Step 1 – Count your beans

- Count number of beans of each type and record

Step 2 – **Environment announcement**

- Listen and record the environment conditions for that generation

Step 3 – Remove the 'dead'

- Remove from the population half of the organisms that would hate the environment condition announced

Step 4 – Count your survivors

- Count and record the number of beans of each type

Step 5 – Add you new 'babies'

- For each bean type add half of the total number of organisms (ie. 4 white beans→ add 2 more white beans; 5 kidney beans→ add 2 more kidney beans)

Go back to step 1 – the total number of bean in the bowl is your new generation population ratio
You could use any trait. Ensure that you have a biological reason behind the traits you choose and link the trait type with an environmental condition.
Examples: Fur and furless / Cold and Hot; Mottle and light (wing colour) / Polluted and Clean; Large and Small leaves / Wet and Dry.

Play the game for 10 generations. Randomly decide the environment. Make a table on the board and ask students to contribute the initial population number and the final population number.

Closure Discussion

Why do you think organisms live in populations? Can they live alone? Why not?

(As organisms of the same species have similar needs, such as food and environmental conditions they tend to remain together at the same place and time. Reproduction is another reason why organisms live in populations, it would be hard to find a mate if they lived far apart from each other.)

Point out the final population ratios and ask them to decide which ratio they think is better for a real population: a balance between the two traits or just one trait? Why?

(diverse population can survive a variety of environmental conditions because the population has organisms that can withstand a variety of environmental conditions.)

Draw three circles to represent three populations: one composed of only green organisms, one composed of only blue organisms and one composed of blue and green organisms. Ask them to decide which population is more prone to surviving and why.

Point out that the populations that started with just one trait never acquired organisms with the other trait. How could a clonal population become diverse?

Talk about bacterial colonies – bacteria reproduce clonally. They simply cut themselves into 2, so all the bacteria in a population are the same. That is why antibiotics are good to cure disease, antibiotics are poison to the bacteria and if they are all the same, all of them die. How is it possible then to create super-bacteria?

Leave them with the question until next class.

References

Freeman, Scott and Herron, Jon. Evolutionary Analysis. 2nd edition. Prentice Hall: Upper Saddle River, NJ (pictures of animal and plant populations)

Extension of Lesson Plan

1. Kinesthetic activity - Play a game outdoors where kids become members of a population with 2 different traits (use different party hats) and have the students go through the same stages as the beans.

Diversity Game

Rules:

1. Count the total number of each bean type.
2. After the season’s weather half of the organisms that are badly adapted for that weather will die – remove the dead from the population.
3. Your survivors can now breed. Add one bean for each 2 (count the total number of each bean type and add half that number to the population).

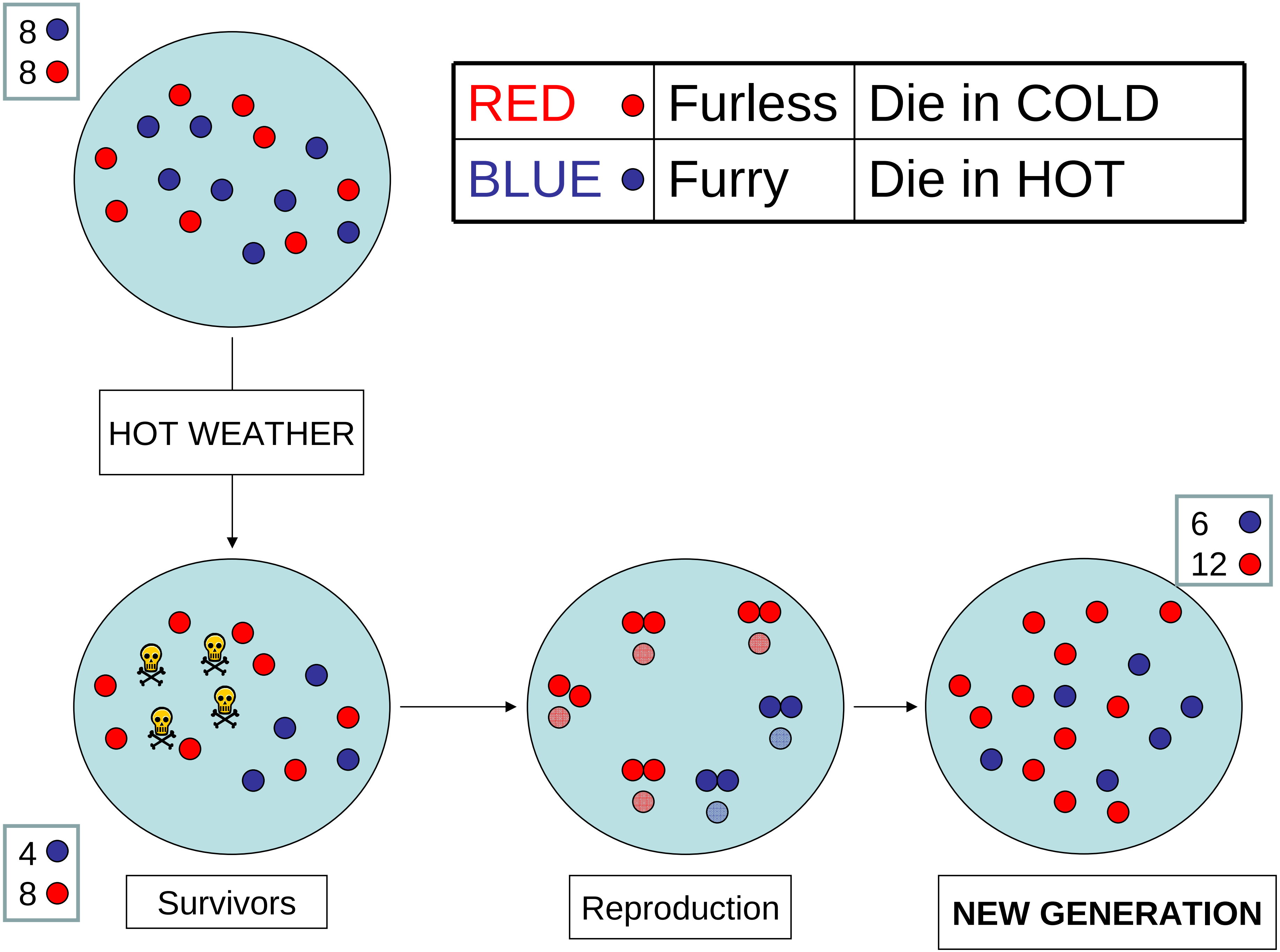
You now have your new generation!

Vocabulary

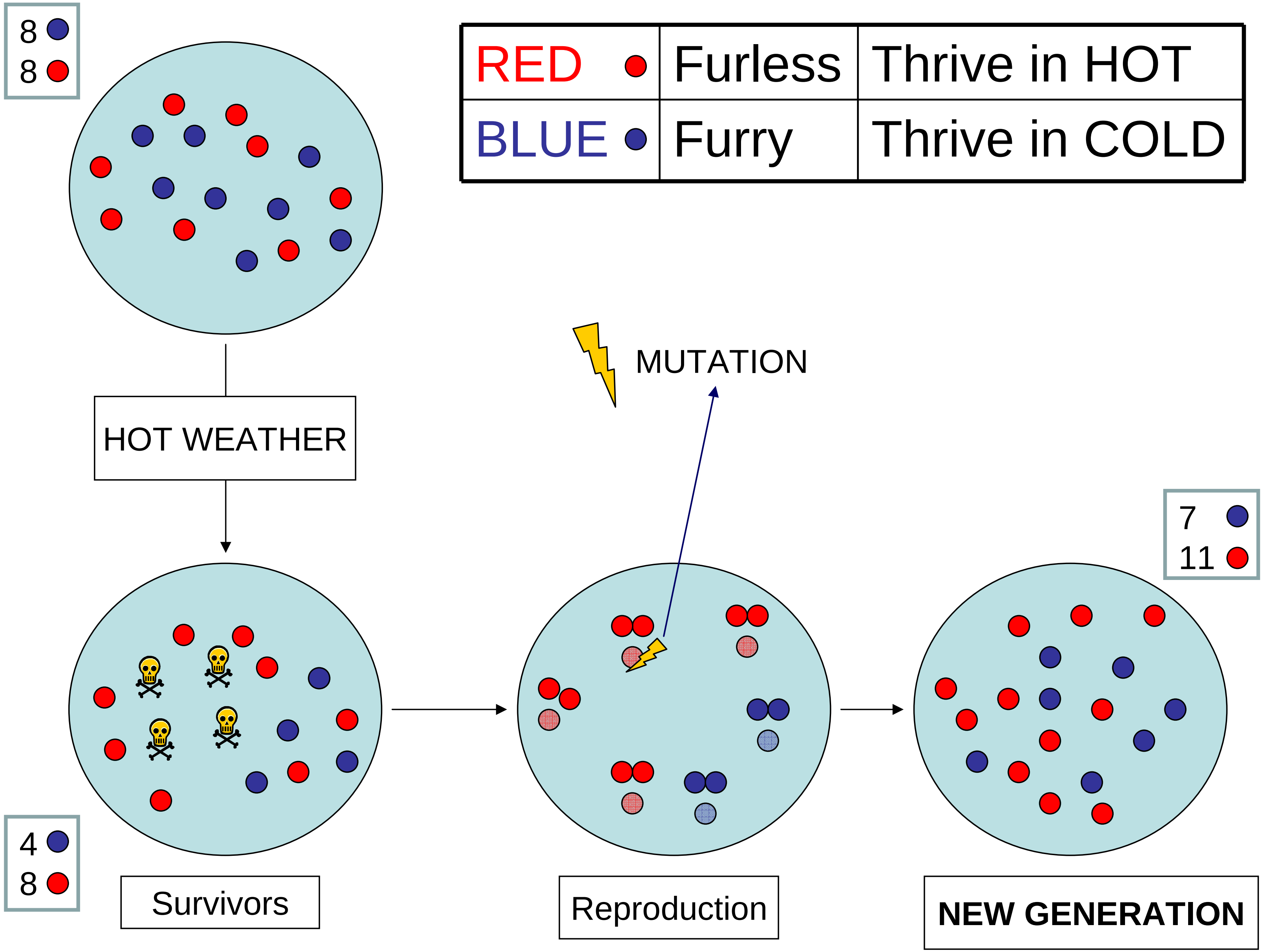
Trait – natural variation of a characteristic

Mutation – a permanent and heritable change in an organism

RED ●	Furless	Die in COLD
BLUE ●	Furry	Die in HOT



RED ●	Furless	Thrive in HOT
BLUE ●	Furry	Thrive in COLD



Survival of the Fittest

Name:______________

Group:_____

Bean type		
Trait		
Initial population ratio		
Weather		
Died		
Survived		
Born		
Generation 1 ratio		
Weather gen. 1		
Died gen. 1		
Survived gen. 1		
Born gen. 1		
Generation 2 ratio		
weather gen. 2		
Died gen. 2		
Survived gen. 2		
Born gen. 2		
Generation 3 ratio		
weather gen. 3		
Died gen. 3		
Survived gen. 3		
Born gen. 3		
Generation 4 ratio		
weather gen. 4		
Died gen. 4		
Survived gen. 4		
Born gen. 4		
Generation 5 ratio		
weather gen. 5		
Died gen. 5		
Survived gen. 5		
Born gen. 5		
Generation 6 ratio		
weather gen. 6		
Died gen. 6		
Survived gen. 6		
Born gen. 6		
Generation 7 ratio		
weather gen. 7		
Died gen. 7		
Survived gen. 7		
Born gen. 7		
Final Population ratio		