Name: _____ Gender: M __ F __ Today's Date: _____

School: _____ Science Teacher: _____ Period:_____

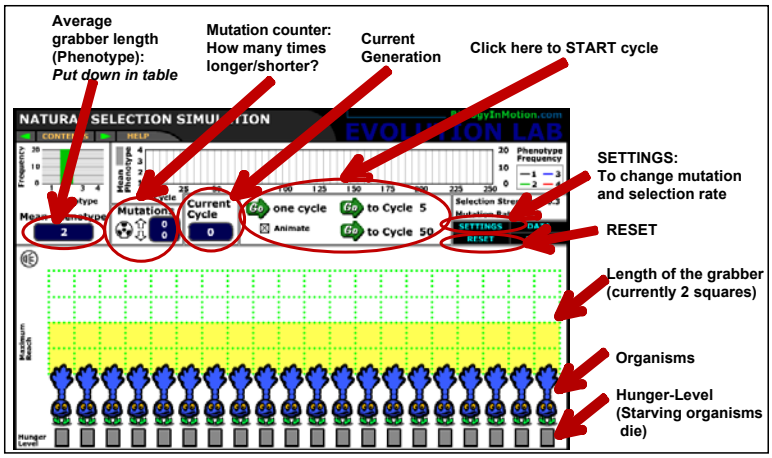
Evolution Lab

This simulation allows you to explore the effects of two factors that influence the evolution of a population – MUTATION RATE and SELECTION STRENGHT.

- We use a population of 20 blue organisms. They are predators who try to catch their prey by extending the grabber on top of their head (see picture to the left).
- In each round, the organism that has gone the longest time without eating (indicated by the 'hunger level') will die. Another organism that successfully caught the prey will produce offspring, which will take the spot of the deceased.
- The length of the grabber can randomly mutate – longer or shorter. A longer grabber means better reach for prey, and more frequent offspring.

INSTRUCTIONS

1. **Click the small green arrow in the upper left corner. You skip through the introductory pages until you reach the simulation main window (shown below).**
2. **Hit the 'GO one cycle' button a few times to see how the simulation works.**
3. **Press the 'Reset' button. You have to reset after each experiment.**
4. **Use the 'settings' button to change the values for mutation rate and selection strength for each experiment (values are given in table on the next page).**
5. **Run the four simulations by using the three different green 'GO'-buttons for 1, 5, or 50 generations at a time.**
6. **Write down the values of mean grabber length ('Mean Phenotype') in the data tables.**
7. **Create a graph for the data of each simulation. Use different colors or symbols for each trial. You will have four lines on your graph; one for each simulation.**
8. **Answer the final analysis questions.**



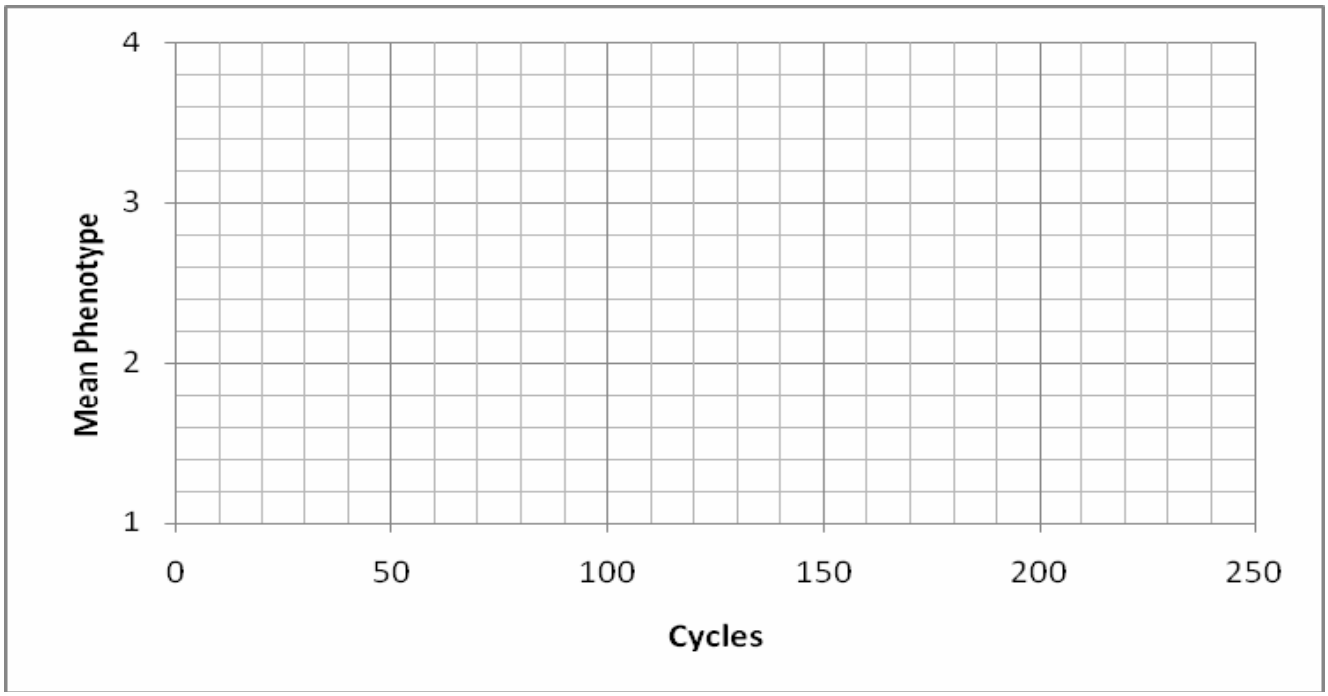
Interpretation of Mutation rate
• Low mutation = 0 → No mutations happen. • High mutation = 1 → Mutations happen very frequently. This leads to high genetic diversity!
Interpretation of Selection strength
• Low Selection strength (stable environment) = 0 → Beneficial traits (longer grabber) have no advantage (because prey comes down vertically and can be grabbed by only one single organism). • High selection strength (Competitive or changing environment) = 1 → Longer grabber become beneficial because prey gets in reach of several organisms and they have to fight for it!

Trial 1:	**Selection strength: 1** **Mutation Rate: 1**			My prediction for the development of average grabber length: Choose one. Shorter / Both Longer / No change						
Cycle	0	10	20	30	40	50	100	150	200	250
Mean Phenotype										

Trial 2:	**Selection strength: 1** **Mutation Rate: 0**			My prediction for the development of average grabber length: Choose one. Shorter / Both Longer / No change						
Cycle	0	10	20	30	40	50	100	150	200	250
Mean Phenotype										

Trial 3:	**Selection strength: 0** **Mutation Rate: 1**			My prediction for the development of average grabber length: Choose one. Shorter / Both Longer / No change						
Cycle	0	10	20	30	40	50	100	150	200	250
Mean Phenotype										

Trial 4:	**Selection strength: 0** **Mutation Rate: 0**			My prediction for the development of average grabber length: Choose one. Shorter / Both Longer / No change						
Cycle	0	10	20	30	40	50	100	150	200	250
Mean Phenotype										



YOUR ANALYSIS

1) *According to your observations, what grabber length is beneficial in …*
   a. *Stable environment (selection strength=0)*

❑ *Longer/* ❑ *Shorter* / ❑ *Both* / ❑ *It cannot be determined*

   b. *Changing, competitive environment (selection strength=1)*

❑ *Longer/* ❑ *Shorter* / ❑ *Both* / ❑ *It cannot be determined*

2) *How did mutations influence the length of the grabber?*

❑ *Longer/* ❑ *Shorter* / ❑ *Both*

3) *Effects of **Mutation**: How did the mean phenotype (grabber length) of the population with no mutations (=clones: See experiments 2+4) develop compared to the population with high genetic diversity (mutations = 1: See experiments 1+3) after 250 generations?*

*Populations with **no** mutations …* *Populations with **many** mutations …*

Explain your findings.

4) Effects of **Selection**: What effect did a different 'selection strength' have on the development of the mean phenotype (grabber length) of the population? Compare outcome of experiment 1 (strong selection) to experiment 3 (no selection).

High *selection strength causes the mean phenotype to …*

Low *selection strength causes the mean phenotype to …*

Explain your findings.

5) *Your conclusion: What kind of colonist population has the highest chance of adapting and surviving in the changing and competitive environment of a new planet?*