**WHAT HAPPENED TO THE FROGS?**

**Background information:**

You and your lab group decide to sample a river for frogs. Once you collect 10 frogs you notice that some of them look different from the others. These differences are known as malformations. Malformations occur when tadpoles have developmental errors. Here, you will assess the malformations associated with tadpoles that have been exposed to aquatic pollutants. You will analyze the malformations of your 10 frogs, graph your data, answer questions relating to malformations, and draw a picture of your hypothetical river.

Some malformations include

* **Amelia**—evidence of a missing limb.
* **Anophthalmia**—missing an eye.
* **Bilateral rear limb malformations**—the occurrence of malformation in both rear limbs, amelia in this case.
* **Ectodactyly**—missing toe; refers to a complete missing digit.

Amphibians may be sensitive biological indicators because their permeable skin absorbs toxins in the environment. Although malformations are seen in adults, their onset occurs during developmental stages. In essence, tadpoles were exposed to ecosystem disturbances (pollutants, UV radiation, and so on) that are then expressed in adult frogs. Malformations are a result of an error that occurred early in development. Therefore, some malformations may come from natural developmental fluctuations in nature. In this lab, we assume that different sources of pollution cause the same effect in all individuals of that ecosystem. In nature, this assumption would not hold, since pollutants have varying effects on different individuals.

**Urbanization**  
- When people live in a community near bodies of water, they create contaminated runoff. In many cases, this runoff includes household chemicals that are toxic. In this case, these household chemicals cause amelia in frog communities.

**Forestry**  
- Forestry operations increase sedimentation into streams because root mass is decreased in the soil. Forest managers use pesticides, herbicides, and controlled burns to create a more viable forest. In this case, these forestry practices lead to bilateral rear limb malformations in frogs.

**Agriculture**  
- Farmers who produce cash crops like corn and tobacco frequently use pesticides, herbicides, and fertilizers to keep the unwanted insects off their crops and to increase nutrients in the soil. In this case, the pesticides and herbicides cause anophthalmia in frogs.

**Mining**  
- The mining process requires the use of heavy metals. Once in water systems, these metals can lead to severe ecosystem problems. In this case, they lead to ectodactyly in frogs.

**Undisturbed natural area**  
- Malformations can occur in the developmental process naturally. However, in this lab, we will assume that the undisturbed natural areas will only produce frogs that completely lack malformations.

**Procedure**

1. Obtain 10 frogs from your teacher. When getting your frogs, pick them out without looking.
2. Analyze what frog malformations you have in your sample. Use the frog malformation definitions provided.
3. Create a bar graph for the number of individuals you have according to malformation. Use the graph below. Don’t forget to label the y-axis!

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1. Determine which frog malformations correlate with the sources of aquatic pollution listed.   
   Rate your aquatic pollution sources from largest to smallest: (4 points) (answers will vary)  
   a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Questions**

1. Which malformation was the most common in your stream?
2. Which malformation was the least common in your stream?
3. Describe how aquatic pollutants affect frog morphology (i.e., how can a pollutant change the way the frogs look?).
4. You and some friends visit a stream behind your home. There, you see a handful of frogs that look completely normal. Does this mean that there is no aquatic pollution affecting the stream? Defend your answer.  
     
     
     
     
     
     
     
   

**Going further**

On a blank sheet of paper, draw a picture of your stream with the pollution sources labeled. Be sure that there is a difference for degree of pollution by the source (i.e., be sure that the teacher can tell that your largest source of pollution is different from your smallest source of pollution on the drawing). *To the right is a sample of a river map for a group that had heaviest influences by agriculture and mining. There were no influences from forestry or urbanization.*