Gizmos

Name: _____ Date: _____

Student Exploration: Temperature and Sex Determination

Vocabulary: embryo, hypothesis, mean, sex, sex chromosome, trial

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Organisms that reproduce sexually can be categorized according to their **sex**. Most organisms have two sexes: male and female.

1. What do you think determines the sex of a human baby? _____

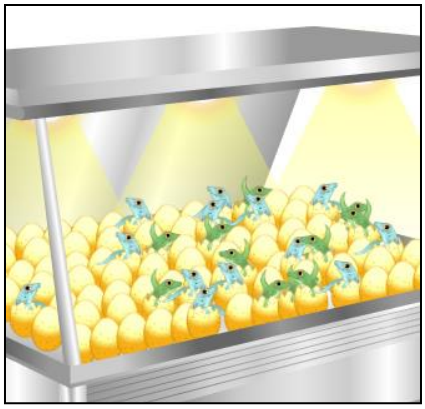
   _____

2. An **embryo** is an organism in an early stage of development. Do you think an embryo's sex can be changed after it is conceived? Explain your answer.

   _____

   _____

Gizmo Warm-up
In humans, sex is typically determined by **sex chromosomes**. Females inherit two X chromosomes. Males inherit one X and one Y chromosome. However, in some species inheritance doesn't always determine sex. Instead, the environment can play a role in determining whether an organism develops as a male or female.



Using the *Temperature and Sex Determination* Gizmo, you are going to carry out a set of experiments to determine whether temperature plays a role in determining the sex of bird and gecko embryos. To start, select the BAR CHART tab and turn on **Show numerical values**.

1. How many eggs are in the incubator? _____

2. Click **Play** ( ) and observe.

   A. What happens? _____

   B. How many green female birds hatched? _____

   C. How many blue male birds hatched? _____

Activity A: **Birds**	Get the Gizmo ready: • Click **Reset** ( ). • Be sure **Bird** is still selected.	Male 

Question: How does temperature affect the sex of developing bird embryos?

1. Form hypothesis: A **hypothesis** is a proposed explanation for an observation. Hypotheses must be testable. Based on what you have seen and learned so far, how do you think temperature will affect the sex of developing bird embryos?

   _____

   _____

2. Observe: Click **Play**.

   A. How many female birds hatched? _____ How many male birds hatched? _____

   B. Click on the TABLE tab. How do these numbers compare with the numbers of females and males that hatched the last time? _____

   C. A **trial** is a single time an experiment is conducted. Random chance often causes identical trials to have different outcomes. Why is it useful to conduct multiple trials while using this Gizmo in order to explore the effects of temperature on sex?

      _____

      _____

3. Experiment: Click **Reset**, and then click **Clear** on the TABLE tab. Use the ***Temperature*** slider on the SIMULATION pane to change the incubator's temperature. Run three trials at each temperature listed in the table and record the numbers of hatched males and females.

Temperature	**Number of hatched males**			**Number of hatched females**		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
78 °F						
81 °F						
84 °F						
87 °F						
90 °F						

(Activity A continued on next page)

Activity A (continued from previous page)

4. Calculate: For each temperature you ran trials for, calculate the **mean**, or average number, of hatched males and females. To do this, add the results from each trial and divide by 3.

   Next, calculate the percentage of eggs that hatched as males. Because there were 100 eggs in each trial, the average number of hatched males is equal to the percentage of eggs that hatched as males. Record these numbers in the last column of the table.

Temperature	Mean number of hatched males	Mean number of hatched females	Percentage (%) of eggs that hatched as males
78 °F			
81 °F			
84 °F			
87 °F			
90 °F			

5. Analyze: What patterns, if any, do you see in the data you collected? _____

6. Draw Conclusions: Click on the GRAPH tab, and look at both the **Male vs. temp.** and **Female vs. temp.** graphs. Does temperature seem to have an effect on the sex of developing bird embryos? Explain your answer.

7. Compare: If possible, compare your results with your classmates. How similar were their results to your results? Did their results show the same patterns, if any, as your results?

Activity B: Geckos	Get the Gizmo ready: • Click **Reset**. Click **Clear** on the TABLE tab. • Select **Gecko** on the SIMULATION pane.	Female 

Introduction: Like humans, the sex of birds is almost solely determined by inherited sex chromosomes. But what about lizards like geckos? In this activity, you will find out whether sex chromosomes or environmental factors are the major determinant in the sex of geckos.

Question: How does temperature affect the sex of developing gecko embryos?

1. Form hypothesis: How do you expect temperature to affect the sex of geckos?

   _____

   _____

2. Experiment: Use the Gizmo to run three trials at each temperature listed in the table below. Record the results in the table.

Temperature	Number of hatched males			Number of hatched females		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
78 °F						
81 °F						
84 °F						
87 °F						
90 °F						

3. Calculate: Find the mean number of hatched males and females. Then, calculate the percentage of eggs that hatched as males. Record your calculations in the table below.

Temperature	Mean number of hatched males	Mean number of hatched females	Percentage (%) of eggs that hatched as males
78 °F			
81 °F			
84 °F			
87 °F			
90 °F			

(Activity B continued on next page)

Activity B (continued from previous page)

4. Analyze: What pattern, if any, do you see in the data you collected? _____

5. Draw Conclusions: Click on the GRAPH tab, and look at both the **Male vs. temp.** and **Female vs. temp.** graphs. Does temperature seem to have an effect on the sex of developing gecko embryos? Explain your answer.

6. Compare: If possible, compare your results with your classmates. How similar were their results to your results? Did their results show the same patterns as your results?

7. Explain: How does the effect of temperature on sex differ for geckos and birds?

8. Extend your thinking: Do you think there are any evolutionary advantages or disadvantages to having sex determined by temperature? If possible, discuss your thoughts with your classmates.