Gizmos

Name: _____ Date: _____

Student Exploration: Reverse the Field

Vocabulary: inversion, mean, retina

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
When you see an object, light from the object is focused on the **retina**, a thin tissue on the back of your eye. This image is upside-down and reversed.

1. How do you think you are able to see a right-side-up image? _____

   _____

2. Suppose you wore a special pair of goggles that turned everything you see upside-down. Do you think you would be able to adjust to this new reality? Explain why or why not.

   _____

   _____

Gizmo Warm-up
Normally, the cursor on a computer screen follows the movements of your hand. If you move your hand to the right, the cursor moves right. But what would happen if the cursor did the opposite of what you intend? Would you still be able to use your computer? The *Reverse the Field* Gizmo allows you to experience a situation in which your mouse cursor does not react to your movements in a normal way.

To start, see how well you can use your cursor in normal circumstances. Check that test **A** is selected and press **Begin test**. Type the word “gizmo” by clicking on the letters with your mouse.

1. How long did it take you to type “gizmo”? _____

2. Type “gizmo” four more times. What were your times? _____ _____ _____ _____

3. What do you notice about your times? _____

   _____

Activity A: **Adjusting to inversions**	Get the Gizmo ready: • Click **Reset clocks**. • Check that the **Goal** is "gizmo." If not, click "Reload" or "Refresh" on your web browser.	

Introduction: An **inversion** is a reversal of position and direction. The *Reverse the Field* Gizmo allows you to work with situations in which the function of your mouse is inverted.

Question: How well do you adjust to inversions in mouse function?

1. Predict: The *Reverse the Field* Gizmo allows you to experiment with three different inversions: left-right (test **B**), up-down (test **C**), and left-right-up-down (test **D**).

   Which inversion do you think you will adjust to most easily? _____

   Which inversion do you think will be the most difficult? _____

2. Gather data: For each test, run six trials with the word "gizmo." Record all times in the table.

Trial	Left-right (test B)	Up-down (test C)	Left-right-up-down (test D)
1			
2			
3			
4			
5			
6			
Mean times			

3. Analyze: What patterns do you see in your data? _____

   _____

   _____

   _____

4. Calculate: Cross out the slowest time in each column. Calculate the **mean** for each test by adding the remaining times and dividing the sum by five. Record the mean times in the bottom row of the table.

(Activity A continued on next page)

Activity A (continued from previous page)

5. Compare: Look at the results and mean for each test.

   A. Which inversions yielded the best and worst individual times?

      Best: _____ Worst: _____

   B. Which inversions yielded the best and worst mean times?

      Best: _____ Worst: _____

   C. If possible, share your results with those of your classmates. Did they experience similar results? Explain. _____

      _____

      _____

6. Draw conclusions: Based on your data, which inversion was the easiest to adjust to? Which was the hardest? Why do you think this was? _____

   _____

   _____

   _____

   _____

   _____

   _____

7. Think and discuss: Why do you think it is sometimes a good idea to drop the most extreme result when calculating the mean of a data set? _____

   _____

   _____

   _____

   _____

Activity B: **Long-term adjustments**	Get the Gizmo ready: • Click **Reset clocks**. • Select test **A**.	multimedia

Question: How well can we adjust to inversions that occur for a longer period of time?

1. Form hypothesis: Given unlimited practice, do you think you can function as well with an inversion as you can without? Explain why or why not. _____

   _____

   _____

2. List: Click **Change goal**. What word is your goal now? _____

3. Gather data: With test **A** (no inversions) selected, type this word five times. Record the times below, and circle your best time.

   _____ _____ _____ _____ _____

4. Select a test: Your challenge is to try to adjust to the most difficult inversion for you.

   Which inversion will you try? _____

5. Gather data: Click on your chosen inversion, and then type the word 30 times. Record your results in the table. (Fill in each row from left to right, starting at the top.) Circle the best time.

6. Gather data: Now select test **A** and try writing the word five more times. Record the times:

   _____ _____ _____ _____ _____

(Activity B continued on next page)

Activity B (continued from previous page)

7. Analyze: Consider your results in the three experiments.

   A. Were you able to perform as well with the inversion as you were without? Explain.

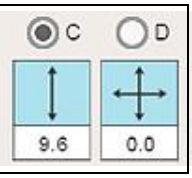
   B. How much did you improve over the course of 30 trials with the inversion?

   C. Compare your times in question 3 to your times in question 6. How did practicing with the inversion affect your ability to function *without* the inversion?

8. Think about it: Do you think you collected enough data to truly answer the question posed at the beginning of this activity? In other words, how well do you think you would do given unlimited practice for many days?

9. Describe: Explain what it was like to type the word with an inversion. Did you have to use a particular strategy to get to the next letter? Did that strategy change over time?

10. On your own: If you like, continue to practice with the inversion until you can type the word as fast with the inversion as without. Share your experiences with your classmates and teacher.

Extension: **Design an experiment**	Get the Gizmo ready: • Click **Reset clocks**.	

Introduction: The *Reverse the Field* Gizmo can be used for a science fair project or other experiment. The first step is to come up with an interesting question to investigate.

Choose a question
Here are a few suggestions to get you started. You can choose a topic from this list or come up with a topic on your own.

- Which type of inversion is easiest to adjust to?
- Which type of inversion is the most difficult to adjust to?
- Does gender affect the ability to adjust to inversions?
- Does age affect the ability to adjust to inversions?
- How do various distracters (music, flashing lights, or background noise) affect a person's ability to adjust to inversions?
- How does putting someone in a stressful situation affect their ability to adjust to an inversion?
- Do video-game enthusiasts adjust more easily to inversions?
- Which is better able to adjust to inversions, the right hand or the left hand?

Which question are you going to investigate? _____

_____

Design your experiment
The key to designing a successful experiment is to control your variables. Everything in your experiments should be the same except for the one variable you are investigating. For example, if you are comparing different inversions, then each subject should have the same goal word.

Before beginning the experiment, explain your project and experimental design to your teacher. Ask if there is any paperwork that you need to fill out. (Many science fairs require specific paperwork to be filed for any project involving human subjects.)

Briefly describe your experimental design: _____

_____

_____

_____

_____

(Extension continued on next page)

Extension (continued from previous page)

Carry out your experiment
A well-designed experiment isn't any good unless you carry it out according to your plan. Gather data from as many subjects as possible. In general, the more data you collect, the more reliable your results will be. After your data has been collected, analyze the data using graphs and tables. Draw conclusions based on your data, not on what you expected to happen.

In the space below, summarize your results and state your conclusions: _____

_____

_____

_____

_____

_____

_____

Present your results
The last step is to present your experiment in a clear and visually appealing way. Include tables and graphs that show the trends in your data. If you are presenting at a school science fair, a nice touch might be to include a computer in your display so passersby can test their own ability to adjust to inversions. Good luck and have fun!