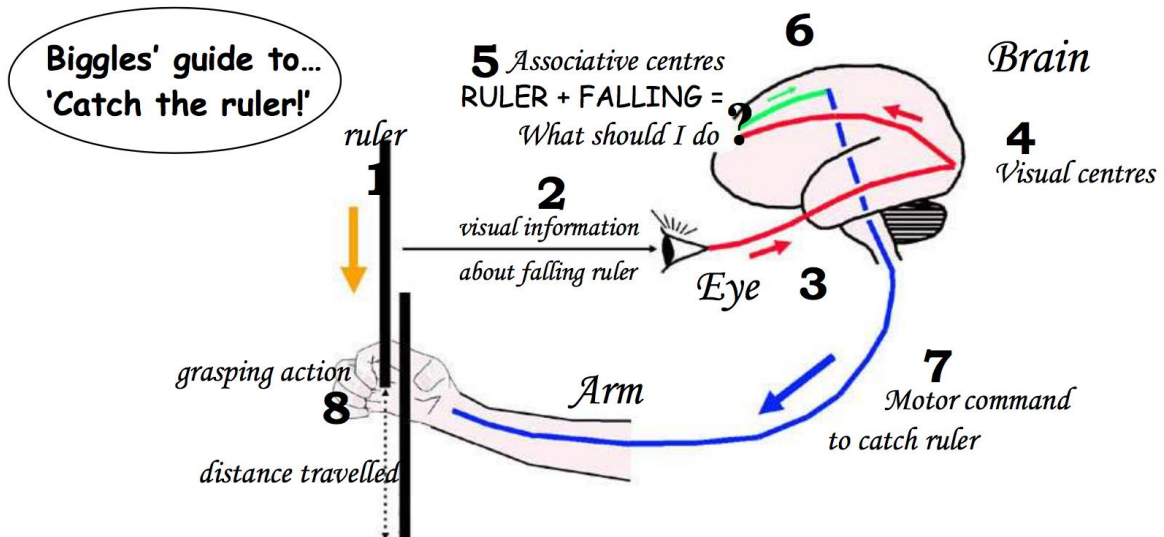Investigative Science –RULER REFLEX

NAME _____ Period _____

THE FIGHTER PILOT CHALLENGE: IN THE BLINK OF AN EYE

To be a fighter pilot you must have very fast reactions – travelling at speeds of over 2500 km per hour (twice the speed of sound) means about 700m every second! So splits of a second can make all the difference, you blink your eyes and you've moved an incredible 140m! Could you respond to outside events with minimal delay and take appropriate action... let's test your reaction time?

The simple experiment described on this page is dead simple, you test the time it takes to react to catch a falling ruler. Just make sure it isn't a metal ruler ...it could seriously injure your foot!

The Science Of Catching The Ruler

The experiment tests how long it takes the brain to translate visual information (falling ruler) into your voluntary (or conscious) motor commands and actions (grasping finger movements) that lead to the ruler being caught. The shorter the time, the faster your reactions..... that's if you were paying attention in the first place! Indeed, practice specifically affects the 'associative centres' in the brain, so that you can respond faster to what's happening in your visual world. The flow of information along the 'visual' and 'motor' nerve pathways is relatively constant even with lots of practice. It all comes down to 'attention' or '…being on the ball!'

Biggles' guide to...
'Catch the ruler!'

6

5 *Associative centres*
RULER + FALLING = **?**
What should I do?

Brain

4
Visual centres

ruler

1

2
visual information
about falling ruler

Eye **3**

grasping action

8

Arm

7
Motor command
to catch ruler

distance travelled

DISTANCE – REACTION TIME CONVERSION TABLE

From the table below, the 'mean catch distance' on the ruler can be converted into a 'mean reaction time' in milliseconds (Remember: 1 millisecond is one thousandth of a second).

Distance (cm)	Reaction time (milliseconds)	Distance (cm)	Reaction time (milliseconds)
1	50	16	180
2	60	17	190
3	70	18	190
4	80	19	200
5	90	20	200
6	100	21	210
7	120	22	210
8	130	23	220
9	140	24	220
10	140	25	230
11	150	26	230
12	160	27	230
13	160	28	240
14	170	29	240
15	170	30	250

Science basics (These are all review)

Qualitative observation: An observation using your senses, just words, no numbers.

Quantitative observation: An observation that includes a number and/or a measurement.

Inference: an interpretation that explains an observation.

Control group: A group that remains under normal conditions during an experiment

Independent (Manipulated) variable (IV): The variable you manipulate in the experiment.

Dependent (Responding) variable (DV): The variable you measure, it is affected by changing the IV.

Conclusion: A summary of what is learned in an experiment.

Control Variable: The variables keep constant in the experiment.

Experimental Question: A formal cause-effect question. Asks about the relationship between two variables.

** Must be in "How does the _____ affect _____?"
                              (Independent variable)   (dependent variable)

Hypothesis: A possible explanation for a set of observations or to a scientific question; must be testable.

Hypothesis: If the _____ is used, the _____
                              (Independent variable)   (dependent variable)

will increase because _____

Guided Experiment

Experimental Question: How does the use of the dominate hand affect reaction time?

Independent variable: _____

Dependent Variable: _____

Control variables:

1. _____

2. _____

3. _____

Hypothesis: If the _____ is used, the _____

                              (Independent variable)   (dependent variable)
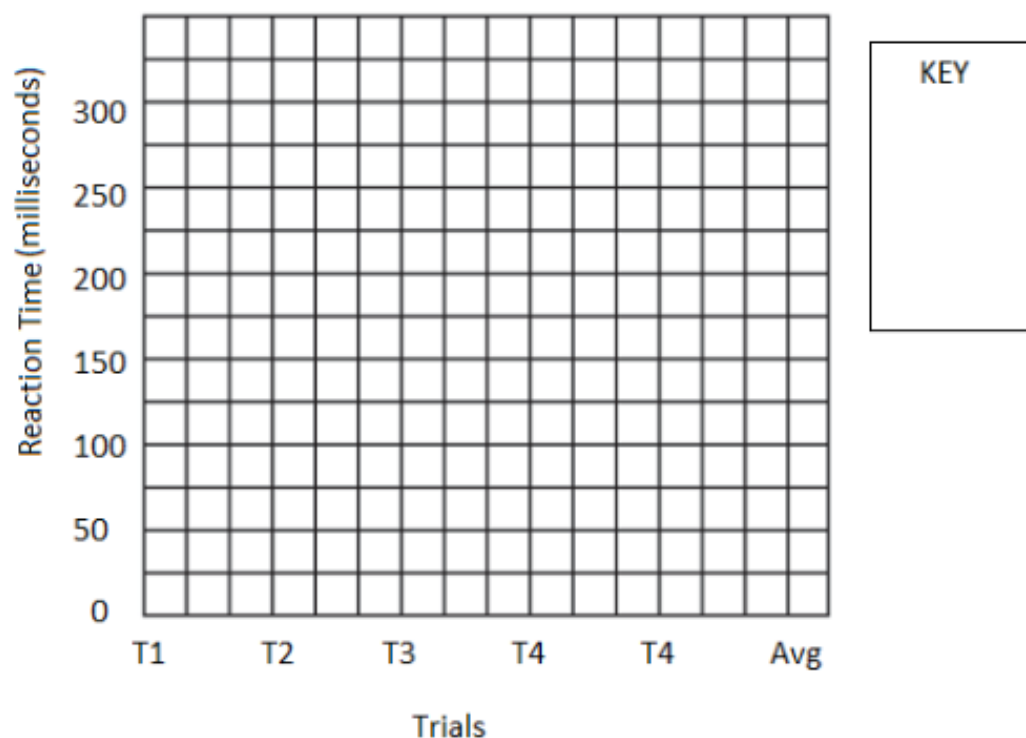
will increase because _____

_____.

Experimental Procedures

1. Get a 30cm ruler...

2. One person holds the ruler near the 30cm mark and lets it hang vertically...

3. The other person places their thumb and index finger either side of the 0cm mark ready to catch it when it falls - their fingers shouldn't touch the ruler.

4. Without warning the person holding the ruler lets go and the subject tries to catch the ruler as soon as possible. [Hint: To prevent guessing, vary the time before letting go of the ruler].

5. The level (in cm) just above the subject's first finger where the ruler was caught is recorded.

6. At any time if you do not catch the ruler in time, record this as 35 cm.

7. The same person is tested 5 times and then calculate the mean average of their results (add all five numbers together and then divide by five).

8. Now swap over and test your partner.

Trial	Dominate Hand		Non-Dominate Hand	
	Distance Ruler Falls (cm)	Time in milliseconds (See chart)	Distance Ruler Falls (cm)	Time in milliseconds (See chart)
1				
2				
3				
4				
5				
Total				
Average				

Experimental question _____

KEY

Reaction Time (milliseconds)

300

250

200

150

100

50

0

T1   T2   T3   T4   T4   Avg

Trials

Data analysis:

The data tables and graphs show (Describe the data in words) _____

_____

_____

_____

The hypothesis, (restate hypothesis), is (supported or refuted) by the data because (use the data to support this) _____

Conclusion

The problem being studied in this experiment was (experimental question) _____

_____

It was proposed that if (hypothesis)_____

_____

If the hypothesis is supported by the data, the results SHOULD (say what the results should look like) _____

_____

_____ _____

The data in this experiment ACTUALLY showed that (describe actual results) _____

_____

_____

_____

Although the experiment was controlled, there were still some possible sources of error. Sources of error in this experiment include (What could have changed your data? What variables were not controlled or could not be controlled? Was your experimental setup successful and effective? Why or why not?)

_____

_____

_____

_____

These errors could be avoided in the future by (How can you improve your procedure so that you don't make the same mistakes and/or how could you better control your variables?) _____

_____

_____

_____Some future research that could be conducted is (what other questions could you explore?)_____

_____

_____

_____

_____

Curiosity Zone – Time To Experiment

After you've tested yourself, why not experiment further. Here's a few suggestions, do reaction times vary: Choose one as your independent variable.

- for people of different ages (children versus adults)?

- if you use your dominant hand versus non-dominant hand?

- if you are tired or alert?

- for men or women?

- depending on your mood?

- Time of Day?

- Length of fingers?

Experimental Question: How does the _____ affect _____?

                                  (Independent variable)   (Dependent variable)

Independent variable: _____

Dependent Variable: _____

Control variables:

1. _____

2. _____

3. _____

Hypothesis: If the _____ is used, the _____

               (Independent variable)   (dependent variable)

will increase because _____

_____.

Experimental Procedures

1. Get a 30cm ruler...
2. One person holds the ruler near the 30cm mark and lets it hang vertically...
3. The other person places their thumb and index finger either side of the 0cm   mark ready to catch it when it falls - their fingers shouldn't touch the ruler.
4. Without warning the person holding the ruler lets go and the subject tries to   catch the ruler as soon as possible.   [Hint: To prevent guessing, vary the time before letting go of the ruler].
5. The level (in cm) just above the subject's first finger where the ruler was caught is recorded.
6. At any time if you do not catch the ruler in time, record this as 35 cm.
7. The same person is tested 5 times and then calculate the mean average of their results (add all five numbers together and then divide by five).
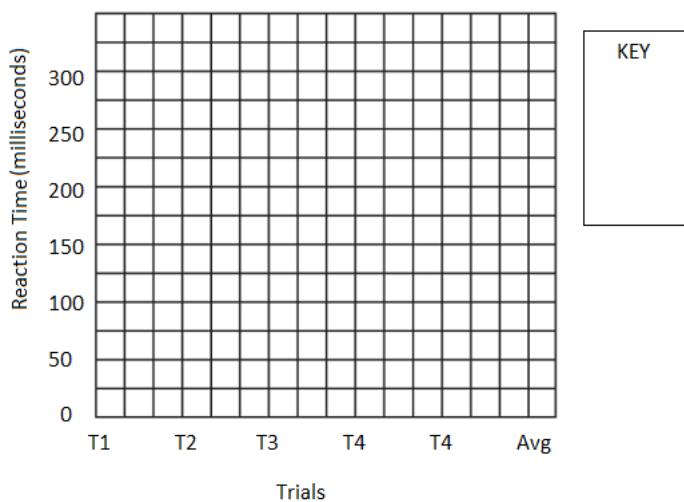8. Now swap over and test your partner.

Changes to the previous Experimental Procedures:

1.

2.

3.

Trial	Dominate Hand		Non-Dominate Hand	
	Distance Ruler Falls (cm)	Time in milliseconds (See chart)	Distance Ruler Falls (cm)	Time in milliseconds (See chart)
1				
2				
3				
4				
5				
Total				
Average				

Experimental question _____

Data analysis/ Conclusion: Complete sentences, paragraph form, no personal pronouns. Use the wording in the previous experiment as a guide

Required components Data analysis:

- Summarize the data

- Restate hypothesis

- Explain if your hypothesis was supported by the data or was disproven
Conclusion:

- Restate the experimental question

- Restate the hypothesis

- What would the results be IF the hypothesis was supported?

- describe actual results

- Describe Error

- How to avoid error

- Future research

Data Analysis:

Conclusion: