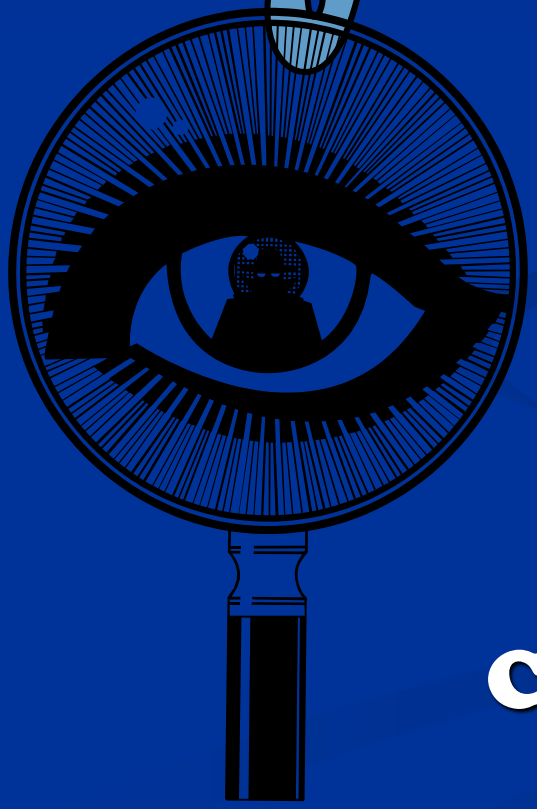
Science Starters

Mystery Photo



Challenge 7

See if you can determine what the following magnified photos are. Number your paper to 5.

The Answers:









EXPERIMENTAL DESIGN

Science answers questions with experiments

DEFINE THE PROBLEM

Begin by asking a question about your topic

What is a good question for an experiment?

One that is testable with the materials at hand

Now we need a hypothesis to guide our investigation.

What is a hypothesis?

Your best thinking about how the change you make might affect another factor.

Tentative or trial solution to the question.

An if ……. then ……. statement.

Design an Experiment

- Must design an experiment that will test your hypothesis.
- This experiment will allow you to change some conditions or variables to test your hypothesis.

Variables

Variables are things that change.

The *independent variable* is the variable that is purposely changed. It is the manipulated variable.

The *dependent variable* changes in response to the independent variable. It is the responding variable.

Constants or Controlled Variables in an Experiment

What are constants in an experiment?

Factors that are kept the same and not allowed to change.

It is important to control all but one variable at a time to be able to interpret data

Materials and Procedures

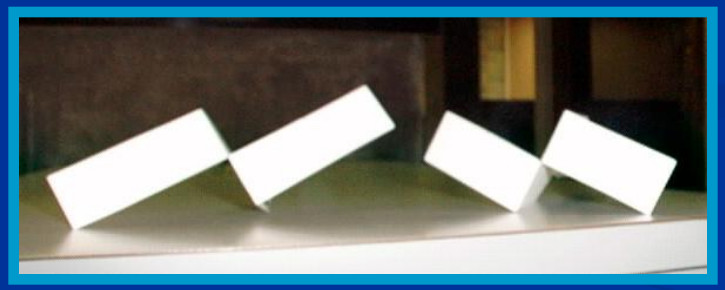
A description of what you will use for your experiment, and how you will do it.

Be sure to include:

- **Listing of the Variables**
- **Repeated Trials**
- **Drawing of Apparatus**

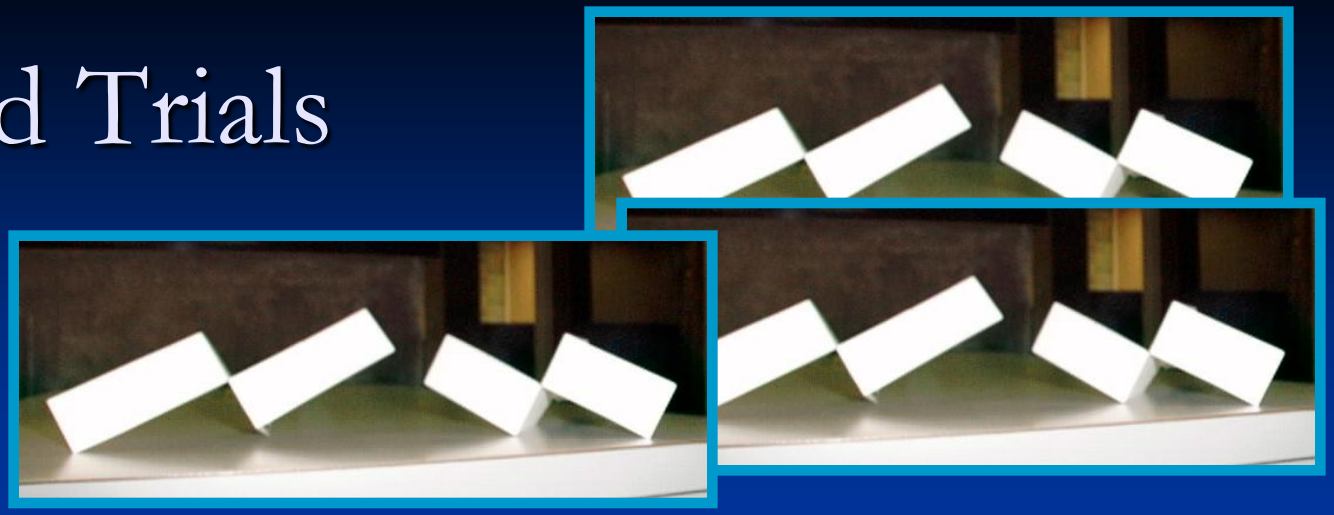
How will you vary the Independent Variable

How many different values of the independent variable should we test?



3 ? 5? 10? The more the better?

Repeated Trials



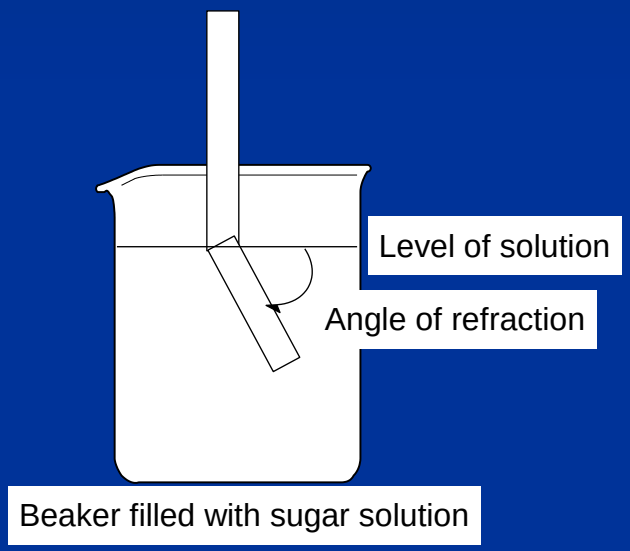
What are repeated trials?

The number of times that a value of the independent variable is tested.

Why are repeated trials necessary?

They reduce the possibility of chance errors affecting the results.

Drawing of Experiment



Include Labels to clearly identify the important parts of the experimental setup

Qualitative Observations and Results

What are qualitative observations?

They are what you perceive that occurred during the course of your experiment. They are identification of trends in the data.

Quantitative Observations and Results

What are quantitative observations?

Numbers in the form of raw data displayed in data tables and graphs

Sample Data Table

Title: **The Effect of *the independent variable* on the *dependent variable***

Column for independent variable	*Column for dependent variable*			*Column for derived quantity*
Label – with units if necessary	Label – with units if necessary – multiple trials included			Label – with units if necessary. Example = average of trials
	1	2	3	

Graphs

Title: **The Effect of *the independent variable* on the *dependent variable***

Independent Variable – include units and an appropriate scale

Analysis and Interpretation of Results

This is where you describe in words what is illustrated by your data as shown in your table and graph

You also describe the meaning of the results

Possible Experimental Errors

What factors in your materials or procedure might have had an impact on your results?

Conclusion

Why or why not your results supported or did not support the hypothesis.

Hypotheses are never "wrong". They are either supported or not supported.

Include reasons for the hypothesis to be supported or unsupported.

Recommendations for Further Experimentation

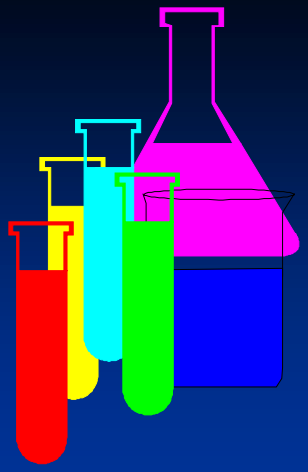
What are some practical applications of your results?

What other questions that could be tested arise from your results?

Sample experiment with data

- Students were asked to build a helicopter and test something.

Writing A Statement of the Problem for the Experiment



What should it state?

It should state: "The Effect of the Independent Variable on the Dependent Variable".

A good statement of the problem for "The Helicopter would be

The Effect of wing length on time of decent

More about our variables:

The *independent variable* is the variable that is purposely changed. It is the manipulated variable.

The *dependent variable* changes in response to the independent variable. It is the responding variable.

What is the "Helicopter" independent variable?

length of one wing as measured in centimeters

What is the dependent variable?

time of descent as measured in seconds

Title for the Helicopter Experiment

The Effect of Wing Length on the Length of Time the Helicopter Takes to Reach the Ground

Another Look at Our Hypothesis

INDEPENDENT VARIABLE

If the length of the wings are increased,

DEPENDENT VARIABLE

then time of descent will increase.

Constants in an Experiment

Factors that are kept the same and not allowed to change

What should be kept constant in the“Helicopter”?

CONSTANTS

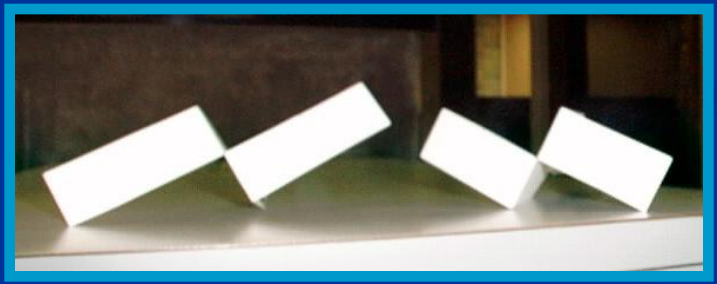
Same structure of helicopters

Same dropping technique

Same dropping height

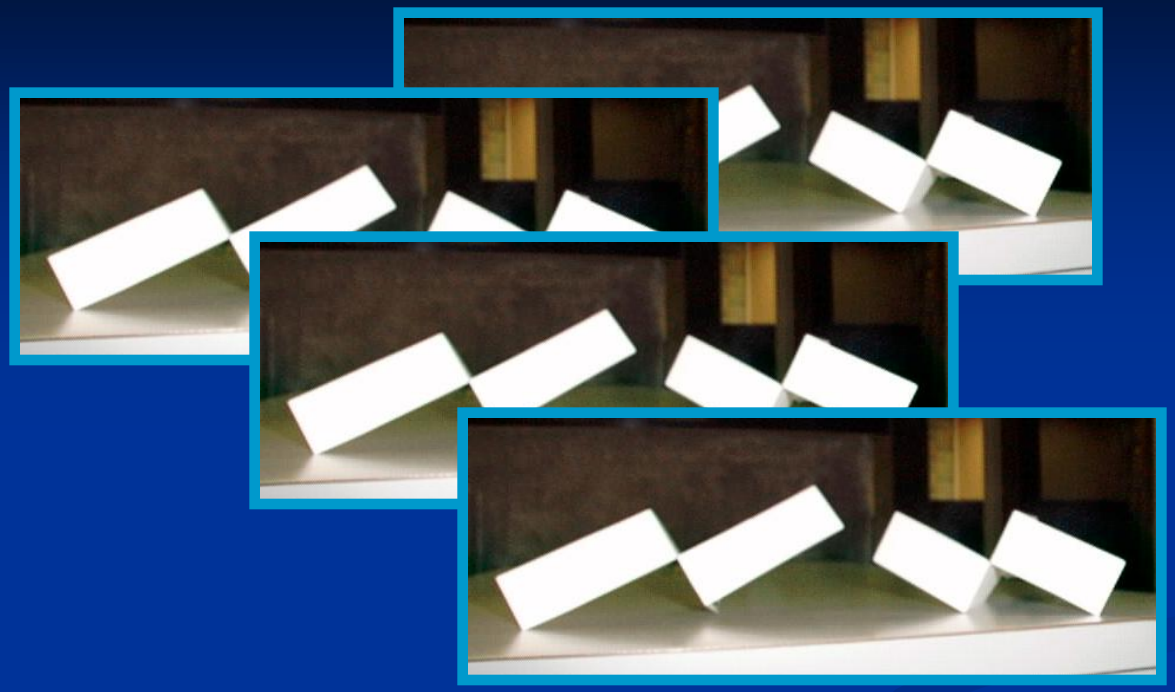
Values of the Independent Variable

How many different values of the independent variable should we test?



Enough to clearly illustrate a trend in the data - 5cm, 6cm, 7cm, 8cm…..

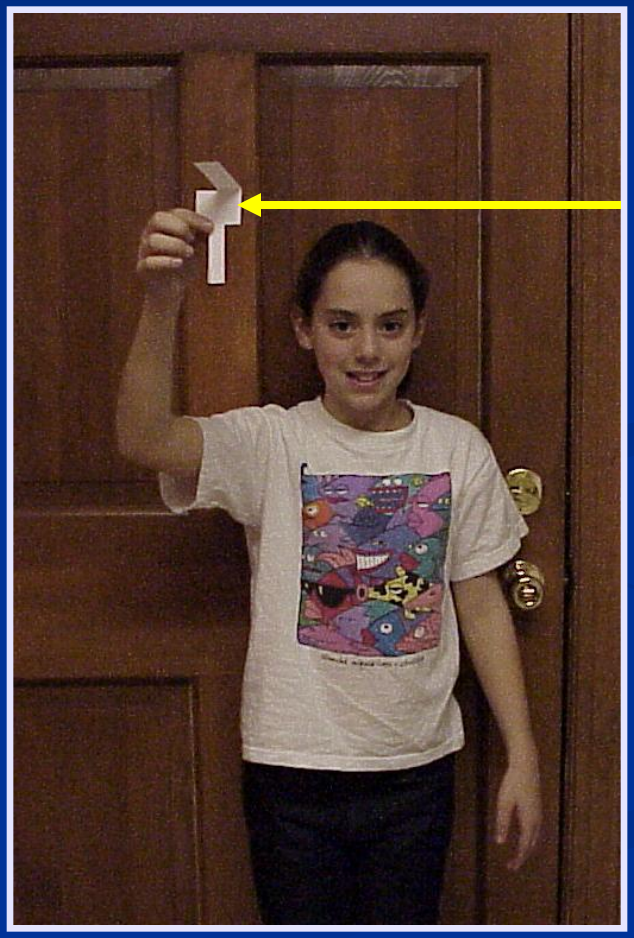
Repeated Trials



How many repeated trials are needed in the "Helicopter"?

At least 3, then calculate an average value for each level of the independent variable

Drawing of Experiment



Hold helicopter in the middle

Drop from same spot each time

Qualitative Observations and Results

- As we dropped the helicopter, we observed that sometimes they seemed to be affected by air currents.
- It appeared that helicopters with longer wingspans took a greater time to reach the ground

Quantitative Observations

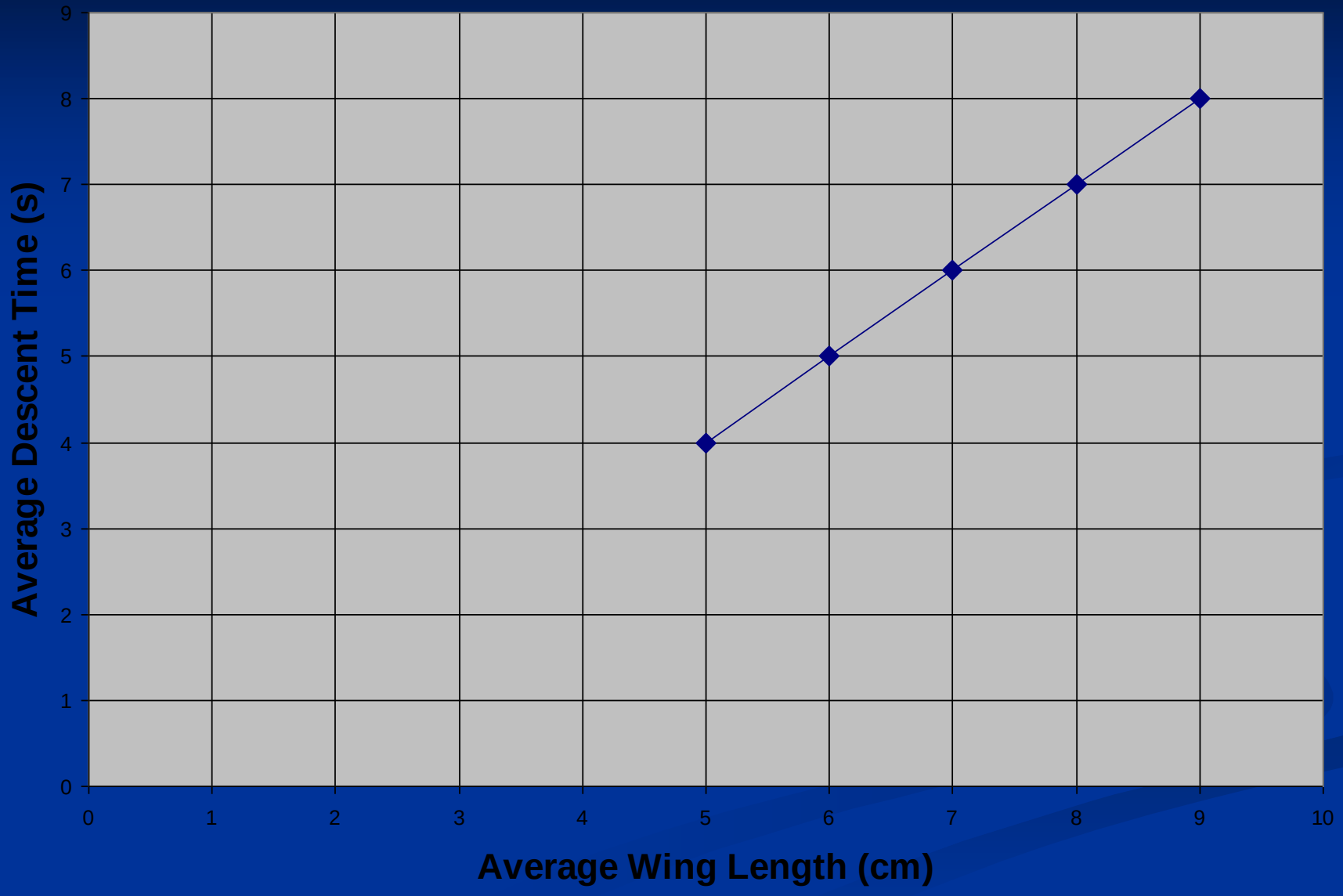
Data Table, Graph and Statistics

Sample Data Table

Title: **The Effect of *wing length* on the *time of descent***

Wing Length (cm)	Descent Time (s)			Average Descent Time (s)
	Trials			
	1	2	3	
5	3	5	4	4
6	4	5	6	5
7	6	7	5	6
8	7	8	6	7
9	9	7	8	8

The Effect of Wing Length on Descent Time



Analysis and Interpretation of Results

While individual trial results showed some variation; overall, as average wing length increased from 5 through 9 centimeters, average time of descent also increased from 4 through 8 seconds.

This shows a direct correlation.

Possible Experimental Errors

Although the average results supported the hypothesis, the individual trial results showed some variation. Some possible reasons for this could be due to air currents in the room or reaction time differences between the timer and the helicopter dropper.

Conclusion

The overall results supported the hypothesis.

A possible reason for this could be due to increased surface area of the wing in contact with the air - allowing for greater air support.

Recommendations for Further Experimentation/ Practical Applications

Increased time of descent due to greater wing length suggests that increased wing length could lead to greater fuel efficiency of an actual helicopter.

Other experiments investigating factors that would contribute to greater descent time might include: making modifications in the shape of the wings, changing the number of wing blades, and making folds in the wing blades

What kind of question would you ask?

- Materials provided: sugar, stir sticks, access to warm and cold water and ice, thermometers, beakers, object that floats partially submerged in water, graph paper, jumbo paper clip, straws, rulers, protractor

- Come up with a question related to solutions

Possible Questions

- effects of temperature on solubility
- effects of concentration on depth object sinks in solution
- effects of stirring on solubility
- effects of concentration on height of solution rising in straw
- effect of amount of sugar dissolved on temperature of solution
- effect of temperature on how long a set amount of sugar required to dissolve

Possible Hypotheses

- If we raise the temperature then the solubility will ???
- If we increase the sugar concentration then the height of solution rising in the straw will ???
- If we dissolve more sugar in the solution then the temperature will ???