Name _____ **Period** _____

The Scientific Method: Come Fly with Us

Background: In this assignment you will use some of the same methods scientists use to solve problems. First you will start with a problem. Then you will write a hypothesis. Then you will make a model helicopter and test your hypothesis. Finally, you will come to a conclusion based on your experimental data.

Materials: copy of helicopter model, scissors, pen or pencil

Problem: How will changing the **direction** that the helicopter blades are folded affect the **flight** of the helicopter?

Experiments involve changing something to see what happens. In this case, you will refold the helicopter blades to change their direction. You will make this change on purpose to learn about its effect on the flight of the helicopter. The parts of an experiment that change are called *variables*.

There are two kinds of variables in an experiment. One, the independent variable, is the one you change on purpose. The other, the dependent variable, is the one that happens as a result of the independent variable. In order to make a fair test, you only change one part of your experiment at a time. By only changing one variable, you will know that your change is what caused the helicopter to respond in the way it did.

Procedure:

Identify the independent variable in this problem. _____

Identify the dependent variable in this problem. _____

Write a hypothesis that you can test using your helicopter.

Hypothesis: If helicopter blades _____,
(Independent Variable)

then the helicopter will _____
(Dependent Variable)

because _____
(reason for effect of independent variable on dependent variable)

2. Once you have made your hypothesis, you should test it for accuracy.

a. Using scissors cut out your helicopter and follow the directions for folding it.
b. Then, hold the helicopter by the "T" so it is level with the bottom of the 5th concrete block from the ceiling.
c. Drop the helicopter and note whether it spins clockwise  or counterclockwise. 
d. Record your data
e. Repeat this test several times
f. Refold the blades so that the square on blade Y shows when you look down on top of the helicopter.
g. Repeat this test several times

Direction of wing fold	Spin direction
X wing up	
X wing up	
X wing up	
X wing up	
X wing up	
X wing up	
Y wing up	
Y wing up	
Y wing up	
Y wing up	
Y wing up	
Y wing up	

Analysis:
You have just performed an experiment and collected data. Now you must figure out what you have learned.

To have a fair test, you need a *control*, or a standard for comparison. A control for the helicopter experiment would be an "unchanged" helicopter against which you could compare the results. In this experiment, you could make another helicopter with blades that remain unchanged. By using both helicopters each time, you could compare the results to be more accurate.

It is important to note that in some experiments, it is impossible to have a control that is completely unchanged. For example, let us say you are trying to determine the effect of light from different light sources on plant growth. The control plant needs some kind of light in order to live through the experiment. So, you have to choose one light source — possibly normal sunlight — to be the standard of comparison.

After you refolded the blades of the helicopter, you dropped the helicopter several times and observed the results. These repeated trials enable you to be more confident of your results. If you conducted your experiment only once, the results could be due to an error or a chance event, such as a draft. But, when you repeat your experiment many times and each time you achieve similar results, you can be more confident that your findings are not due to an error or chance.

Conclusion Questions:

1. In the helicopter experiment, what was the independent variable?

2. What was the dependent variable?

3. In which direction did the helicopter spin when you dropped it with the x dot up

4. In which direction did the helicopter spin when you dropped it with the y box up

5. Why did you observe a change in helicopter direction?

6. List three things you should try to keep constant (the same) each time you try this experiment.
    a.

    b.

    c.

7. Read the following paragraph and answer questions:

Alicia wanted to know if adding mass to her paper helicopter would affect how long it would stay in the air. She predicted that adding some mass would help to stabilize the helicopter and keep it in the air longer than a helicopter without extra mass. She experimented with different numbers of paper clips attached to her helicopter.

8. What is the problem question in Alicia's experiment?

9. What is Alicia's hypothesis?

10. What is her independent variable?

11. What is her dependent variable?

12. What should her constants be?

13. What can she use for a control?

14. Why should Alicia retest her experiment between 5-10 times?

Now use your model helicopter to test her hypothesis.

a. Start by folding the wing with x facing up.
b. Add one paper clip to the bottom of the model helicopter
c. Drop the helicopter the same way you did before
d. Record your data
e. After three trials add a second paper clip
f. Record your data.
g. Reverse the wing so y is facing up and repeat the test.
h. Record your data

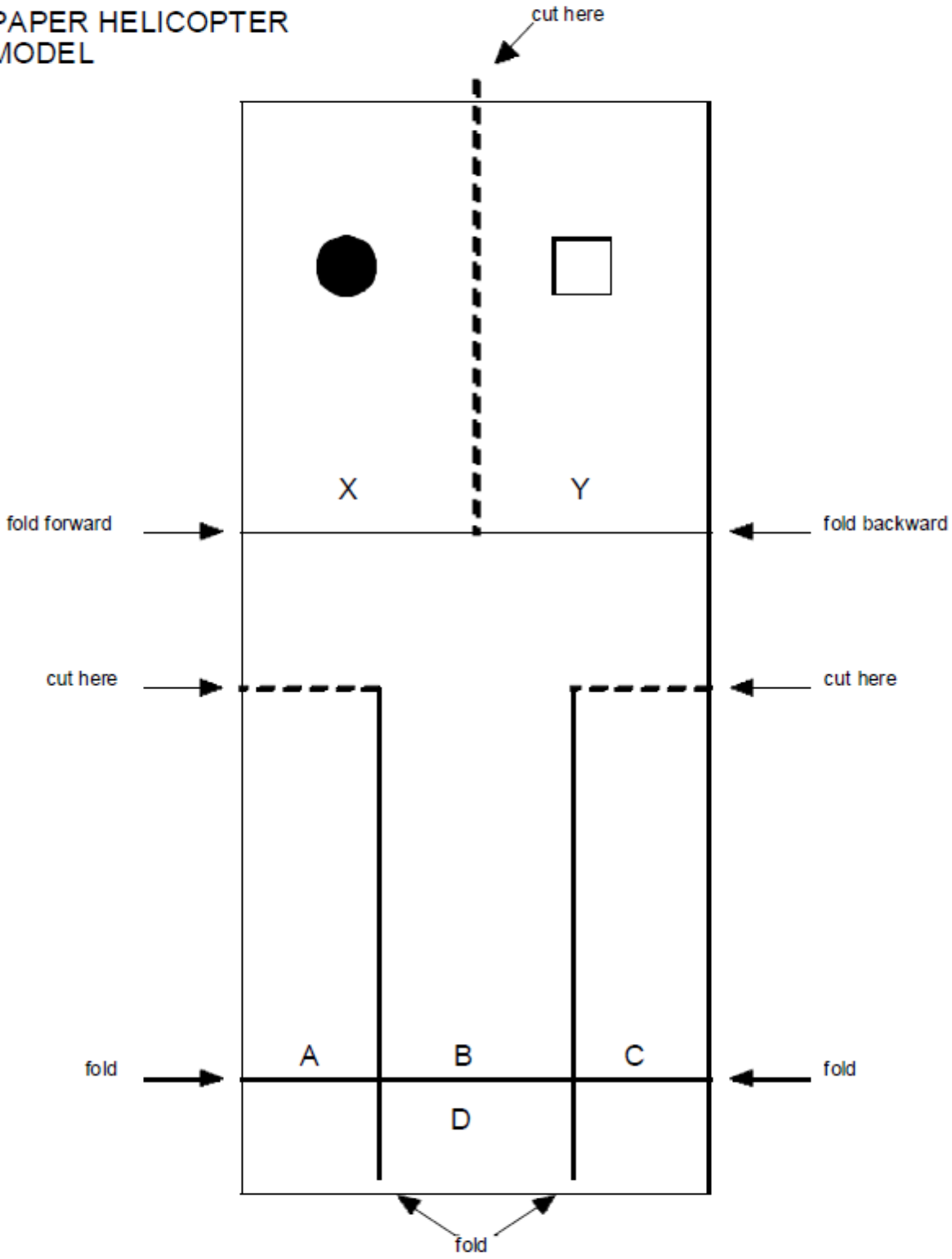
Testing with extra mass (paper clip)

Direction of wing fold	Spin direction	Speed of Fall (faster/slower)
X wing up with one clip		
X wing up with one clip		
X wing up with one clip		
X wing up with two clips		
X wing up with two clips		
X wing up with two clips		
Y wing up with one clip		
Y wing up with one clip		
Y wing up with one clip		
Y wing up with two clips		
Y wing up with two clips		
Y wing up with two clips		

1. Does your data support Alicia's hypothesis? Explain.

2. Did adding a second paper clip change the way the helicopter flew?

PAPER HELICOPTER MODEL



INSTRUCTIONS:

1. Cut out the rectangular helicopter (above).
2. Now cut along dotted lines.
3. Fold along the solid lines: section C behind section B, section A behind section B, and section D behind section B.
4. Complete the helicopter by folding blade X with the dot up and blade Y in the opposite direction with the square down.