



## I Wonder Why.....

**1. gravity is a pull?**

*It is a force, it pulled the helicopter towards Earth, a much bigger object.*

**2. air causes a push?**

*The air caused a force in the opposite direction, it pushed back against gravity.*

**3. all wings are curved?**

*To make the air flow over and under it at different rates, this causes lift.*

**4. a plane flies?**

*The wing's lift is greater than gravity, if not it will fall.*

**5. the helicopter fell if there was lift on the wing?**

*Gravity was stronger, there was no motor, the lift slowed the fall, etc.*

## Think Like a Scientist.....

**1. What two forces affect the wings of a plane?**

*Lift opposes gravity, these are the two forces in a pair.*

**2. What two forces affect the plane's forward motion?**

*Thrust of the motor opposes drag or air resistance.*

**3. How does the lift/gravity pair interact to cause flight?**

*If lift is more than gravity, the plane rises and vice versa.*

**4. How does the thrust/drag pair interact to cause flight?**

*If thrust is more than drag, the plane goes forward and vice versa.*

**5. What are the only kinds of forces in nature?**

*All forces can be classified as either push or pull.*

# Flight with a Twist



## The Science Connection

### *Engineering*

Science learns about the world. Knowing why your helicopter flew, how gravity pulled it down, etc. is science. When you use this knowledge to do something practical you have brought technology into the picture. Technology applies science to everyday situations and uses. That hand operated can opener in your kitchen is a bunch of science machines being used to open a can. Your computer uses the science of light, sound, and electricity. Science and technology work hand in hand to make our life better.

But what is engineering? Engineering designs and builds objects to solve a problem. Engineers must use lots of science, as well as technology to do their job. The computer is technology applying science to an everyday use, but engineers design better, faster, and cheaper ones to get a job done faster or better.

Let's use engineering for your paper helicopter. Use another helicopter model exactly like you used. Make a hypothesis, a guess about one thing you could change on this helicopter to make it stay in the air longer when dropped from the same height. Drop your original one 5 times from the same height and average the times. This is your control. Now make the one change you made the hypothesis about to a second model. Drop it from the same height five times and average the times. Did your change affect performance?

You just learned about science, used technology to apply the science to your helicopter. Then you used the scientific method of a hypothesis, procedure, data collecting and calculating to improve the helicopter. That makes you an engineer.

## The Initial View (Introducing the Activity)

This activity lends itself well to some inquiry and design work. Encourage the kids to try different changes of the basic design to determine cause and effect relationships. *The kids will want to start climbing higher up to achieve longer flights, so be advised and be warned!!* The photocopy page for the activity is located in the back of the text.

## Take a Deeper View! (More Science)

**Flight** with winged craft is due to the effects of the **Bernoulli Principle**. All wings must have a curved surface, whether on a duck or a Boeing 757! This curve means the air rushing at the wing's front has two choices. It can go over the top or underneath. The wing's curve means the air going over the top is going faster than underneath. Bernoulli stated the faster the air (other **Fluids**, like **Liquids**) moves, the lower the **Pressure**. With the pressure greater underneath the wing compared to the top, **Lift** is produced. An airplane (or motorized helicopter) has four **Forces** acting on it at all times. The forward **Push** from the motor is the **Thrust**, **Drag** is the air pushing back against the airplane (**Air Resistance**). The downward **Pull** is **Gravity** and you just discovered the fourth force, lift! Airplane and helicopter flight is controlled by these four forces. The pilot's job is to be sure these forces are controlled!

## More and Bigger Views! (Additional Classroom Ideas)

1. Make larger and smaller versions of the helicopter thanks to the enlarging and reducing ability of the copier.
2. Encourage kids to do measurements and enlargements even beyond the photocopy machine's ability! This is a great practice for comparisons and proportions in math!!
3. Have the kids compete to find the helicopter that can fly for the longest time. Drop them all from the same height. Give only one sheet of regular photocopy paper for them to use. Modify the helicopter in any way they think will help them stay in the air longer!!!!
4. Research the history of helicopters on the Internet. Write a summary of what you found. Investigate how the helicopter has been used in warfare, rescue, agriculture, etc.
5. Have a pilot visit class to tell more about these four forces!
6. Get back into history to find out what kinds of wings were invented and how well they worked. Find out more about using multiple wings for extra lift.
7. Research gliders and how their huge wings create lots of lift!
8. Find out more about some of the famous people in flight history. What were their accomplishments? How did some of them change flight forever?
9. Make a bulletin board of some "firsts" in flight. (first flight, first woman pilot, etc.)
10. What kinds of careers are there related to airplanes, airlines, and flying?
11. Find some video of airplanes taking off or landing on US Navy carriers!
12. What kind of modern helicopters are there? What are they used for?
13. If there is a local helicopter ambulance service, visit and find out more!
14. Find out how many paper clips is *too many* to let the helicopter fly!
15. Modify the wings by shortening, cutting into strips, etc. Does this change flights?
16. NASA's web site has all sorts of flight concepts, ideas, and history!!

## Answers

1. (ones who flew turned, the others fell down) 2. ( the twisting of the "wings")

# Flight with a Twist



**Safety Alert:**

**Scissors**

## Getting Ready

How do helicopters fly? Ok, *whoever* said “the engine” is only part right. The engine supplies the “go”. What’s the science behind these noisy mobile ceiling fans with an attitude?

## Stuff to Make it Happen (Materials)

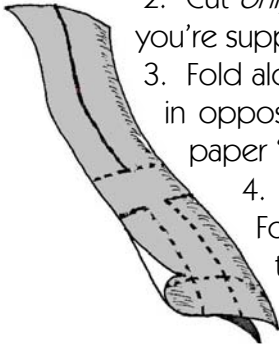
helicopter pattern worksheet

scissors\*

paper clip

## Making it Happen (*Let's be careful with the scissors!*)

1. On your photocopy page you'll find the outline of a helicopter. Cut one out.  
2. Cut *only* along the solid lines, never the dotted ones. These are lines marking where you're supposed to do some folding. *Check out the picture below if you need help!!!!*  
3. Fold along the dotted line at the base of part 1 and 2. Fold the two strips of paper in opposite directions. Looking at the helicopter from the side, it looks like a large paper “T”.



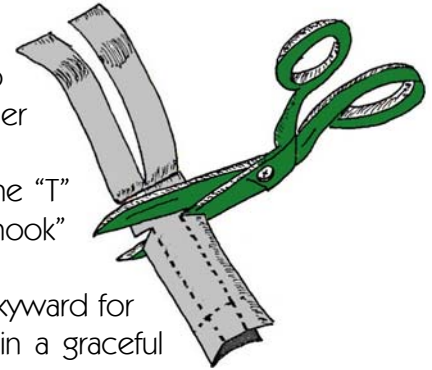
4. Notice the cuts you made above part 3 and part 4. Fold part 3 toward the *inside* on its dotted line. Do the same thing for part 4. Now the “T” has a skinnier base!

5. Just one more fold! Fold part 5 upwards. The “T” now has a little “hook” on the end. Push the paper clip over this “hook” so this part 5 flap is held tightly against the base.

6. Fling your paper helicopter in the air! It should wobble skyward for a little ways, stop, and begin spinning and floating to the ground in a graceful spiral.

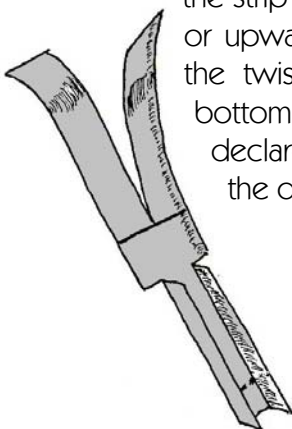
7. If it crashes, you probably bent the wings too far down in step #3! Try again!

8. To change the spin direction, reverse the direction you bent the wings in step #3.



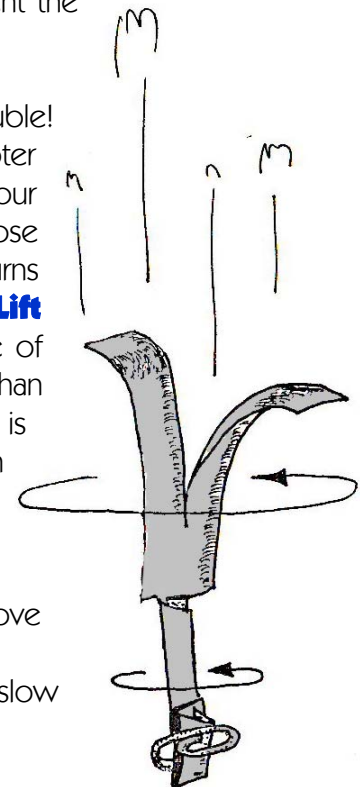
## Understanding the Science

There is a fight going on here. Nobody is going to get in trouble! But something is going to win! **Gravity** is trying to **Pull** the helicopter downward, like it does everything else! Normally gravity wins, but your gallant paper machine puts up a great resistance by spinning. A close examination of the wing while falling would show a twist. This twist turns the strip of paper into a **Wing**, complete with wing-like **Lift** or upwards **Push** back against gravity's pull. (Because of the twist, air is rushing faster over the wing's top than bottom. This creates lift!) Granted, gravity eventually is declared the winner. But lift managed to slow down the descent!

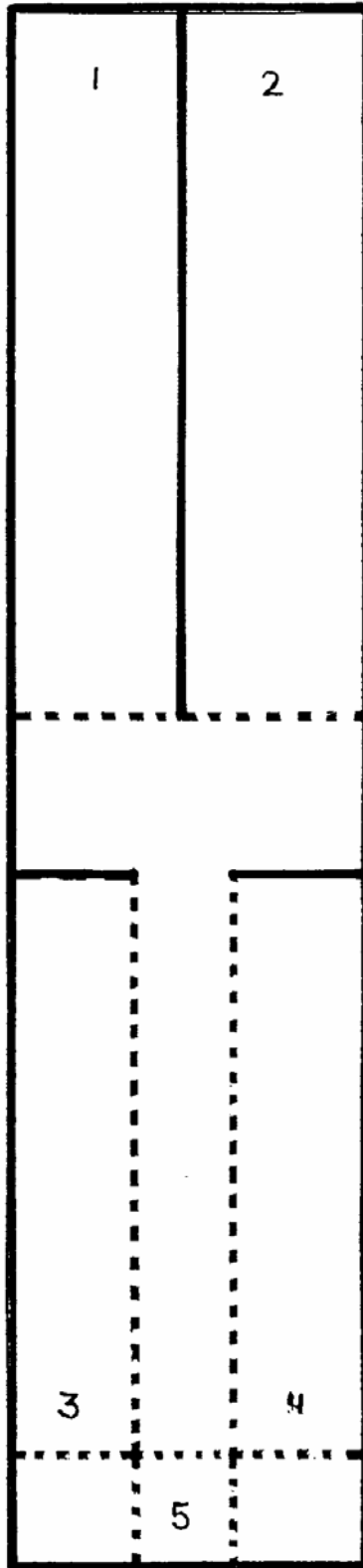


## Let's Check the View! (Questions and Assessments)

1. How did the helicopters that crashed move in comparison to the ones that flew?
2. What did your helicopter's wings do to slow down how fast it fell?



# Flight with a Twist





**"Stanley" the Force says it's time to  
learn more about this activity!  
Follow your teacher's directions!**

**Name** \_\_\_\_\_

# Flight with a Twist

*Student Assessment*

*Let's Think About It!*

1-2. What two forces are battling against each other with your helicopter? Make a drawing if it will help you explain your answer.

3-6. Tell what happened to your helicopter to create lift. Make a drawing if it will help you explain your answer.

7. T or F Lift pulls up, gravity pulls down.

8. T or F Air is moving faster under the helicopter's wing than over the wing's top.

9. T or F Air is moving at the same speed on top and bottom of your helicopter's wing.

10. T or F If gravity is less than lift, something can fly.

*Optional; Research helicopter history or how helicopters fly and move.*



*"Stanley" the Force* says it's time to  
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# Flight with a Twist

## *Student Assessment*

### *Let's Think About It!*

1-2. What two forces are battling against each other with your helicopter? Make a drawing if it will help you explain your answer.

**gravity and lift**

3-6. Tell what happened to your helicopter to create lift. Make a drawing if it will help you explain your answer.

**air is moving faster over the wing's top than bottom, this creates lift, etc.**

7. T or F Lift pulls up, gravity pulls down.

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**student research**

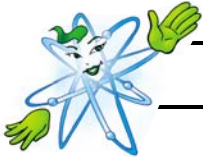


Student: \_\_\_\_\_ Date: \_\_\_\_\_

# Flight with a Twist

## Think It Through Questions

**1. How are forces involved in an object that flies?**

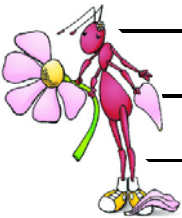


**2. Why do you want to learn about flying objects?**



**3. Why is flight important to our country?**

**4. What makes an object fly?**



**5. Do the same flight forces affect birds and airplanes? Why?**



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Student: \_\_\_\_\_ Date: \_\_\_\_\_

# Flight with a Twist

## Observations, drawings and things I did



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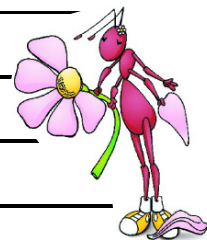
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## My Discoveries — What did I find?



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## Internet ideas and places



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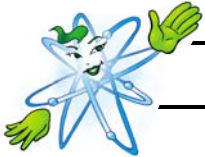


Student: \_\_\_\_\_ Date: \_\_\_\_\_

# Flight with a Twist

**Think It Through Questions — How have my thoughts changed?**

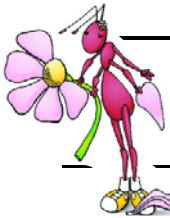
**1.**



**2.**



**3.**



**4.**

**5.**



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