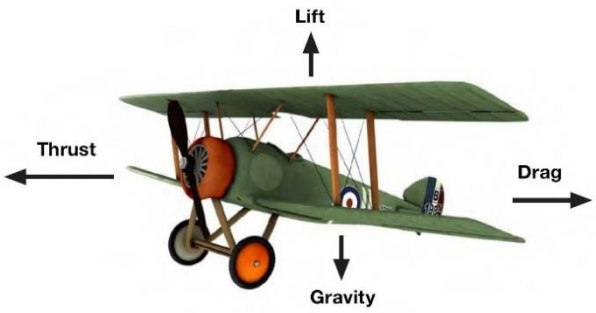
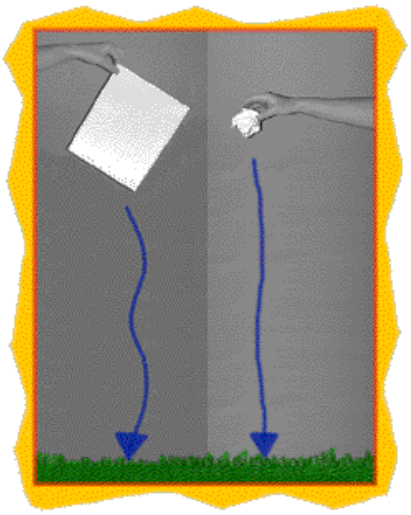
Aviation
Module One





Investigation One
FOUR FORCES OF FLIGHT

Paper Shape activity

Problem

What will happen when you drop a sheet of paper and a bouncy ball from the same height at the same time? What will happen if you crumple the sheet of paper and repeat the drop?

How will the sheet of paper fall in comparison to the bouncy ball? _____

How will the crumpled paper fall in comparison to the bouncy ball? _____

Procedure

1. Drop the sheet of paper horizontally and the golf ball from the same height at the same time. Record your observation below.
2. Crumple the sheet of paper into a tight ball.
3. Drop the bouncy ball and the crumpled paper from the same height at the same time.Record your observation below.

Observation

Compared to the bouncy ball, the sheet of paper fell_____

Compared to the bouncy ball, the crumpled paper fell _____

Conclusion

This happened because _____

Which force of flight was demonstrated? _____

FOUR FORCES OF FLIGHT, Continued

Chin Ups

Problem

What will happen when you blow across the top of a piece of paper held against your chin?

Prediction

The paper will _____

Procedure

1. Hold the piece of paper under your lip against your chin with one finger. Make sure that most of the paper is hanging over your finger.
2. Blow across the top surface of the paper.

Observation

The paper _____

Conclusion

This happened because _____

Which force of flight was demonstrated? _____

Paper Pull

Problem

What will happen to two long strips of paper when you blow air between them?

Prediction

The strips of paper will _____

Procedure

1. Hold a strip of paper in each hand about 5 cm (2 in.) apart between thumb and forefinger.
2. Blow between the pieces of paper and observe what happens.

Observation

The strips of paper _____

Conclusion

This happened because _____

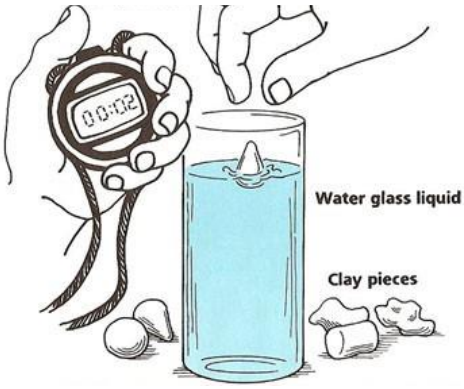
Which force of flight was demonstrated?

FOUR FORCES OF FLIGHT, Continued

It's a Drag activity

Problem

What will happen to pieces of modeling clay of the same mass but different shaped when they are dropped into a bottle of water?



Prediction

The_____shape will drop the quickest.

Procedure

1. Form various shapes with the four pieces of clay ranging from very streamlined like a pencil to more bulky shapes like a teardrop, a cube, a sphere, or a rectangular prism. Draw a sketch of your shape in the table on the back.

2. Drop the shapes, one at a time, into the bottle of water and observe how long it takes each shape to fall to the bottom of the container. Record your observations on the table on the back.

3. Retrieve the shapes and discard. Make sure the container is filled to the line again.

Career Spotlight: Aerodynamicist

Use physics, mathematics, and engineering to solve problems about how to make people, cars, and airplanes (and more) move fast and efficiently.

Aerodynamicists in the United States need four years of college, and make an average salary of $120,000 a year, or about $60 an hour.

Observation

The_____shape dropped the quickest.

Conclusion

This happened because_____

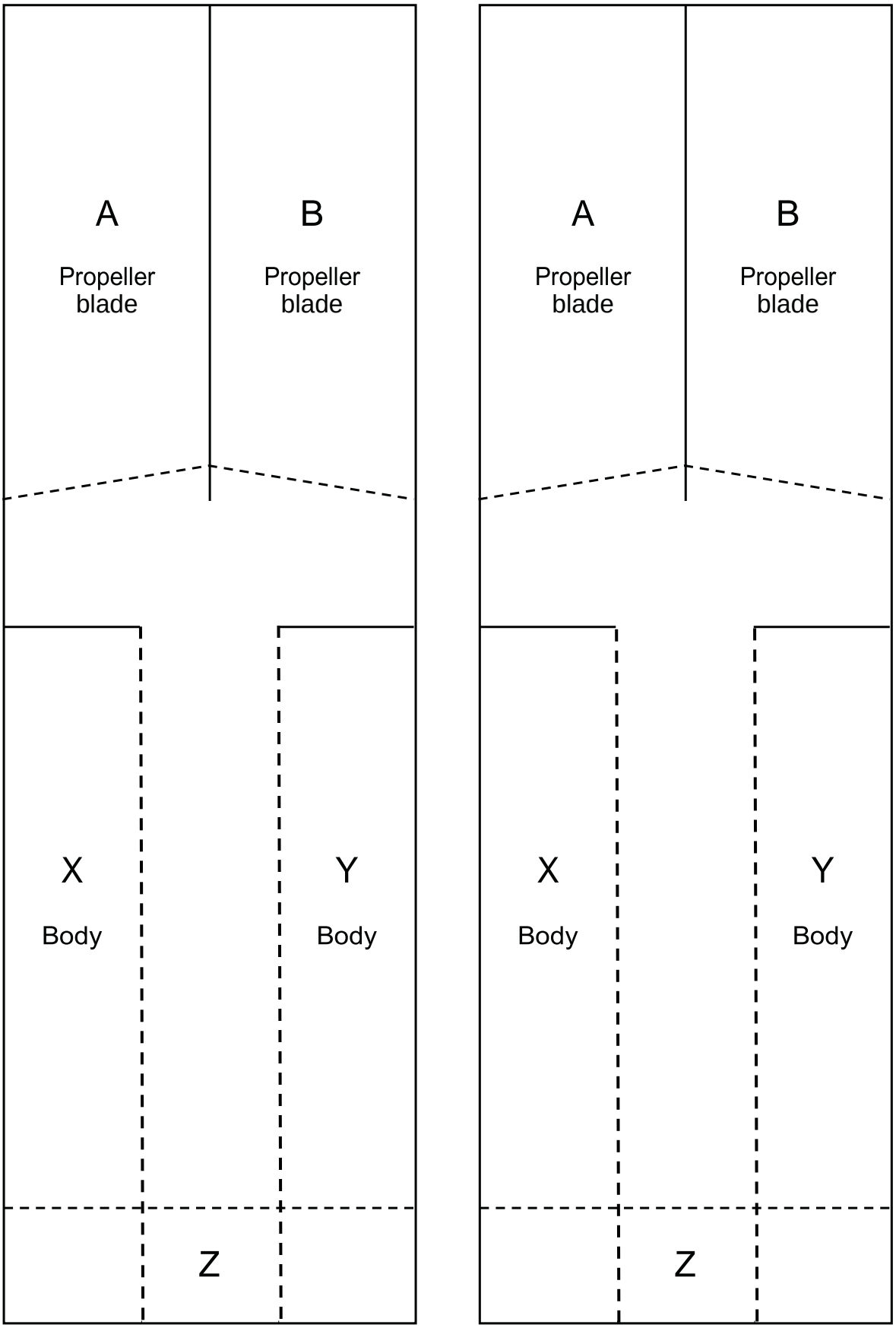
Which force of flight was demonstrated? _____

Shape	Observation

Industry Spotlight

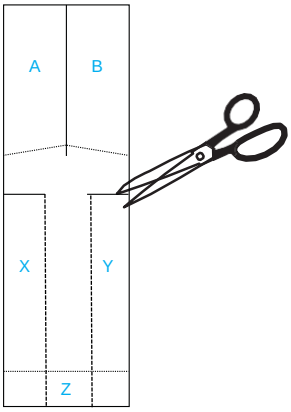
- **Zero G is t**he only commercial opportunity on Earth for individuals to experience true **zero gravity** without going to space.
- After 11 years of careful procedures and safety regulations, a geophysicist, an astronaut, and a former NASA engineer got FAA approval for G-FORCE ONE, a specially modified Boeing 727-200, to take passengers on commercial parabolic flights.

ROTOR MOTOR


A
Propeller blade
B
Propeller blade
X
Body
Y
Body
Z
A
Propeller blade
B
Propeller blade
X
Body
Y
Body
Z

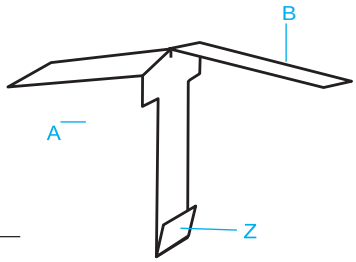
ROTOR MOTOR

Directions



1. Cut along the solid lines of the template.
2. Fold along the dotted lines. The propeller blades should be folded in opposite directions. X and Y fold toward the center, and Z is folded up to give the body rigidity and lower the center of gravity.
3. Go to the designated drop location your facilitator has prepared and drop the rotor motor. Have a partner time your rotor motor descent time and record your observations in the table below.

Trial	Descent time, seconds
1	
2	
3	



4. What modifications would make the rotor motor descend slower?

_____

_____

5. Select one modification and make the change.
6. Test and time your new design. Record the information in the table below.

Trial	Descent time, seconds
1	
2	
3	

7. Were your changes successful? How do you know?

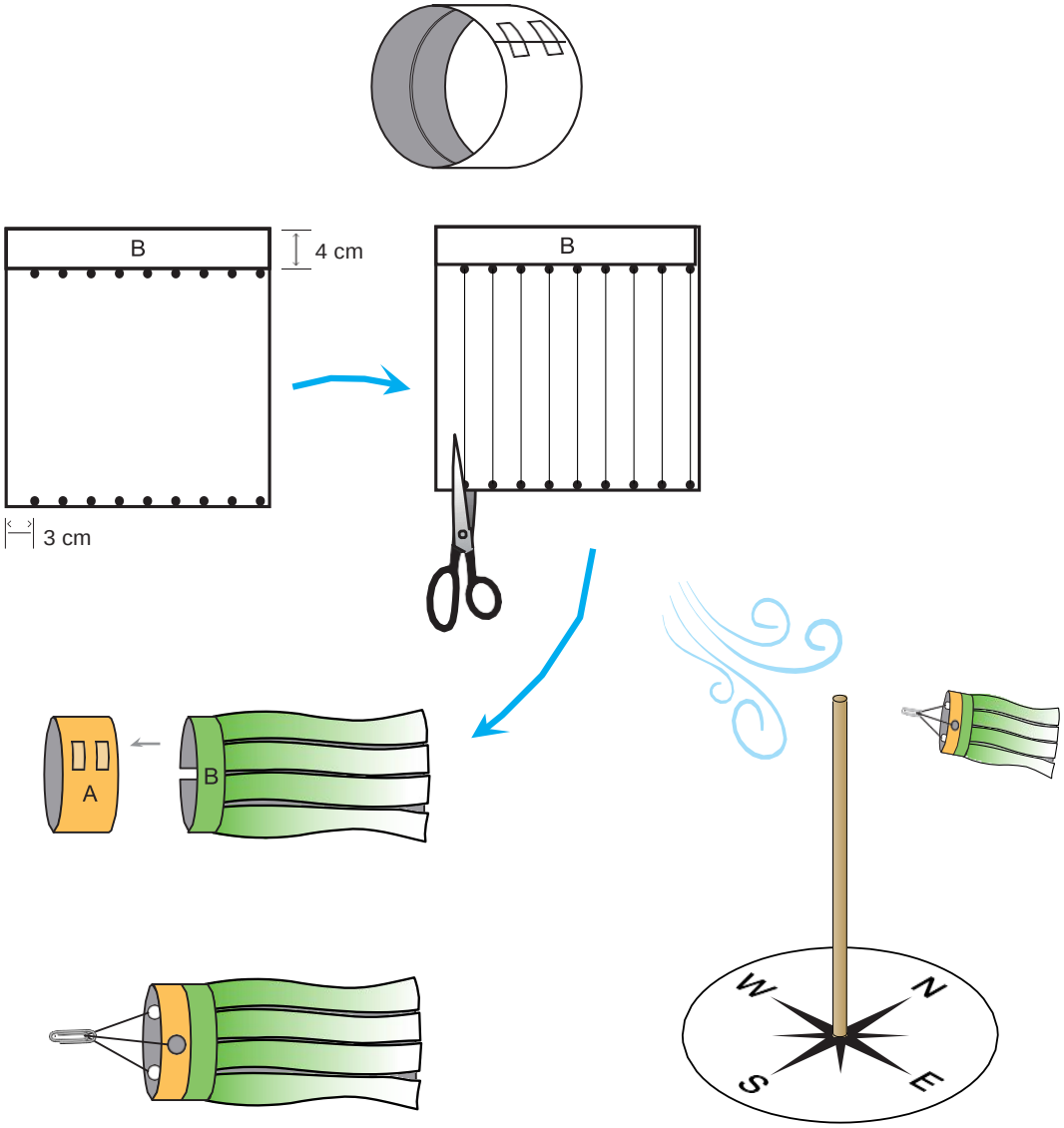
_____

_____

8. If time permits, modify your design again and record your results in the table below.

Trial	Descent time, seconds
1	
2	
3	

How to Build a Windsock



Career Spotlight:

Meterologist: Studies Weather Patterns

A Meteorologist must have at least a college degree, be able to analyze information. Can work in broadcasting or in the field. Average Salary $102,500 year.

Forensic Meteorologist studies the effects of weather and climate on crimes and accidents like plane crashes.

WINDSOCK

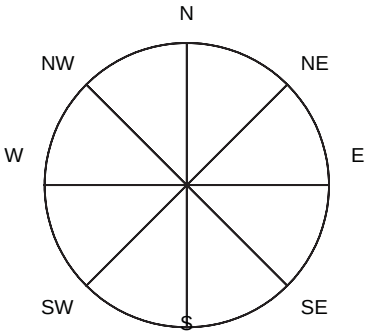
Using your windsock, record the following information. Color the charts to show the correct wind strength and directions.

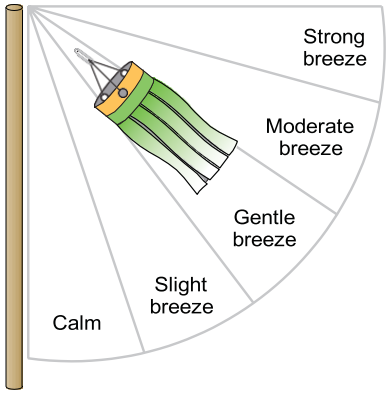
Day: _____

Time: _____

Weather conditions: _____

_____





1. How does the weather affect the wind strength and wind direction?

_____

_____

2. What does the windsock do in the wind?

_____

_____

3. What are some ways windsocks can be used?

_____

_____

4. What did you observe when you placed the smaller objects between the fan and the windsock?

_____

_____

5. What did you observe when you placed the larger objects between the fan and the windsock?

_____

_____

6. How did the various land mass shapes affect the wind strength and direction?

_____

_____

7. Why do pilots need to know about geographical features when they fly a plane?

_____

_____

OVERCOMING GRAVITY

Directions

Step 1

Use the hole punch to make three holes around the top of the cup. Space the holes evenly as shown in Figure 1.

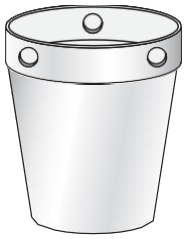


Figure 1

Step 2

Cut three pieces of 30-cm-long string. Tie one string to each hole in the cup.

Step 3

Use the balloon pump to blow up the balloon and count the number of pumps it takes. Use a clothespin to keep the air from escaping until you are ready to release it.

Step 4

Tape the other end of the strings to the balloon so that it looks like a hot air balloon with a basket under it.

Step 5

Take your device to the designated test area that your instructor has provided and tape the balloon to the straw as shown in Figure 2.

Step 6

Lower the balloon to the floor, count down, and let go of the clothespin.

Step 7

Mark how high the top of the balloon rose on the string. Measure and record data in the table.

Step 8

Blow up the balloon about the same size as before, and add five paper clips in the basket. Launch the balloon and record the height the balloon reaches.

Step 9

Repeat Step 11, adding five more paper clips each time until the balloon will no longer launch.

Step 10

Analyze data and graph your results.

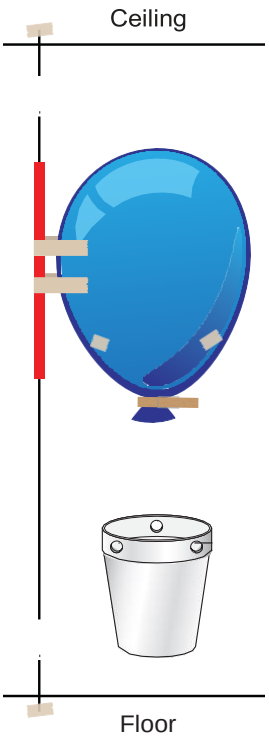
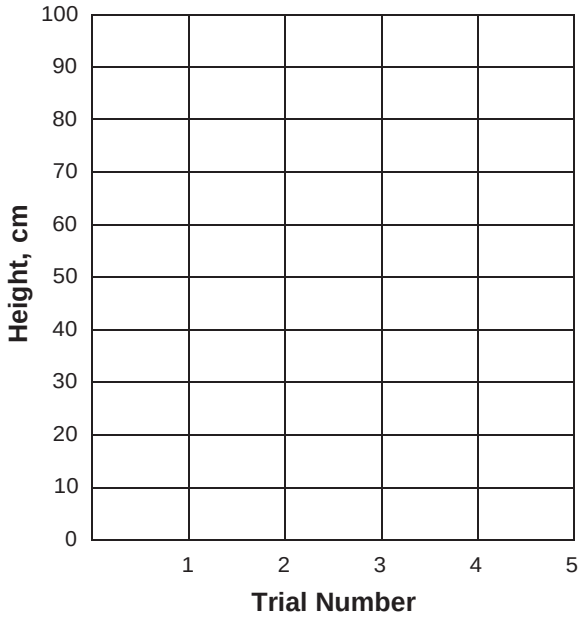


Figure 2

OVERCOMING GRAVITY

Trial	Number of paper clips	Launch height from the floor, cm
1	0	
2	5	
3	10	
4	15	
5	20	



Questions

1. What happened during the trials?

2. Did everything happen the way you thought it would?

3. What happened to the elevation of the balloon as you added weight? Explain why this occurred.

4. What could you do to redesign this activity to allow 20 paper clips to rise to the same height that the balloon reached initially? Illustrate your idea.

RING WING

1. Fold a piece of 8.5- by 11-in. paper diagonally as shown in Figure 1.
2. Make a 1/2-in. fold along the previously folded edge and another 1/2-in. fold as shown in Figure 2.
3. Curl the ends of the paper to make a ring and tuck one end into the fold of the other. Use tape to hold the ring shape together (Fig. 3).

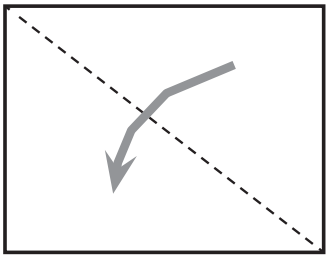
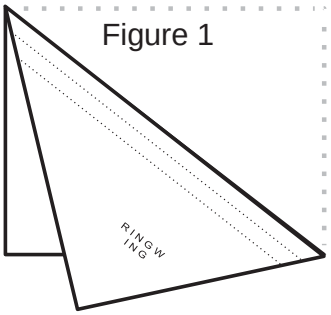
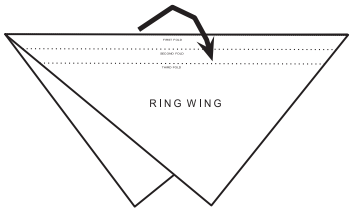
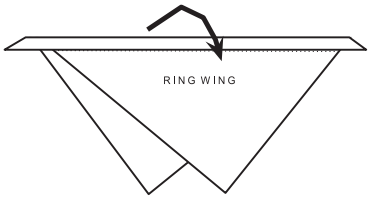
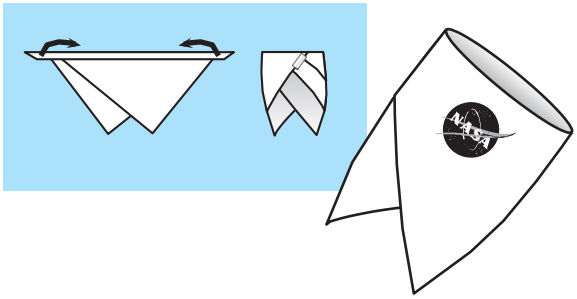


Figure 1







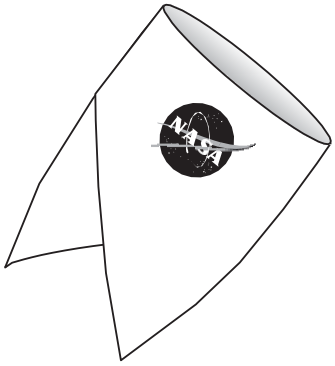


Above: OG Tuskegee Pilots
Right: Dr. Roscoe Brown, who flew 68 combat missions and numerous escort & reconnaissance missions in his military career.

History Spotlight: Tuskegee Experience

- Established in 1940 for first Black men to become military airmen.
- Tuskegee Experiment trained 922 pilots, navigators, bombardiers, instructors, aircraft and engine mechanics, control tower operators, maintenance and support staff.
- Known as Red Tails.
- Responsible for more than 15,000 missions in two years during WWII.
- Motto: Spit Fire

RING WING



Directions

Step 1

Make the ring wing as your instructor demonstrated.

Step 2

To fly: Gently grasp the V between the two points with your thumb and index finger. Reach back over your head and toss the glider lightly forward.

Step 3

Fly your ring wing three more times and answer the questions below.

Questions

1. What did you notice about the flight of your aircraft?

_____

_____

2. Does it repeat the pattern each time you tested it?

_____

3. According to your group, what constitutes the best flight?

_____

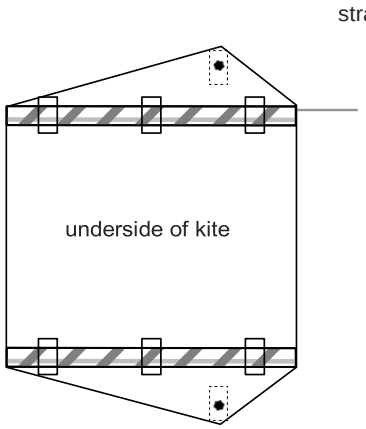
_____

4. Create the best ring wing glider you can. What changes did you make to the original design to create the best flying craft?

_____

_____

SLED KITE

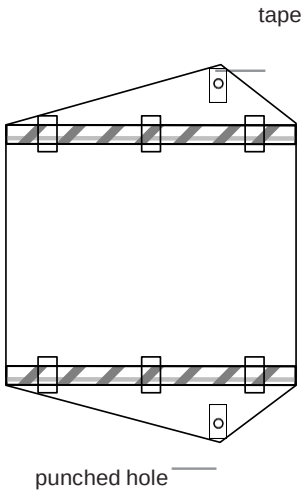


Step 1

Trim the two drinking straws so they will fit in the template area marked for them and tape them in place.

Step 2

Place two or three pieces of tape over the circles as shown, and use the hole punch to punch the holes in the circles.



Step 3

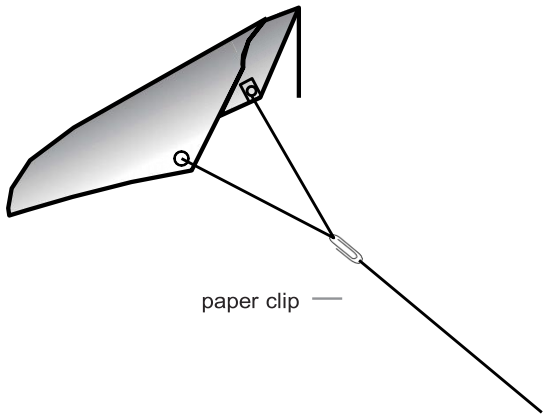
Cut two pieces of 45-cm string. Tie a string through each hole in the template but not tight enough to tear the paper.

Step 4

Tie the opposite ends of both strings to a paper clip.

Step 5

Tie one end of a 1-m-long piece of string to the other end of the paper clip. The sled kite is ready to fly!



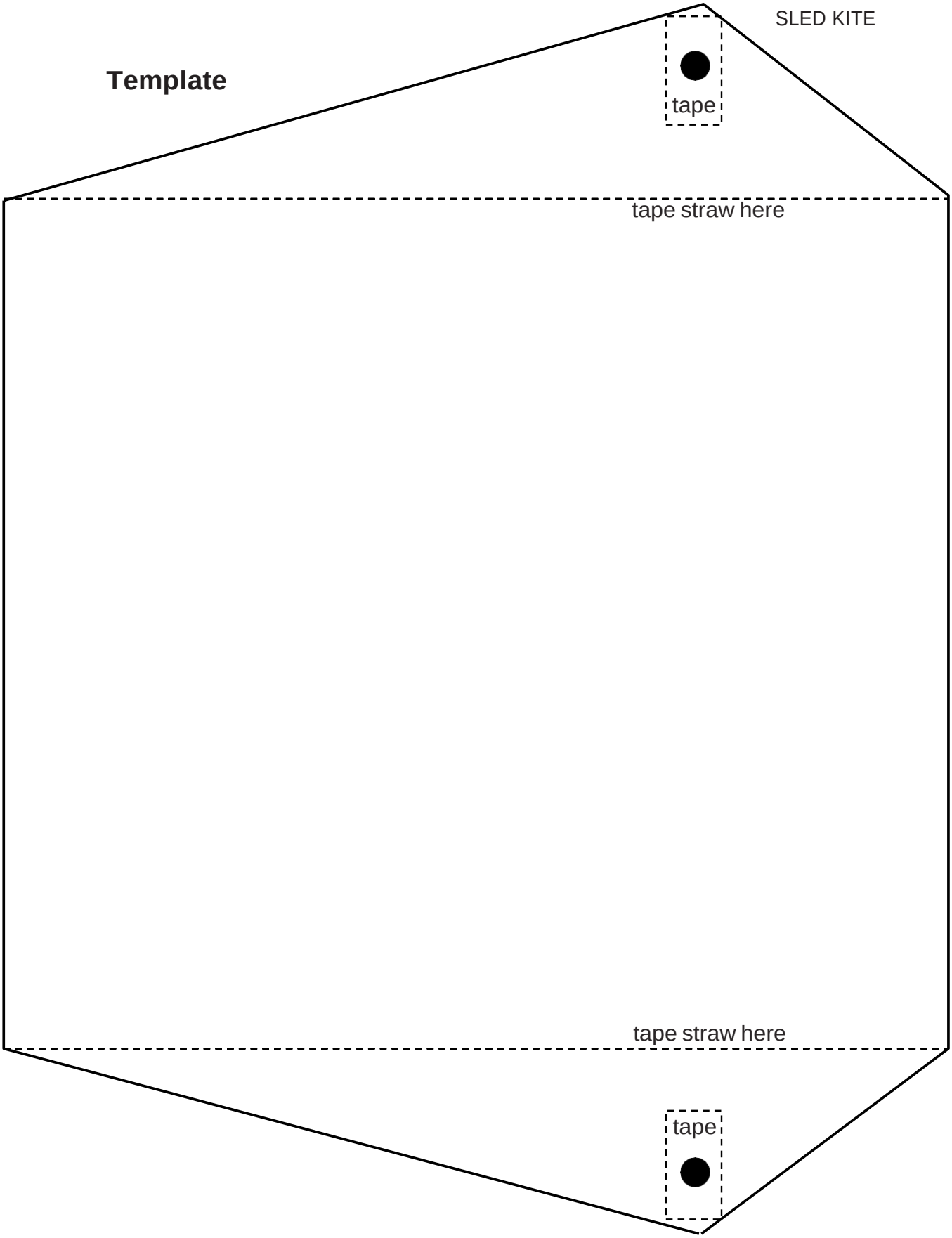
Step 6

Go outside to a clear area, hold the 1-m length of string, and run with the kite to make it fly.

Step 7

Run slow and fast, observe how the kite flies at different speeds, and answer the questions on the back.

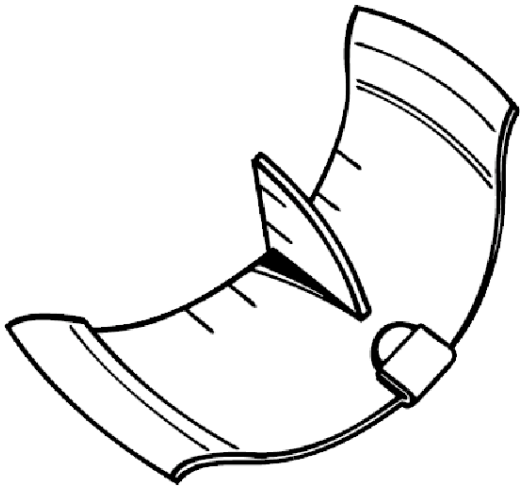
Template



Right Flight

Build an FPG-9 (**F**oam **P**late **G**lider, 9 inch)

1. Cut around glider on solid lines.
2. Separate tail from glider body.
3. Cut slots on the solid lines.
4. Gently score (trace over with a pencil or pen but not deep enough to go through) along the dotted lines.
5. Gently fold along scored lines so flaps will bend up and down.
6. Slide tail piece into the body of the plane, matching slots.
7. Tape tail in place.
8. Attach a penny or paper clip to nose and tape flap over it.



Right Flight

Directions

1. Why does the model glider fall erratically during test flights before its proper weight and balance is determined?

2. How did you determine the weight and balance for your glider?

3. What adjustments did you make to achieve balance on your glider?

4. Test your glider and fill out the information in Table 1.

Test	Distance flown, cm
1	
2	
3	
4	

Table 1

5. Redesign wings for your glider that will improve the performance and distance it will fly.

6. Test your redesigned glider and fill out the information in Table 2.

Test	Distance flown, cm
1	
2	
3	
4	

Table 2

7. Did your design improve your glider's performance? Why or why not?