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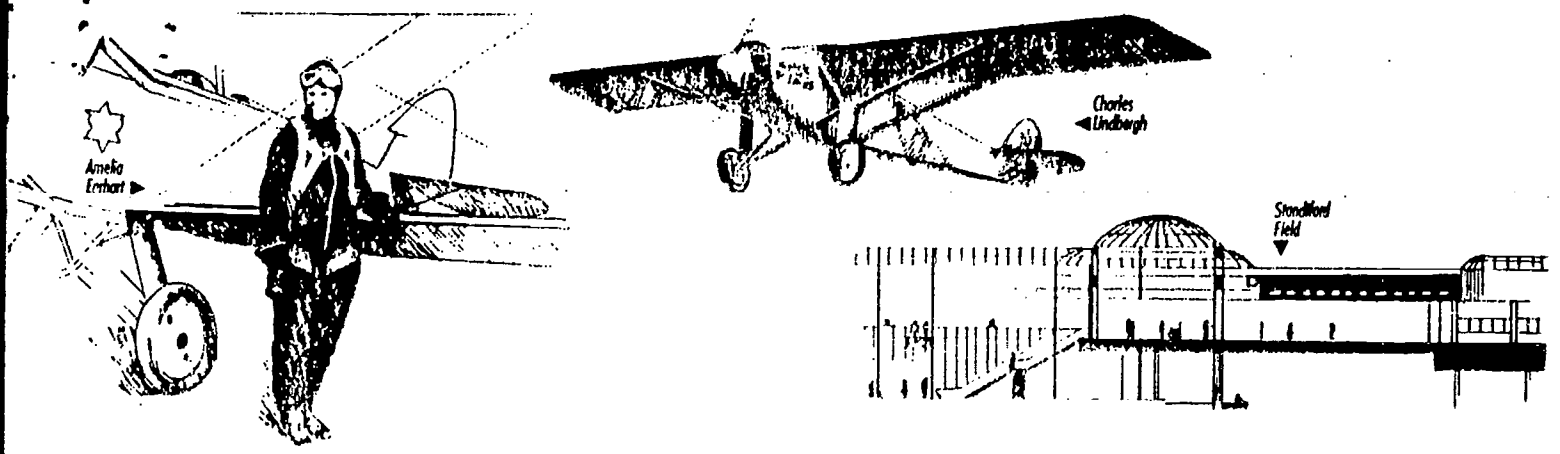
ABSTRACT

This science curriculum was written for teachers of children in the elementary grades. It contains science activities for the following lessons: (1) Whirly Birds and the Concept of Lift; (2) Parachutes; (3) Weather Vanes; (4) Paper Airplanes; (5) Flying an Airplane; (6) Jet Engine; (7) Identifying Flying Objects; (8) It's a Bird! It's a Plane; (9) Airport Numbers; and (10) Kites in the Wind. The detailed lesson plans are divided into the following sections: grade level, skills to be learned, performance objectives, materials, procedure, concepts, and questions for further study. (PR)



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ELEMENTARY SCIENCE LESSONS

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New Albany, Indiana

June 1992

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ELEMENTARY SCIENCE LESSONS

LESSON TITLE: **WHIRLY BIRDS and the CONCEPTS of LIFT**

GRADE LEVEL: 1, 2, 3, 4, 5, 6

SKILLS:

Goal 2 Concepts and Principles
Science
No. 17 Scientific Skills
No. 20 Using Models

PERFORMANCE OBJECTIVES:

. The student will begin to understand the concept of lift, which is how things are supported by air.

MATERIALS:

Whirly bird patterns
Scissors
Paper clips
Strips of paper 1" wide by 11.5" long

PROCEDURE:

1. Have the students cut out the whirly bird and assemble it.

2. Have students experiment with the whirly bird by letting it fall through the air from about six feet above the ground. Standing on a chair or table will give enough height or use a stairwell.

3. Have students count the number of revolutions the whirly bird makes in its descent.

4. Have students reverse the bends in the wings. What happens to the direction of the spin? (It should reverse.)

5. Ask the students if they have any ideas about what makes the whirly bird spin instead of drop or float to the ground.

6. Have students experiment with dropping a plain sheet of paper. Does it spin? Describe its descent.

7. Have students hold the short end of the one inch strip of paper just below their bottom lip and blow a stream of air across it.

The students should see the paper move from a dangling position to waving in the air in front of them. Ask if the students have any explanation for what happened.

CONCEPTS:

Air has weight (14.69 or approximately 15 pounds per square inch). It is pushing against all objects in every direction with the same force.

When you blow across the paper strip, the air pressure above the strip is less than the air pressure pushing up from the bottom of the strip. Thus the air pushing up on the paper strip holds it up as long as the air is moving across the top of it. This is the concept of LIFT. Air can lift things, when the air pressure above it is lower than the air pressure below it---like your strip of paper.

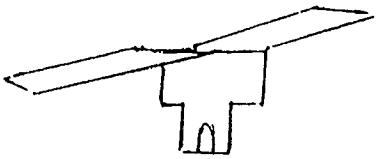
Your whirly bird moves the air as it falls through it, creating small pockets of lower air pressure and, thus, is held back a little by it moving from lower to higher pressure areas. Gravity, however, is stronger than the lift so that the whirly bird is gradually pulled to the ground.

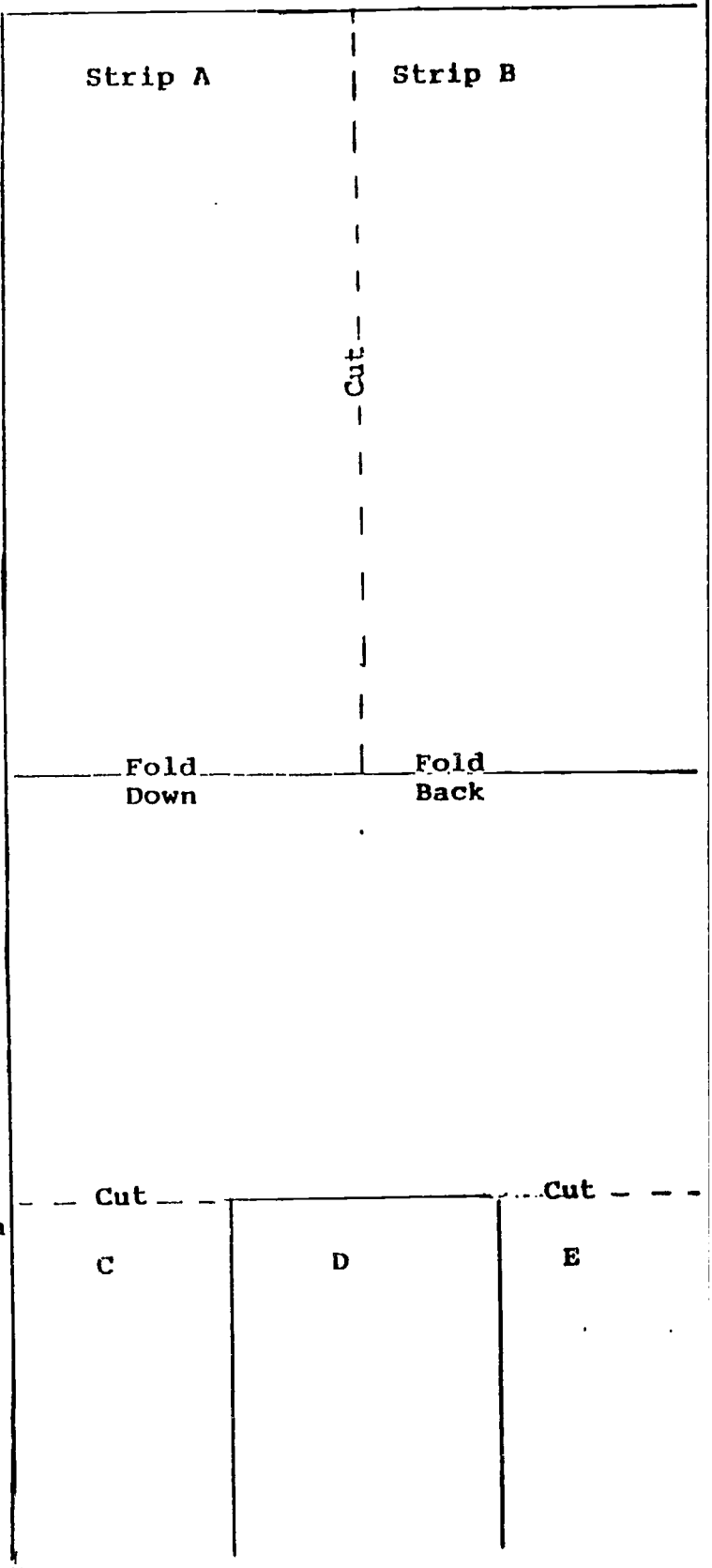
A helicopter creates lift directly above it with its rotating propeller. As it circles, it produces enough lift to support the helicopter.

WHIRLY BIRD PATTERN

1. Cut out the pattern.
2. Cut on the dotted lines.

ONE INCH STRIP





3. Fold strip A forward and strip B backward.

4. Fold C and E behind D and secure with a paper clip.

5. Cut off the one inch strip.

LESSON TITLE: **PARACHUTES**

GRADE LEVEL: 1, 2, 3, 4, 5, 6

SKILLS: Goal 2 Concepts and Principles
Science
No. 17 Using Scientific Skills
No. 20 Using Models

PERFORMANCE OBJECTIVES: . The student will begin to understand how and why a parachute works.

MATERIALS: For each child or group of children you will need:

1 handkerchief (Men's large handkerchiefs are the best size.)
4 pieces of string 12 inches long
1 metal washer

PROCEDURE:

1. Have the students make a parachute by tying a string to each corner of the handkerchief. Tie the other end of the strings together. Tie the metal washer to the place where the strings are joined.

2. Have the students fold the washer into the center of the handkerchief making a loose package.

3. Instruct the students to throw the parachute as high into the air as possible. (This activity is best done out of doors.)

4. Have the students record what happens as the parachute slowly descends.

5. After several trials, have the students time the descent.

6. Have the students try several different experiments with the parachute--e.g.--change the amount of weight on the parachute, tie only two corners instead of four, and move the position of the weight.

7. Ask students if they can explain how and why the parachute works.

HOW A PARACHUTE WORKS:

As the parachute falls, it cups the air underneath it. This added air pushes up against the cloth and you can see it ballooning. This is what causes the parachute to fall slowly. The force of the air is pushing up and stopping the force of gravity that is pulling down. This is a simple explanation of the law that says: "Any force going in one direction impedes the progress of a force going in the other direction."

This simple toy parachute is very much like the large parachutes that are used by pilots who must abandon a plane during flight.

QUESTIONS FOR FURTHER STUDY:

What material is a parachute made of and why?

Is a kite like a parachute?

Is a hot air balloon like a parachute?

Is a kite like a balloon?

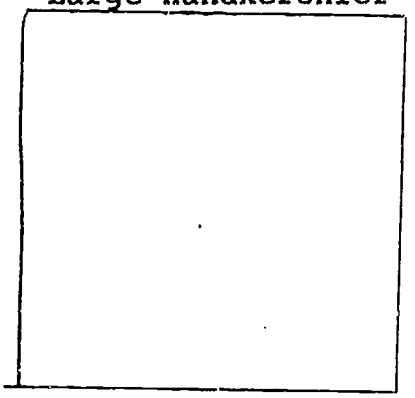
Do kites, hot air balloons and parachutes follow the same laws of physics to fly?

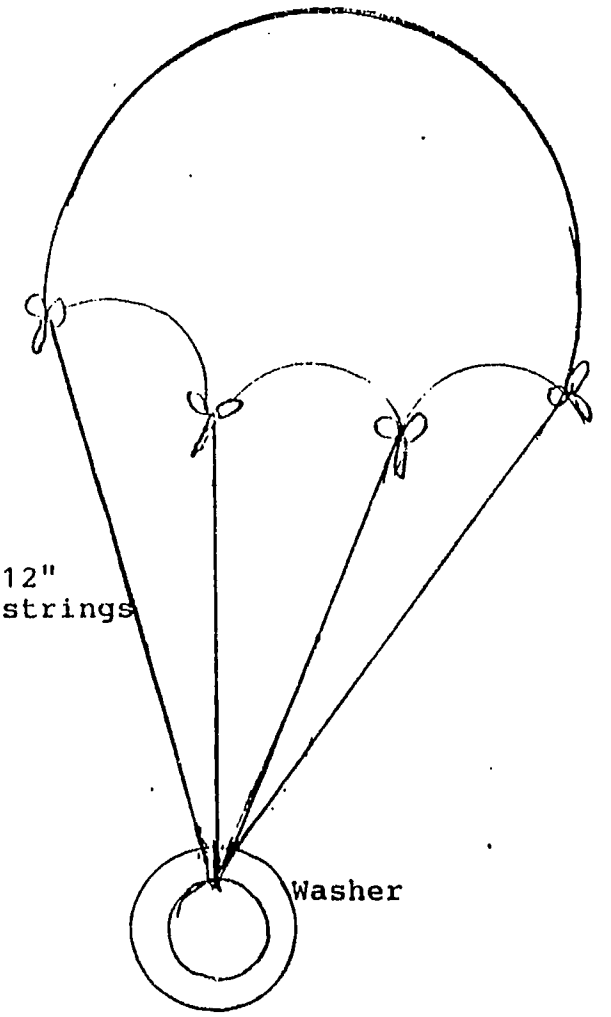
Do airplanes have anything in common with kites, balloons, and parachutes?

What are some of the reasons people use parachutes?

PARACHUTE DIRECTIONS

Large Handkerchief





1. Tie a string to each corner of the handkerchief.

2. Tie the strings to the washer.

LESSON TITLE: **WEATHER VANES**

GRADE LEVEL: 1, 2, 3, 4, 5, 6

SKILLS: Goal 2 Core Concepts and Principles
Science
No. 20 Using Models
No. 17 Using Scientific skills

PERFORMANCE OBJECTIVES: . The student will build a weather (wind) vane and learn how to tell from which direction the wind is blowing.

MATERIALS:
Pattern for wind vanes
Straws
Paper clips
Pencils with erasers
Scissors
Scotch tape
Large straight pins

PROCEDURE:

1. Have students cut out the parts and assemble the wind vane as directed.

2. Have students try their wind vanes outdoor.

THINGS TO WATCH FOR:

Keep the wind vane level. Make sure that the wind vane turns easily on a pivot. The tail must extend farther from the pivot than the head does. The tail has a larger area than the head, so that the wind can exert more force on the tail that the head. The head is weighted so that it balances the tail. The tail has two parts that are spread slightly to steady the wind vane.

3. Have students use a compass to find the cardinal points - North, South, East, and West, and mark them on a level spot on the ground at the ends of a large cross.

4. Have the students each stand at the intersection of the cross holding their wind vanes. If the wind vane is working correctly, the

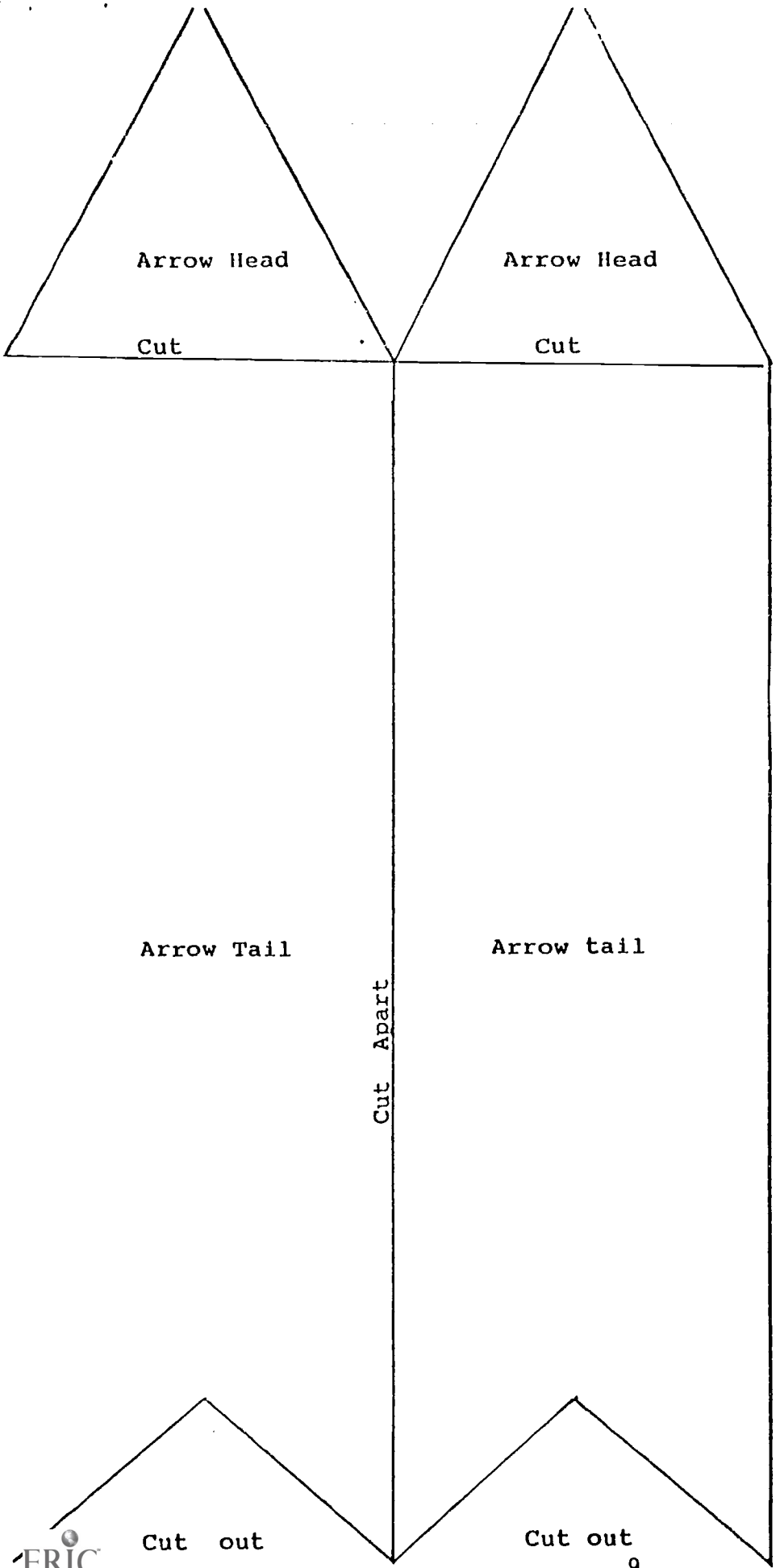
point of the wind vane should be pointing into the wind. Wind direction is always stated as the direction from which it is blowing. For example, the North wind blows from the North and the West wind blows from the West. Have the students identify which way the wind is blowing. Wind is seldom blowing directly north, south, east or west but some point in between like northwest or southeast. Older students may want to state the degrees as on a compass.

5. Have students identify problems with the wind vanes and try to correct them. They may suggest other materials from which they may be made or better ways of balancing them.

6. Have students discuss wind vanes and the kinds of information we get from them. Who uses them? (Aircraft pilots and airports.) Why? (To tell which direction the wind is blowing when they take off in their aircraft.) Where are wind vanes usually found? (On the tops of houses and barns.) How long will your paper wind vane last? (Not long out of doors.) Will it work in stormy weather? (It will probably fall apart.) What is a wind sock? (Another wind vane, but it also indicates wind speed.)

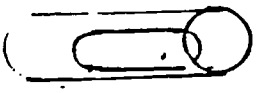
7. Have students locate interesting wind vanes (also called weather vanes) in your town. Find out how they are used today or if they are decorative. Have the students collect and display pictures of weather vanes. Find an antique vane at a flea market.

8. Have students chart wind direction for several weeks. Note the prevailing wind direction. (In the northern hemisphere we have prevailing westerlies. This means that the wind most often comes from the west.)

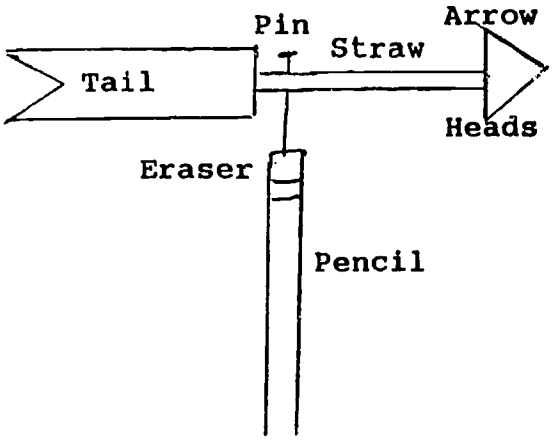


WIND VANE DIRECTIONS

1. Cut out the two long arrows.
2. Clip and save the arrow heads.
3. Slip a paper clip over one end of a straw. See diagram.
4. Tape the two arrow heads over the paper clip end of the straw.
5. Tape the two long tails to the other end of the straw covering about two inches of the straw. See diagram.
   Do not tape the back ends of the tails together.
6. Push a straight pin through the straw near the tail. It will be the pivot of the wind vane. Anchor the pin in the top of a pencil eraser. You may have to move the position of the pin in the straw for balance. The wind vane should be level and move freely.



End of straw with paper clip.



LESSON TITLE: **PAPER AIRPLANES**

GRADE LEVEL: 1, 2, 3, 4, 5, 6, 7, 8

SKILLS:

Goal 2 Core Concepts and Principles
Science
No. 18 Patterns
No. 20 Using Models

Goal 2 Mathematics
No. 26 Measuring

PERFORMANCE OBJECTIVES:

. The student will begin to understand the principles of flight by trying to design and fly a paper airplane.

MATERIALS:

Sheets of paper 8.5 by 11 inches. (Various weights)
Paper airplane pattern - one per student
Paper clips
Measuring tapes or sticks in metric units

PROCEDURE:

1. Have the students fold the paper airplane pattern and predict how far it will fly.

2. Explain that an airplane must be stable about three axes:

ROLL - tip sideways
PITCH - nose up or down
YAW - turn right or left

3. Explain that the four forces affecting the paper airplane are:

THRUST - forward push by your hand
DRAG - air resistance
LIFT - upward push caused by the air deflected downward by the wings
GRAVITY - downward pull from the earth

4. Have the students fly the airplanes and measure the distance flown.

5. Repeat the flight several times and compute the average distance

flown. Record the results.

6. Have the students change one thing about their airplane and repeat steps four and five.

Suggestions for changes: Add a paper clip to the nose of the plane for weight. Change the weight of the paper. Add flaps to the wings. Change the design by folding the wings at a different angle.

7. Repeat the design changes and trial flights at least three times making sure that only one variable is changed each time, keeping everything else constant.

8. Have students determine which design was best according to their results. Ask students to come up with reasons why that design works best. (Example: Wing position reduces drag.)

9. Have a paper airplane contest to see which student's plane flies the farthest. Make sure all the conditions such as breeze, location, height of launch, are the same for each student. Ask students why they think the design of the winning plane made it fly farthest.

PAPER AIRPLANE PATTERN

1. Fold corner into the center.

1. Fold corner into the center.

2. Fold paper in half lengthwise, with folded corners inside.

3. Fold out.

3. Fold out.

4. Fold out.

4. Fold out.

LESSON TITLE: **FLYING AN AIRPLANE**

GRADE LEVEL: 1, 2 , 3, 4, 5, 6

SKILLS: Goal 2 Concepts and Principles
Science
No. 19 Systems and Interactions
No. 20 Using Models

PERFORMANCE OBJECTIVES: . The student will begin to understand how a pilot controls an airplane and to identify some of the major parts of a plane.

MATERIALS: Diagram of an airplane showing the main features and controls.

PROCEDURE:

1. Have students look at both the model of an airplane and the diagram as you name each part and explain its use.

2. Students will probably be able to identify the wings, tail and the propellers. They will probably not know that the body of the plane is called the fuselage. Students will also be able to identify the engine(s).

3. Point out the movable parts of the wings called the ailerons, located on the back edge of the wings. These are used to 'bank' the plane or tilt it sideways and for balance. The ailerons work together, if one goes up the other goes down.

4. Indicate the tail or rudder. Show how the back vertical edge moves to control the right and left turning of the plane.

5. Demonstrate the stabilizers or the movable flaps on the back edge of the tail. These point the plane up or down.

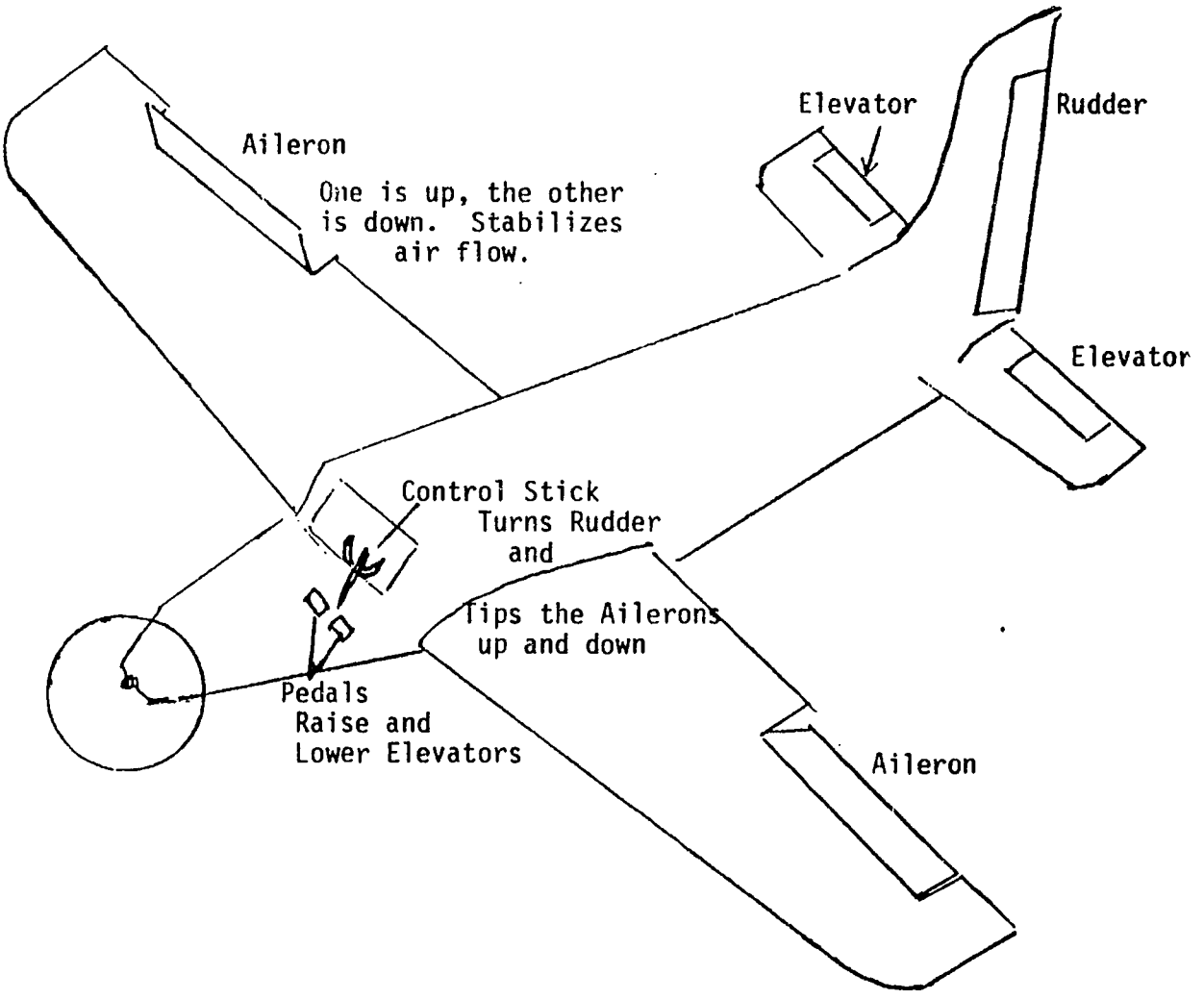
CONCEPTS:

Airplanes are controlled by the pilot from the cockpit with the pedals and stick. With these

instruments the flow of air is adjusted to move the plane up, down, and right and left. The pedals are attached to the rudder and turn the plane right or left. The stick controls the ailerons and the stabilizers for balance and up and down movement. Pushing the stick forward causes the downward movement while pulling it back causes the upward movement. Turning the stick right raises the right aileron and lowers the left one. Turning the stick left raises the left aileron and lowers the right one.

EXTENSIONS:

Ask students to identify the instruments used in an airplane to tell them which direction they are flying (Compass); how fast they are going (Speedometer - Air Speed Indicator); how high they are flying (Altimeter). Getting to see the cockpit of any type of plane will give the students some idea of the complexity of flying.


Aileron
One is up, the other is down. Stabilizes air flow.
Elevator
Rudder
Elevator
Control Stick
Turns Rudder and
Tips the Ailerons up and down
Pedals
Raise and
Lower Elevators
Aileron

LESSON TITLE: THE JET ENGINE

GRADE LEVEL: 1, 2, 3, 4, 5, 6, 7, 8

SKILLS:

Goal 2 Concepts and Principles
Science
No. 19 Systems and Interactions
No. 17 Scientific Skills

PERFORMANCE OBJECTIVES:

. The student will begin to understand how a jet engine works.

. The student will become familiar with the scientific process.

MATERIALS:

Balloons of various sizes and shapes
Plastic straws
String

PROCEDURE:

1. Have students blow up balloons of different sizes and shapes. Do not tie the ends.

2. Have students take turns letting their balloons go into the air. Have students observe carefully which way the balloon is moving - opposite of the air that is being expelled.

3. Have students try to predict which way the balloon will go when it is released. Which balloons are more predictable? (Long thin ones)

4. Have students suggest ways to direct the stream of air thereby controlling the direction of the balloon.

5. Have students fasten a straw to the mouth of the balloon before blowing it up. What happens this time when it is released?

6. Have students try tying a string or some other tail to the balloon. Does this help to guide the path of the balloon?

7. What shapes were easiest to control? What conclusions can you make about controlling balloon

rockets?
(Balloon rockets are hard to control. The faster the air is expelled, the faster the balloon moves forward. The balloon stops moving when all of the air is expelled.)

CONCEPTS:

Balloon rockets are useful in demonstrating some of the effects of a jet engine. When the air in the balloon is released, the balloon moves forward in the opposite direction of the air stream. This is a demonstration of the action-reaction principle which states that for every action there is an opposite and equal reaction. In the jet engine, air is taken in at the front of the engine. It is then compressed and heated before being pushed out the back of the engine. This backward push thrusts the airplane forward. The action-reaction principle can be demonstrated in some very familiar situations:

The push off from the dock of a row boat moves it out into the water away from the pier.

If a roller skater pushes against the wall, he moves away from the wall.

LESSON TITLE: **IDENTIFYING FLYING OBJECTS**

GRADE LEVEL: 1, 2, 3, 4, 5, 6, 7, 8

SKILLS:

Goal 1 Basic Communication
- No. 2 Reading
- No. 3 Observing
- No. 4 Listening
- No. 11 Writing

Goal 2 Concepts and Principles
Science
- No. 17 Scientific Skills
- No. 18 Patterns

PERFORMANCE OBJECTIVES:

. The student will be able to identify the different types of aircraft usually seen at today's airport.

MATERIALS;

Chart of airplanes
Worksheet

PROCEDURES:

1. Have students study the characteristics of the various jet planes--e.g. the L1011, the 747, the 727, the 737, the DC9, and the DC10.

2. Point out some of the most significant features of the different aircraft used for passenger service today. Use the chart and the information on it to illustrate these things.

3. Relate any personal experiences that you have had with flying. Ask students to share their experiences with flying.

4. Have students write stories about their flying experiences.

5. Have students complete the worksheet that compares the seating capacity, wing spread, engine number and size, number of windows, placement of engines and special markings.

6. Have students collect pictures of airplanes and airships of all kinds. Display the pictures on a

bulletin board with labels so students will become familiar with them.

7. An optional activity would be to make a collage of airship pictures cut from magazines.

CHART OF DATA ABOUT PLANES

Type of Plane	Wing Span	No. Seats	No. Windows	No. Engines	Type of Engine	Special Markings
24						25

LESSON TITLE: **IT'S A BIRD! IT'S A PLANE!**

GRADE LEVEL: 1, 2, 3, 4,

SKILLS:

Goal 1 Basic Communication
No. 1 Accessing Sources of Information

Goal 2 Concepts and Principles
Science
No. 17 Scientific Skills
No. 18 Patterns

PERFORMANCE OBJECTIVES:

. The student will be able to identify a variety of things that fly both naturally and man-made.

. The student will become familiar with man's attempts to build a machine that flies.

PROCEDURE:

1. Open a discussion of flying by asking the students to describe the way birds fly. Ask the students to imitate some of the things they have seen birds do. (Swooping, soaring, floating, dipping, darting, flapping their wings, turning, taking off and landing)

2. Ask students if they would like to be able to do those things. Ask the students if they know a way of doing them. Lead the discussion to naming all the types of flying machines that they know. Add some that they do not from the following list. Write them on the blackboard as they are named.

Gliders
Hang Gliders
Pedal Powered Planes
Light Aircraft (small planes)
Propeller Planes
Prop jets
Jets
Supersonic Transport
Space Shuttle
Helicopters
Airships (Blimps, Dirigibles)
Kites
Balloons

3. Have students discuss how it feels to fly.

4. Show pictures or diagrams of each type of flying machine.

5. Have students discuss the list of flying machines on the board. Have students circle the ones that have engines. Underline the ones that carry only one or two people. Put a star beside any that the students have flown. Which ones are the most efficient? Which ones are the most fun? Which ones go the highest? Which ones do you see most often?

6. Have students design their own flying machine. Have them draw them and explain their special features and display them.

7. Make a collection of books about planes, flying, airships, ballooning and other related topics available to the students.

LESSON TITLE: **AIRPORT NUMBERS**

GRADE LEVEL: 1, 2, 3, 4

SKILLS: Goal 2 Concepts and Principles
Mathematics
No. 23 Number
No. 24 Mathematical Procedures

PERFORMANCE OBJECTIVES: . The student will recognize and understand the uses of numbers found in the airport.

MATERIALS: Worksheet

PROCEDURE:

1. Have students look for numbers at the airport and record them on the worksheet.

2. Have students discuss the meaning of the numbers that they have found.

EXAMPLES:

Flight Numbers
Arrival Times
Departure Times
Airplane Designation
Gate Numbers
Seat Numbers
Ticket Numbers
Clock Time
Time Zones
Ticket Windows
Ticket Prices
Telephone Numbers
Emergency Numbers
Runway Numbers
Weight Limits for Luggage
Weight Limits for Aircraft
Seating Capacity
Number of Crew Members
License or Badge Numbers of Airport Personnel
Locker Numbers
Combination Lock Numbers
Prices on Menus
Prices in Gift Shop
Stock Numbers on Items In Gift Shop
Exchange Rates on Foreign Currency

Taxi Numbers
Bus Numbers
Exit Numbers
Carousel Numbers
Baggage Claim Numbers
Car Rental Rates
Car License Numbers
Lottery Numbers
Calendar Numbers
Passport Numbers
Social Security Numbers
Drivers License Numbers
Identification Numbers
Credit Cart Numbers
Bank Machine Numbers

3. Compare and contrast the kind of numbers the students have recorded. Discuss the uses of the numbers the students have recorded and what they mean.

Some Roman numerals may be used and sometimes a combination of letters and numbers is used. Make sure students know that it is necessary to include both letters and numbers for identification purposes whenever known.

AIRPORT NUMBERS

NUMBER	WHERE FOUND	ITS USE

LESSON TITLE: **KITES IN THE WIND**

GRADE LEVEL: 1, 2, 3, 4, 5, 6, 7, 8

SKILLS:

Goal 2 Concepts and Principles
Science
No. 17 Problem Solving
No. 19 Systems and Interactions
Mathematics
No. 25 Space and Dimensionality
No. 26 Measurement

PERFORMANCE OBJECTIVES:

. The student will understand more about the forces of lift, drag, thrust and pull as they act upon a flying kite.

. The student will gain skill in measuring and following directions as he/she constructs kites and windmills.

. The student will learn to fly a kite safely.

MATERIALS:

Worksheet
Pinwheel pattern

PROCEDURE:

1. Have students put together kites from kits or follow the directions on the enclosed pattern to make their own kite.

2. Instruct students about the parts of a kite and how they help it fly.

The **tail** of the kite keeps the bottom pointed away from the wind to allow the wind to lift and push. (The tail supplies the **drag**.) Too much tail - the kite is sluggish. Too little tail - the kite spins and dances out of control.

The **bridle** (the string that is attached to the body of the kite) is important because the angle at which it is placed determines how the kite flies. Small angles - the kite rides high or soars. Large angles - the kite rides low and pulls on string.

The power to fly the kite comes from the wind. (This is called **thrust**.) You don't have to run with your kite to make it fly; the wind should do the work. Steady winds between 4 to 18 miles per hour are the best to fly kites. Gusty wind may break the kite. As the kite is carried into the air you may encounter some turbulence, because of air currents, for the first 50 to 100 feet, but once the kite is above 100 feet it should fly smoothly.

3. Choose a large clear area for flying kites. Before taking the students outside to fly their kites, go over some common sense safety rules about where and when to fly kites. Caution students to fly their kites away from power lines, trees, antennas and tall buildings. Also caution children not to climb trees, poles, fences or buildings to retrieve their kites.

4. While the students are flying their kites, have them notice the way their kites behave in the air and what forces are acting upon the kites. If the students have different sizes and kinds of kites, have them determine which ones are the best fliers and why.

5. Getting the kites out of the air safely and in one piece can be accomplished by walking it down, and reeling in the string when there is less pull on the line.

6. The pinwheel pattern can be cut out and pinned to the eraser of a pencil. This wind indicator can be used to determine if there is sufficient wind to fly kites and which direction it is blowing. If the pinwheel spins lazily, there is probably not enough wind to support the kites. If it spins steadily and quickly enough so that it is a blur, conditions are probably good for kite flying. Determine which way the wind is blowing and face the kite into it. The lift from the wind should push against the front of the kite.

EXTENSIONS

Challenge the students to make a tetrahedron fly! or a triangular prism! or a cube! or a rhombohedron! These geometric shapes have all been used as kite shapes.

Show the students some pictures or diagrams of box kites and kites of other shapes. Some examples are included on a work sheet.

You may have students work individually or in small groups to design the kites and then transfer the design to a three dimensional figure.

The following factors need to be considered when designing your own kite. The weight of the materials; the surfaces that will face the wind; the balance; (Does it need a tail? and where would it do the most good?) the place for attaching the bridle.

Set reasonable deadlines, have trial runs, allow remakes, and finally have a kite flying contest with their original designs.

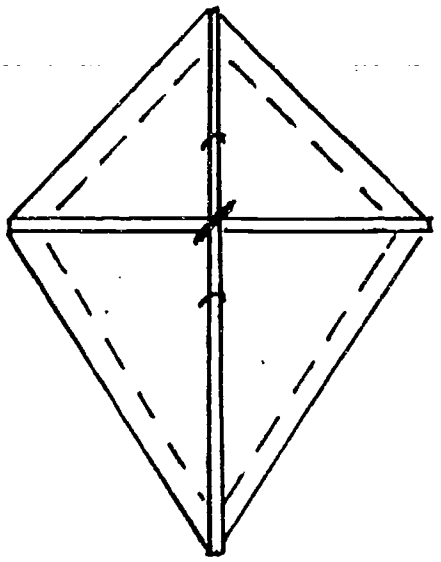
Award prizes in several categories:

- Best all over design
- Best/most unusual geometric solid
- Highest fliers
- Most intricate design
- Most attractive
- Best individual entry
- Best group entry

Discuss the geometry involved in creating the kites. The shapes, the angles, the drawing and designing of the kites and then transferring them to three dimensions.

This activity is more appropriate for students from grade five and up.

WORK SHEET FOR KITES IN THE WIND



KITE DIRECTIONS

Make a frame

1. Fasten two lightweight sticks together to make a cross 24" by 30".
2. Thread a length of string around the outside of the frame making a diamond shape.

Cover it

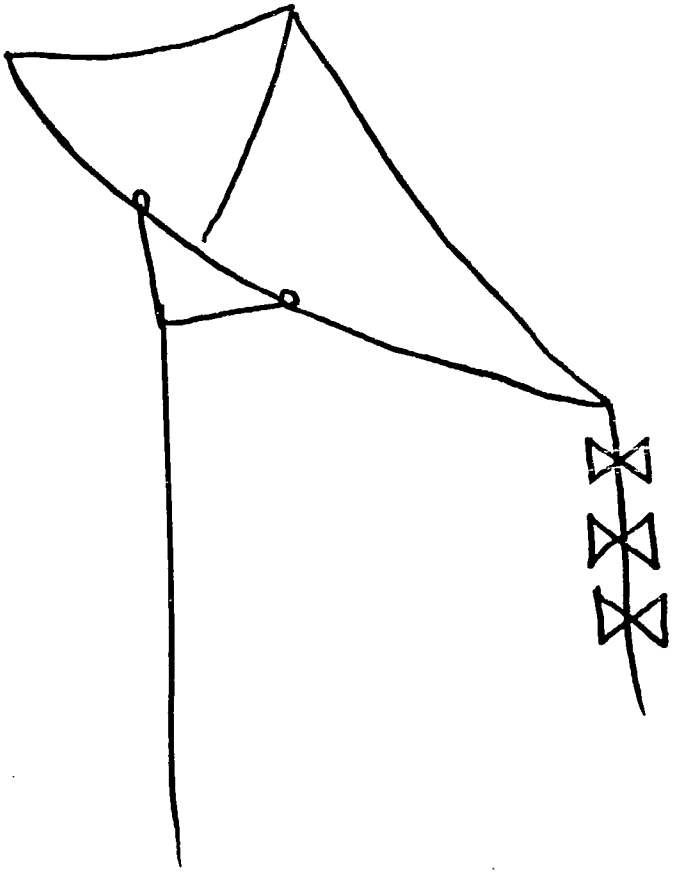
3. Lay the frame on a length of tissue paper. Two sheets glued together at the wider edge will work.
4. Fold the edges of the tissue over the frame.
5. Trim the tissue to one inch of the fold.
6. Paste the edges over the string with a glue stick.

Fasten the String

7. Tie a 12" length of string to the vertical part of the frame above and below the crosspiece.
8. Attach the string to this bridle.

Add a Tail

9. Add a narrow strip of material about 30" long to the bottom of the kite to make a tail.



WORK SHEET FOR KITES IN THE WIND

PINWHEEL PATTERN

1. Cut out the Pinwheel Pattern.
2. Cut in to the center on the lines from each corner.
3. Pin each numbered corner to the center with a straight pin.
4. Attach the pinwheel to a pencil eraser.