



insanely cool experiences

POWER OF AIR

EXPERIMENT GUIDE



POWER OF AIR

What's all around us, is usually invisible, but you can feel it? What is necessary for life on Earth and is one of the most powerful forces in nature? Have you guessed what it is? It is air and it is all around you! In this guide, we will explore the properties of air.

Take a deep breath. Ready? – Set! – **GO!**



WHAT YOU NEED

- DIAPER GENIE® REFILL KIT OR WINDBAG
- SCISSORS

1 Cut a length of bag as tall as you are.



Tie a knot in one end.

5



Now, try to fill the bag in one single breath. Open the end of the bag as wide as you can.

3 Blow a few breaths of air into the bag.



Slide the air to the bottom to see how you did.

6 Keep your mouth about 6 inches away from the opening and blow a single breath of air into the bag.

7



Quickly seal the bag and tie off the end.



HOW DOES IT WORK

The bag quickly inflates because air from outside the bag is pulled into the bag along with the stream of air from your lungs. However, when you put your mouth ON the bag, none of the outside air can get into the bag. By keeping your mouth OFF of the bag, you allow the outside air molecules to follow the stream of air from your mouth into the bag. In other words, you're using science to get more air inside the bag simply by holding the bag away from your mouth. Blowing into the bag actually creates lower pressure inside the bag and higher pressure air outside the bag rushes in with your airstream to equalize things.

For the technical explanation, we have to go back to 1738 and talk about a scientist named Daniel Bernoulli. Bernoulli observed that an area of low atmospheric pressure surrounds a stream of fast moving air. In fact, the faster the stream of air moves, the lower the air pressure is around it.

⇒ TAKE IT FURTHER: WINDBAG STRUCTURES

Now that you know the secret to inflating that giant bag with a single breath, you can easily inflate any amount of Windbags you would like. What's next, you ask? A clever engineering challenge just for you.

- 1 First, you need to link two rubber bands together by pushing one rubber band through the middle of the other. Pull them through each other in opposite directions and the rubber bands link together to form a figure eight...OR it will work with just one rubber band and two Windbag ends.
- 2 Inflate six (or more) Windbags.
- 3 Using a rubber band, connect the knotted ends of two of your Windbags.
- 4 Continue by adding one more Windbag to the two you've already connected to create a Windbag triangle on the floor. All three corners should be connected with rubber bands.
- 5 Add another Windbag to EACH corner of the triangle. You will add three more Windbags.
- 6 Once all of the corner bags are connected, bring them to a point above the middle of the triangle on the floor. Use rubber bands to connect the three together and – voilá! – you have a Windbag Pyramid.

WHAT YOU NEED

- LOTS OF WINDBAGS
- LOTS OF RUBBER BANDS

TAKE IT EVEN FURTHER: FLOATING ON AIR

Make sure one end of the Windbag has a knot in it. Lay the deflated bag on the floor. Now, you lay down on the bag! Position your feet at the knotted end with the open end by your mouth. Hold the open end of the bag in your hand just like you would do if you were blowing up a brown paper bag. Blow air into the bag but squeeze the bag shut after each breath. With each breath you'll feel yourself rise a little. Eventually you'll have so much air in the bag that you could roll off of it. Try to keep your body completely balanced on the bag so that you can proudly state, "I floated my body on a cushion of air that I made!"

Maybe you could lift even heavier things by using two Windbags and a helper. An upside down table is a good choice to try first. Lay the bags parallel to each other with opposite ends of the bags next each other. Lay the upside down table on top of the bags. Blowing at the same time, you and your helper will watch the table slowly rise as the volume of air increases in both bags.

SCIENCE FAIR CONNECTION

While inflating these bags is a fun activity, it is not a science fair project. You can create a science fair project by identifying a variable, or something that you can change, in this experiment. Let's take a look at some of the variable options that might work:

- ▶ Cut different lengths of bags. Use the one breath method to inflate each. Are you able to inflate each bag with only one breath, or do the bags eventually get too long to inflate in just one breath?

This is just one idea, but you aren't limited to that! Come up with different ideas of variables to test and give them a try. Remember, you can only change one variable at a time for each test. For example, if you are testing the length of the bags, make sure that all other factors in the test remain the same!

TEACHER NOTES:

SCIENCE CONCEPTS OVERVIEW ▶ Properties of Air, Air Movement, Bernoulli's Principle

The learning experiences contained in the following Experiment Guide are designed to engage students and deepen understanding, not only of the underlying scientific concepts upon which these experiments/demonstrations are built, but also of critical thinking and problem solving skills. Teachers should allow students to actively participate in each activity as an investigation, where questions are being asked, hypotheses are developed and redeveloped, and where students own the discoveries. Vocabulary was included, assessments were created and critical thinking questions were designed with this underlying goal in mind.

The following are some suggested teaching points that could accompany this experiment/demonstration:

SICK Science Teaching Points: The SICK Science video can be utilized in a variety of ways. It can be used to introduce a scientific concept or in place of doing the demonstration/experiment if materials are unavailable. The video can also be used as a review or to help students complete the various learning experiences included in this guide. The video can also be used as a review or to help students complete the various learning experiences included in this guide.

Visit the landing page below to locate the appropriate video for this activity

stevespangler.com/sick-science-resources

Vocabulary: Students will enhance their science-content related vocabulary. You may choose to introduce the vocabulary words and explicitly teach the meaning of each. You may also use the vocabulary words as an investigation, where students may research the meanings of the words. Finally, students may develop their own meaning for each word through their experience with the experiments and critical thinking work.

Scientific Method: Students can complete a full lab report for the demonstration, including asking questions, identifying variables, forming a hypothesis, designing the experiment, collecting data, and drawing conclusions. Differentiation using the lab report is easy. For lower levels, complete the lab report as a class. As students are more independent, encourage students to work in partnerships or groups to complete the lab report. Eventually, students should be able to complete the lab report independently or design a new experiment using the lab report form based on the demonstration completed in class.

Sequence: Students will put the steps to inflate a windbag in the correct order. Older students should also include transitional phrases.

Summarize: Students will create a summary that includes the important ideas and details of Bernoulli's Principle.

Real World Application: Students will be able to apply their critical thinking strategies and scientific concepts to a real world scenario.

Literature Connection: Gilberto and the Wind, by Marie Hall Ets. This book supports the reading strategies of visualization and cause and effect.

Informational Writing: Students can write an informational piece about air movement and molecules. They should include relevant vocabulary and apply their new understandings to other familiar topics and scenarios such as wind, hair dryers, fans, etc. Younger students may use diagrams and pictures to explain their thinking.

✓ A
✓ B
✓ C

Expert Vocabulary

NAME _____

WORDS AND DEFINITIONS —

Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

VOCABULARY WORDS

DEFINITIONS

1 ____ Atmosphere

• A •: A reasonable guess.

2 ____ Air Flow

• B •: A group of two or more atoms that stick together.

3 ____ Molecules

• C •: The layer of air around the Earth held in place by gravity.

4 ____ Estimate

• D •: An invisible mixture of gases that people and animals breathe.

5 ____ Air

• E •: The movement of air through or past an object.



Critical Thinking

NAME _____

SEQUENCE —

Students will put the steps to inflate a windbag in the correct order. Older students should also include transitional phrases.

Today you will share your science experience with a friend. Your job is to sequence the steps of inflating the Windbag in this experiment as you observed them in the SICK Science video. Be sure to write the steps in order on a Windbag using a permanent marker. It is helpful to use transition words or numbers to lead your friend from one step to the next. When you have finished, roll up the bag and send it to a friend.



Critical Thinking

NAME _____

SUMMARIZE —

Students will create a summary that includes the important ideas and details of Bernoulli's Principle.

In your own words, explain why you are able to inflate the Windbag with only one breath, given that your lungs cannot hold the same volume of air as was in the filled Windbag. Add a picture with labels to show your understanding.



Critical Thinking

NAME _____

REAL WORLD APPLICATION —

Students will be able to apply their critical thinking strategies and scientific concepts to a real world scenario.

Create a new experiment to test the following statement about inflating a Windbag using one breath of air. Share your findings with the class.

Fast moving air will fill the bag fuller than slow moving air.



Assessment

NAME _____

ASSESSMENT QUESTIONS —

Read each question, then circle the letter next to the correct answer or write your response on the back of this page or in the box.

1 What is the stream of air called as it moves into the bag?

- a. Wind
- b. Air flow
- c. Jet stream
- d. A gentle breeze

2 What is the layer of air that surrounds the Earth called?

- a. Outer space
- b. Jet stream
- c. Atmosphere
- d. Carbon dioxide

3 When you fill a Windbag you are demonstrating Bernoulli's principle. On the back of this page, draw a diagram to illustrate what is happening as you inflate the Windbag. Make sure to draw yourself, the Windbag, the air from your lungs, as well as the surrounding air molecules. Draw arrows to show the direction of the air flow.

4 Air takes up space. Explain how you know on the lines below.

5 Imagine that you had a 20 foot long Windbag. Estimate how many breaths it would take to fill the Windbag. Make sure you explain why you think this.

- A
- B
- C

Expert Vocabulary - Answer Key

WORDS AND DEFINITIONS —

Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

VOCABULARY WORDS

DEFINITIONS

1 **(C) Atmosphere**

:A: A reasonable guess.

2 **(E) Air Flow**

:B: A group of two or more atoms that stick together.

3 **(B) Molecules**

:C: The layer of air around the Earth held in place by gravity.

4 **(A) Estimate**

:D: An invisible mixture of gases that people and animals breathe.

5 **(D) Air**

:E: The movement of air through or past an object.



Critical Thinking- Answer Key

SEQUENCE —

Students will put the steps to inflate a windbag in the correct order. Older students should also include transitional phrases.

Today you will share your science experience with a friend. Your job is to sequence the steps of inflating the Windbag in this experiment as you observed them in the SICK Science video. Be sure to write the steps in order on a Windbag using a permanent marker. It is helpful to use transition words or numbers to lead your friend from one step to the next. When you have finished, roll up the bag and send it to a friend.

Possible Answer:

1. Unroll your Windbag.
2. Tie one end of the Windbag with a knot.
3. Ask a friend to hold the tied end of the Windbag in their hand. Unroll the bag and hold it out so that it is straight across between the both of you.
4. Open the untied end of the Windbag as wide as you can without tearing the bag.
5. Hold the end open as wide as it can be about 6"-12" from your face.
6. Take a deep breath and blow as hard as you can into the Windbag.
7. When you see the bag "snap", quickly close the open end with your hand.
8. Tie a knot to keep the air in the bag.



Critical Thinking- Answer Key

SUMMARIZE —

Students will create a summary that includes the important ideas and details of Bernoulli's Principle.

In your own words, explain why you are able to inflate the Windbag with only one breath, given that your lungs cannot hold the same volume of air as was in the filled Windbag. Add a picture with labels to show your understanding.

Possible Answer:

When I breathe out, the air coming from my lungs travels in a straight line into the bag. As that air is going into the bag, air molecules from around my airflow rush to join in and travel in the same direction. The result is that all the air molecules I exhale, along with the other air molecules that joined in, fill the bag. This is why I can fill the Windbag with one breath.



Critical Thinking- Answer Key

REAL WORLD APPLICATION —

Students will be able to apply their critical thinking strategies and scientific concepts to a real world scenario.

Create a new experiment to test the following statement about inflating a Windbag using one breath of air. Share your findings with the class.

Fast moving air will fill the bag fuller than slow moving air.

Answers will vary. Be sure that students design an experiment in which they are able to follow the scientific method, identify variables, and explain their results and what the results tell you as a scientist.



Assessment - Answer Key

ASSESSMENT QUESTIONS —

Read each question, then circle the letter next to the correct answer or write your response in the boxes.

1 What is the stream of air called as it moves into the bag?

- a. Wind
- b. Air flow
- c. Jet stream
- d. A gentle breeze

2 What is the layer of air that surrounds the Earth called?

- a. Outer space
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3 When you fill a Windbag you are demonstrating Bernoulli's principle. On the back of this page, draw a diagram to illustrate what is happening as you inflate the Windbag. Make sure to draw yourself, the Windbag, the air from your lungs, as well as the surrounding air molecules. Draw arrows to show the direction of the air flow.

4 Air takes up space. Explain how you know on the lines below.

Possible Answer:

When I breathe out, the air coming from my lungs travels in a straight line into the bag. As the air travels into the bag, other air molecules from around my air flow rush to join and travel the same direction. The bag fills in one breath. If I were to blow up the bag like a balloon, then only the air from my lungs would be allowed to go into the bag. I don't have enough air in my lungs to fill the Windbag in one breath.

5 Imagine that you had a 20 foot long Windbag. Estimate how many breaths it would take to fill the Windbag. Make sure you explain why you think this.

Possible Answer:

In theory, if you hold the windbag open wide and you take a step back, you should be able to inflate the bag (no matter what size) in one breath, according to Bernoulli's principle.

Common Core State Standards

Student Outcomes	Standards
Students will be able to ask and answer questions about key details about their observations and discussion to demonstrate their understanding of the scientific concepts presented through the experiment.	RI.K.1, RI.1.1, RI.2.1, RI.3.1, RI.4.1
Students will be able to retell key details presented in the experiment.	RI.K.2, RI.1.2, RI.2.2, RI.3.2, RI.4.2, RI.5.2
Explain the procedure and ideas presented in a scientific experiment including what happened and why, based on the information presented.	RI.4.3
Students will be able to ask and answer questions to help determine the meaning of vocabulary presented as part of an experiment.	RI.K.4, RI.1.4, RI.2.4, RI.3.4, RI.4.4, RI.5.4
Students will be able to use information gained from observations of the experiment to demonstrate understanding of the concepts presented.	RI.3.7
Students will actively engage in share informational learning activity with purpose and understanding.	RI.K.10
Students will be able to recall information from experiences to answer a question.	W.K.8, W.1.8, W.2.8
Students will be able to participate in writing projects and write a sequence of instructions.	W.1.7, W.2.7
Students will be able to write an informative/explanatory text that includes facts.	W.K.2, W.1.2, W.2.2, W.3.2, W.4.2, W.5.2