SICK! science®
insanely cool experiences

LEAKPROOF BAG

EXPERIMENT GUIDE

LEAKPROOF BAG

Who would have thought that a plastic bag, some water, and a few pencils would have kids everywhere scratching their heads in amazement? Learn how to poke holes in a plastic bag filled with water without spilling a drop. This is a cool way to learn about the chemistry of polymers.

WHAT YOU NEED

- ROUND, SHARPENED PENCILS
- PLASTIC BAG
- WATER

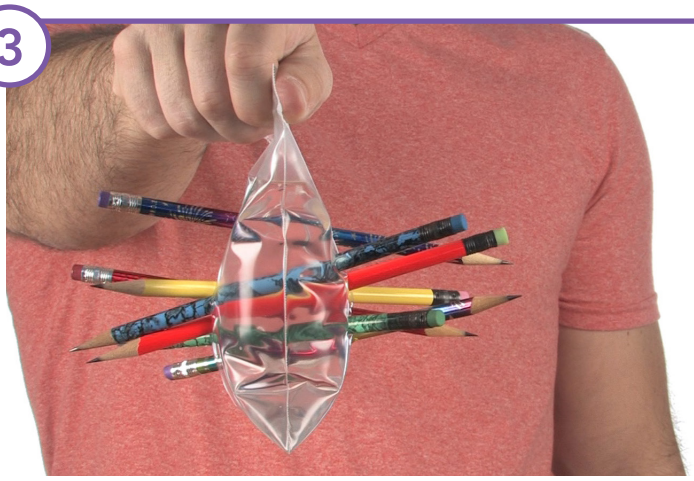
1

Fill the plastic bag half full with water and seal it tightly.

2

With one quick movement, pierce the bag with a sharp pencil, making sure to go through both sides of the bag. Leave the pencil in the bag.

3



Continue adding pencils. How many can you add?

4

Remove the pencils one at a time while holding the bag over the sink to drain the water.

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HOW DOES IT WORK

The plastic bag you used was most likely made out of a polymer called low-density polyethylene (LDPE). It's one of the most widely used packaging materials in the world. LDPE is low in cost, lightweight, durable, a barrier to moisture, and very flexible.

Think of the polyethylene molecules as long strands of freshly cooked spaghetti. The tip of the sharpened pencil can easily slip between and push apart the flexible strands of spaghetti, but the strand's flexible property helps to form a temporary seal against the edge of the pencil. When the pencil is removed, the hole in the plastic bag remains because the polyethylene molecules were pushed aside permanently and the water leaks out.

SCIENCE FAIR CONNECTION

While sticking pencils through a water filled bag is super entertaining, 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:

- Try using different types of plastic bags. Does the size of the bag or thickness of the plastic make a difference in the results you get?
- Try using different shapes of pencils. Do round pencils work differently than pencils with flat sides?

These are just a couple of ideas, but you aren't limited to them! 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 types of plastic bags, make sure that all other factors in the test remain the same!

TEACHER NOTES:

SCIENCE CONCEPTS OVERVIEW ▸ Polymers

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.

Sequencing: Students will put the steps in the correct order. Older students should also include transitional phrases.

Summarizing: Students will create a summary that includes the important ideas and details of the polymers sealing the hole in the bag.

Synthesis: Students will create an informational writing piece using the knowledge that they have gained from the experiment/demonstration.

Writing Connections: Students can research the types, uses, and environmental impacts of polyethylene. They may present their findings through a well-organized piece of informational writing.

Leadership Connections: Use "The Leakproof Bag" as an object lesson for a message on school spirit and leadership. Let the bag of water represent the student body and use the pencils to demonstrate the excitement of school spirit (spear-it!). Each pencil represents a different element of school spirit—teamwork, pride, unity, attitude, dedication, and fun. As the pencils pass through the water, the student body helps to magnify the message of involvement and participation in school activities throughout the year. What happens when the spirit pencils are removed? Is it possible to stop the leaks? How do we keep the enthusiasm alive?

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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 ____ **Polymer**	A A group of two or more atoms that stick together.
2 ____ **Molecule**	B A commonly used plastic material.
3 ____ **Flexible**	C A chemical compound formed from a long chain of the same molecule group.
4 ____ **Polyethylene**	D The ability to bend without breaking.

Critical Thinking

NAME

SEQUENCING —
Students will put the steps in the correct order. Older students should also include transitional phrases.

Sequence the steps of this experiment as you observed in the SICK Science video. Be sure to write the steps in order and use transition words or numbers to lead your reader from one step to the next.

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Critical Thinking

NAME

SUMMARIZING —
Students will create a summary that includes the important ideas and details of the polymers sealing the hole in the bag.

In your own words, summarize how the polyethylene polymers keep water from leaking out of the bag, even after the bag has a pencil poking through it.

Critical Thinking

NAME

SYNTHESIS —
Students will create an informational writing piece using the knowledge that they have gained from the experiment/demonstration.

This question uses what you learned in the experiment combined with some independent research you will need to do about polyethylene.

Think of a creative way to inform other students about the uses for and different types of polyethylene. Include information about how the flexibility of the polymers is important when thinking about its various uses. Your creation could be in the form of a poster, skit, song, comic strip, video or any other form you might choose.

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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. The polymers in the plastic bag are
   a. stiff
   b. fragile
   c. flexible
   d. insulators

2. The plastic bag is made out of _____ molecules.
   a. hydrogen
   b. polyethylene
   c. diazomethane
   d. helium

3. Why doesn't the water leak out of the bag once it has been punctured by the pencils?
   a. The polymers in the plastic bag create a seal around the pencils.
   b. Water has magnetic properties which hold the bag together.
   c. The pencils attract all of the gravity so there is no gravity to pull the water out of the bag.
   d. The pencils do not actually create a hole in the bag, it is an optical illusion.

4. Draw and label a diagram that shows what the polymers in the plastic bag might look like around the pencils that have punctured the bag.

_____

_____

_____

5. Low Density Polyethylene is also used to make Saran® wrap and bubble wrap. What do you predict would happen if you were to puncture one of these other materials with a pencil? Why?

_____

_____

_____

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 Polymer	A	A group of two or more atoms that stick together.
2	A Molecule	B	A commonly used plastic material.
3	D Flexible	C	A chemical compound formed from a long chain of the same molecule group.
4	B Polyethylene	D	The ability to bend without breaking.

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Critical Thinking- Answer Key

SEQUENCING —
Students will put the steps in the correct order. Older students should also include transitional phrases.

Sequence the steps of this experiment as you observed in the SICK Science video. Be sure to write the steps in order and use transition words or numbers to lead your reader from one step to the next.

Possible Answer:

- *First, fill a zipper-lock bag half full with water and seal it closed.*
- *Next, poke a sharpened pencil through one side of the bag and out the opposite side.*
- *Then, repeat poking pencils through the bag at different angles.*
- *Finally, remove the pencils one at a time over a sink or bucket.*

Critical Thinking- Answer Key

SUMMARIZING —
Students will create a summary that includes the important ideas and details of the polymers sealing the hole in the bag.

In your own words, summarize how the polyethylene polymers keep water from leaking out of the bag, even after the bag has a pencil poking through it.

Possible Answer:
When the pencil first punctures the bag, it is sliding in between the polyethylene polymers. The flexible polymers split apart, allowing the pencil to go in between them. Then, the polymers squeeze back together, creating a seal around the pencil which prevents the water from leaking out of the bag.

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Critical Thinking- Answer Key

SYNTHESIS —
Students will create an informational writing piece using the knowledge that they have gained from the experiment/demonstration.

This question uses what you learned in the experiment combined with some independent research you will need to do about polyethylene.

Think of a creative way to inform other students about the uses for and different types of polyethylene. Include information about how the flexibility of the polymers is important when thinking about its various uses. Your creation could be in the form of a poster, skit, song, comic strip, video or any other form you might choose.

Possible Answer:
Students may include information about the different densities of polyethylene which include a variety of uses from artificial implants and bullet-proof vests to plastic piping and plastic baggies. The flexibility of the polymers is important as it allows for the stretchy abilities in things like baggies, or for the shock absorption in bullet-proof vests.

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. The polymers in the plastic bag are
   a. stiff
   b. fragile
   c. flexible
   d. insulators

2. The plastic bag is made out of _____ molecules.
   a. hydrogen
   b. polyethylene
   c. diazomethane
   d. helium

3. Why doesn't the water leak out of the bag once it has been punctured by the pencils?
   a. The polymers in the plastic bag create a seal around the pencils.
   b. Water has magnetic properties which hold the bag together.
   c. The pencils attract all of the gravity so there is no gravity to pull the water out of the bag.
   d. The pencils do not actually create a hole in the bag, it is an optical illusion.

4. Draw and label a diagram that shows what the polymers in the plastic bag might look like around the pencils that have punctured the bag.

   Possible Answer:
   Students may draw a diagram that shows the pencil squeezing between polymer chains, and the polymers chains closing up around the pencil to form a seal.

5. Low Density Polyethylene is also used to make Saran® wrap and bubble wrap. What do you predict would happen if you were to puncture one of these other materials with a pencil? Why?

   Possible Answer:
   I think that if I punctured Saran wrap or bubble wrap, the polymer chains would create a seal the hole around the pencil just like they did with the plastic baggie, but if it was holding water like the bag was it probably won't leak. I think this because they are all made out of the same materials and have the same types of polymer chains.

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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 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 explain the connection between scientific ideas presented in the experiment.	RI.1.3, RI.2.3, RI.3.3, RI.4.3, RI.5.3
Students will be able to retell key details presented in the experiment in order to understand/determine the main idea.	RI.K.2, RI.1.2, RI.2.2, RI.3.2, RI.4.2, RI.5.2
Students will be able to participate in writing projects and write a sequence of instructions.	W.1.7, W.2.7
Explain the procedure and ideas presented in a scientific experiment including what happened and why, including cause and effect, based on the information presented.	RI.3.3, RI.4.3
Students will be able to recall information from experiences to answer a question.	W.K.8, W.1.8, W.2.8