SUGGESTED ACTIVITIES

(*What is Matter?*)

From *Invitations to Science Inquiry 2nd Edition* by Tik L. Liem:

Activity	Page Number	Concept
• The Air Catcher	5	Matter occupies space
• The Bottle and The Bag	6	Matter occupies space
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From *Harcourt Science* Teacher's Ed. Unit E: (For ALL grade levels)

Activity	Page Number	Concept
• Physical properties of matter	E4-5 (4th grade text)	Matter occupies space
• Conservation of matter	E26-27 (5th grade text)	Matter is neither created nor destroyed

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THE AIR CATCHER
THE AIR CATCHER

A. Question: *What and where is air?*

B. Materials Needed:

1. A medium plastic bag.
2. One plastic sandwich bag per student

C. Procedure:

1. Take the medium size garbage bag, open its mouth and ask students: “What’s in the bag?” (Anticipated answer: ‘nothing’).
2. Move the bag now with two hands back and forth (like wanting to catch a bug in a bag), then quickly close the mouth of the bag with a twisting motion.
3. Ask the students: “What do I have in the bag now?”
4. Distribute sandwich bags to the students and let them try to catch air in their own seats, without blowing into the bag.

D. Anticipated Results:

The students will collect air that is odorless and colorless. After they have collected their air, they will twist the bag to trap it. They can then feel the firmness of the bag, demonstrating that the bag is not empty.

E. Thought Questions for Class Discussion:

1. What was filling the bags?
2. Can we catch air under the bench or behind the door?
3. Is the air the same everywhere?
4. How else can we fill the bag?
5. Would the material in the bag be the same if we blew in it?
6. How can we keep the bag inflated?
7. What would happen if we hit the inflated small plastic bag with the palm of the other hand?

F. Explanation:

Air is found everywhere. The plastic bags may be filled with air above the table, under the table, behind the door or anywhere else. The bags can also be inflated by blowing in them, but then the bags would contain exhaled air. This air is different because it has a higher percentage of carbon dioxide (CO_2) and more water vapor.

THE AIR CATCHER

When the filled bag is slammed between the two palms of the hands, it will burst with a loud pop. This explosion is caused by the sudden expansion of the air rushing out of the torn plastic bag. An common example of this is a popping balloon.

THE BOTTLE AND THE BAG

A. Question: *What is air pressure?*

B. Materials Needed:

1. One or two plastic sandwich bags.
2. One or two large wide-mouthed glass jars (for example, pickle jars).
3. Masking or transparent adhesive tape.

C. Procedure:

1. Place the materials on a table in front of the students. Ask the class: “What’s inside the jar?

2. Invert a sandwich bag over the mouth of a jar and blow a little air into the bag so that it stays inflated over the jar.

3. Tape the bag air-tight against the jar.

4. Now ask one of the students to push the bag into the jar (without tearing it). It won’t work!

5. Place another plastic bag inside another wide mouthed jar (if necessary you can reuse the previous bag and jar). Let the edge of the bag hang over the jar rim.

6. Tape it air-tight against the jar and let a student try and take the bag out of the jar (without tearing it). It won’t work!

D. Anticipated Results:

With each part of the experiment, you and your students will see that it is not possible to either push down on the plastic bag or remove it from the jar.

E. Thought Questions for Class Discussion:

1. What is holding the bag out of the jar (when trying to push it in)?
2. What is holding the bag inside the jar (when trying to take it out)?
3. How could we get the bag inside the jar without making a hole in it?

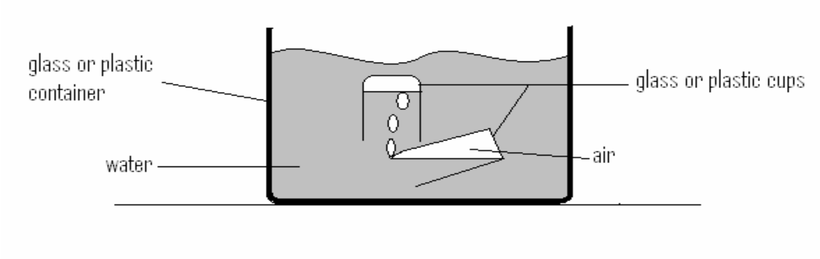
F. Explanation:

It is the air occupying the space in the jar which kept the bag from going inside after it had been taped air-tight against the jar. In trying to push the bag in, the pressure increased (became the volume decreased) and this held the bag out.

When trying to take the bag out of the jar, the air pressure inside the jar decreased. This occurred because the volume increased and this is what kept the bag inside of the jar. We encounter the first situation when we try to fold up a plastic air mattress or an inflatable plastic toy (ex. beach ball).

POUR AIR UNDER WATER

A. Question: *Does air take up space under water?*



B. Materials Needed:

1. Two transparent cups, either glass or plastic
2. A large transparent container (for example, a small aquarium)

C: Procedure:

1. Fill the large container about ¾ full with water.
2. Hold one cup in each hand upside down, and push them under water.
3. Fill one of the cups with water by holding it at a slanted angle. This will release the air bubbles. Do not leave any bubbles.
4. Now, position the cup with air still remaining so that it is lower than the other.
5. “Pour” the air from one cup to the other by slowly slanting it in the same way as before. Use the airless cup above it to catch the air bubbles.
6. This “pouring” of air can be repeated from one cup to the other.

D: Anticipated Results:

The students should expect to see the air collected between the cups. The air will be collected and take up space at the top (bottom end) of the cups.

E: Thought Questions for Class Discussion:

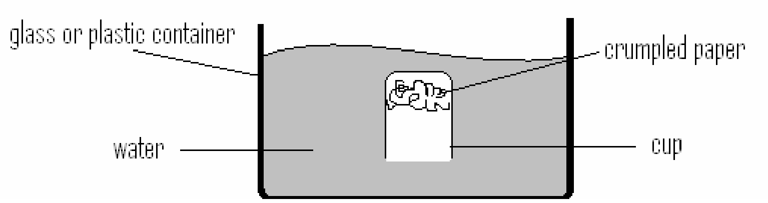
1. Before immersing the cups, ask: “What is in the beakers or cups?” (anticipated answer: “nothing”)
2. At the time of immersing the inverted cups, ask: “Why doesn’t the water enter the cups?”
3. Why do bubbles rise and not sink?
4. Can the cup with water be held partly above the water level without letting the water run out of the cup?

F: Explanation:

Air occupies space and also the space in the cups. At the time the cups were immersed under water, they were filled with air, and this is why the water could not fully enter the cups. By holding one cup slanted, the air bubbles were free to escape and thus the water could take its place. Air is much lighter in weight than water and that is why air bubbles rise and not sink in water. The water-filled cup can be held above the water level without letting the water run out, because the atmospheric pressure is pushing on the water surface.

KEEP PAPER DRY UNDER WATER

A. Question: *Is it possible to keep something dry underwater?*



B. Materials Needed:

1. One dry transparent cup, either glass or plastic
2. A larger beaker or transparent plastic container. It should be large enough to fit a person's hand.

C: Procedure:

1. Fill the large container about 2/3 full with water.
2. Crumple a piece of dry paper and squeeze it to the bottom of the transparent cup.
3. Invert the glass. Make sure that the paper is fixed tightly to the bottom of the cup.
4. Immerse the cup completely under water, holding it as vertically as possible.
5. Leave the cup underwater for a couple of seconds. Then take the cup out of the water.
6. Allow the water on the outside of the cup to drip off. Then (with your dry hand) removed the crumpled paper out of the cup.
7. Pass the paper around the classroom, allowing the students to check whether it is wet or dry.

D: Anticipated Results:

The students should expect to feel a dry crumpled ball of paper. When the cup is immersed into the large container full of water, the paper will remain at the top and the air trapped within it will prevent water from getting in.

E: Thought Questions for Class Discussion:

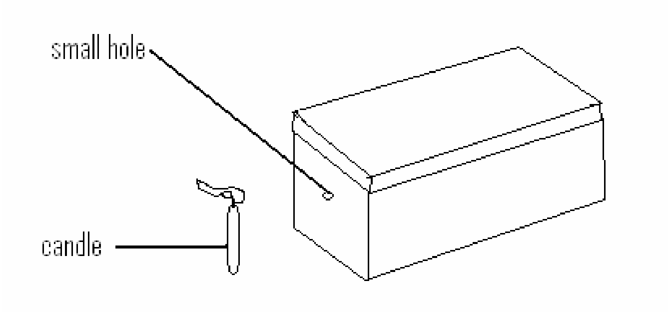
1. Before inserting the crumpled paper into the cup, ask : "What is in the cup?" (anticipated answer: 'nothing').
2. Before immersing the cup under water, ask: "What else besides the paper is in the cup?"
3. While immersing the cup: "Why doesn't the water enter the cup?"
4. Why does the paper have to be crumpled?

F: Explanation:

Air is "space occupying." The cup is therefore filled with air, no matter if it is being held right side up or upside down. In addition to the crumpled paper, there is also air in the cup and this is why water is unable to enter the cup when it is submerged under water. Therefore, the paper stays completely dry. Applications of this characteristic of air are found when people have to work under water. It is sometimes necessary for people to work underwater in a water-tight walled environment where air is pumped in and around the area. This air allows them to breathe and stay below the surface for long periods of time.

THE EMPTY BOX CANDLE SNUFFER

A. Question: *Does air have power?*



B. Materials Needed:

1. One empty shoe box
2. A birthday candles and matches
3. Masking tape

C: Procedure:

1. Show the open shoe box to the students and ask: "What is in the box?" (anticipated answer: 'nothing')
2. Make a small hole in the shorter, width end of the box (about ½ cm in diameter). The hole should be made at approximately the same height as the candle. Measure this height from the bottom of the box.
3. Light the candle and place it in front of the hole about 5 cm away.
4. Using an open hand, hit the shoe box top with a sudden tap.

D: Anticipated Results:

The students should expect to see the candle flame go out when the box top is struck. The force of the strike will push air in the shoebox container out through the hole. And if positioned correctly this air should either blow out the candle or move the direction of the flame. This lighting and snuffing of the candle can be repeated.

E: Thought Questions for Class Discussion:

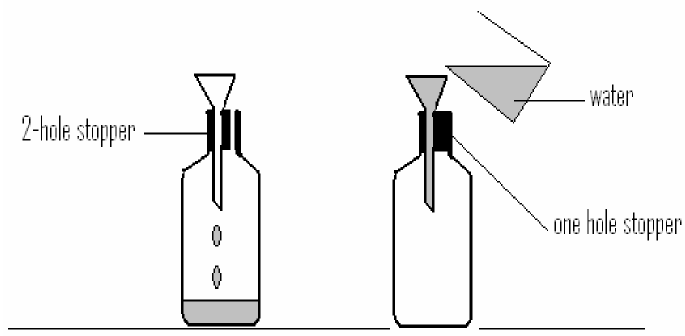
1. What blew the candle flame out?
2. What did the tap do to the volume of the box?
3. How far can you hold the candle from the box and still have the flame be blown out?
4. What would happen to the flame if you pushed the box top gently, instead of giving it a sharp tap.

F: Explanation:

The shoe box is occupied with air and by tapping the top of it, the air was forced through the little hole. This blew the candle flame out, just like when we pucker up our lips to blow out a candle. By tapping the box, the volume of it becomes smaller for a brief moment and this action forces air out. Pushing the box in gently is like blowing very lightly against the flame. This demonstration shows that air is occupying all the space around us; it's even within an "empty" box..

THE REFUSING FUNNEL

A. Question: *Will water defy gravity?*



B. Materials Needed:

1. Two identical glass or plastic funnels with a narrow stem
2. One two-hole stopper & one one-hole stopper
3. Two identical empty jars

C: Procedure:

1. Set up the jars so that the stoppers are positioned snugly and the stems of the funnels are placed within the holes of the stoppers.
2. Fill the funnels with water. Water will run through the funnel and into the jar which has the two-hole stopper. For the jar with the one-hole stopper, the water will remain in the funnel.
3. Take the jar with the two-hole stopper by the neck, and cover the second hole with your forefinger.
4. Keeping the hole covered, use your other hand to pour additional water into the funnel. Give the students enough time to see what happens before removing your finger.
5. Now, take the jar with the one-hole stopper and squeeze the stopper so that water will run through.

D: Anticipated Results:

Students should expect to see water flow through the funnel that is inserted into the jar with the two-hole stopper. Water will cease to flow through this funnel when the second hole is covered up. Water from the funnel that is inserted into the one-hole stopper, will be released once the stopper is squeezed.

E: Thought Questions for Class Discussion:

1. Before pouring the water, ask: "What is in the bottle?"
2. Why is the water only running through in one bottle?
3. After step 3 of the procedure, ask: "Why has the water stopped flowing from the funnel?"
4. What is holding back the flow of water?
5. Before performing step 5 of the procedure, ask: "How can we let the water run through this funnel?"

F: Explanation:

Each jar is filled with air. In the jar with the two-hole stopper air is allowed to escape through the second hole. And thus, water runs through the funnel. But in the jar with the one-hole stopper, there is no way for the air to escape and this holds back the water. There is limited space within the jar. For water to be added to it, something must be released. In this case, that something is air.

THE PLASTIC BAG AIR LIFT

A. Question: *Can air lift heavy objects?*

B. Materials Needed:

1. Twelve to twenty medium size garbage bags (plastic).
2. Two identical flat top tables.

C: Procedure:

1. Ask students to stand around the table and give them each a plastic bag.
2. Let them spread the bags out on the table and hold the bag's mouth in their hands to get set to blow air in them (let the students stay in a squatting position around the table).
3. Make sure that all students are ready to blow air into the bags with their hands and fingers away from the table top.
4. Ask two or four other students to lift the other identical table, turn it upside down and put it slowly on the first table (this has to be done carefully as it has to move over the heads of the students!).
5. Ask one or two students to climb up and sit on top of the set of tables.
6. Let the squatting students now blow air in the plastic bags all together on the count of three.

D: Anticipated Results:

The students should be able to lift the table when blowing air into the plastic bags.

E: Thought Questions for Class Discussion:

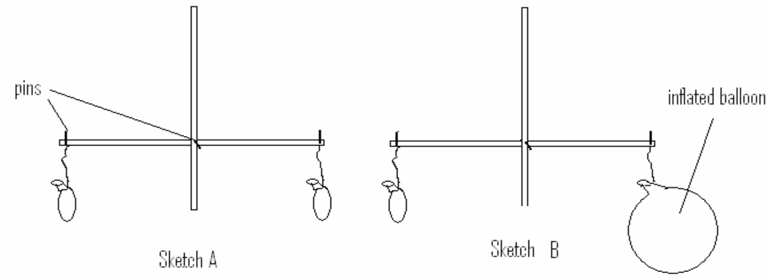
1. Did you expect a heavy weight like that to be lifted by air?
2. What made the table top rise?
3. How did the pressure of the air inside the plastic bags compare to the outside atmospheric air pressure?
4. Where do we find applications of this principle?

F: Explanation:

By blowing in the plastic bags, air is being compressed. This compressed air is exerting pressure underneath the inverted table causing the table to rise. This principle is being applied when pumping tires of a bicycle or automobile, or compressing air in air lifts (at gas stations or garages). Tire pressures are twice or four times as high as the atmospheric pressure, and in air lifts theses pressures go as high as 20 to 50 atmospheres.

THE BALANCING BALLOONS

A. Question: *Does air have weight?*



B. Materials Needed:

1. Two drinking straws
2. Three pins or needles & two pieces of thread
3. Two identical non-inflated balloons

C: Procedure:

1. Tie a piece of thread to each of the two balloons. Then tie these threads to the ends of one of the straws.
2. Take this straw and position it on your finger so that it balances. At this point where it is balanced, push a pin through the straw.
3. Take the other straw and position it so that it is perpendicular to the straw with the attached balloons. A "+" will form. Push the pin through this second straw. The needle will allow the horizontal straw to swivel like a balance.
4. So that the balloons on the end of the straw do not slip off of it, push a pin through the threads that are serving as attachments.
5. Make sure that the straws are moving freely around the needle and make sure that the two non-inflated balloons are in perfect balance.
6. Blow air into one of the balloons and tie it in a knot.

D: Anticipated Results:

The students will see how a balance can easily be made. They will also see how this balance functions. And when one of the balloons is inflated, the balance will tip down at the end where it is attached.

E: Thought Questions for Class Discussion:

1. What is inside the non-inflated balloons?
2. What kind of air was blown into the balloon?
3. What could happen if no pins were placed on the ends of the horizontal straw where the thread were attached?
4. What does the balance indicate after inflating one balloon?
5. What would you expect the balance would do if the other balloon was also inflated?
6. How else could we show that air has weight?

F: Explanation:

The straw balance may be adjusted by moving the threads further or closer to the end of the straw. In order to keep these attached threads from sliding, we need the pins. The air that was blown in the balloon was exhaled air, which contains some water vapor but, for our purposes may be neglected. Inflating the other balloon with the same amount of air should put the balance back to equilibrium again.

THE BALL THAT GAINS WEIGHT

A. Question: *Can air be heavy?*

B. Materials Needed:

1. A basketball or volleyball with a valve
2. A hand pump (to pump up the ball)
3. A technical scale or balance

C: Procedure:

1. Place a rather soft basketball or volleyball on the pan of the technical scale and determine the weight.
2. Connect the hand pump to the ball and pump ten strokes of air into the ball.
3. Disconnect the pump and read off the new weight of the ball. How much did the ball gain in weight?
4. Repeat steps 2 and 3, and have students predict what the gain in weight would be after 5, 10, 15, 20, and 25 strokes of the pump.

D: Anticipated Results:

The students will see how an increase in air to the ball also increases its weight.

E: Thought Questions for Class Discussion:

1. What made the ball gain in weight?
2. What can we sat about the relationship between the number of pump strokes and the gain in weight of the ball?
3. How can we make the ball lose weight?
4. How much would a beach ball gain in weight when pumped with 5, 10, or 15 strokes of the same hand pump?
5. Would an airtight bottle gain weight if air were pumped into it?

F: Explanation:

This demonstration shows that air has weight. By adding air to the ball, it increases in weight. The same number of pump strokes should result in the same gain in weight. Half the number of pumps gives half the gain in weight. The number of pump strokes is therefore directly proportional to the increase un weight. If the data were plotted on a graph, a straight line relationship would be obtained between the number of pump strokes and the weight of the ball. Whether a ball or an air mattress or an airtight bottle is pumped, the increase in weight should be the same, provided that the same pump is being used and the same number of strokes is applied.