

Unit 4 Big Idea: Air is a gas that surrounds us, takes up space and creates weather.

Lesson 4 – Air and Weather

Olive: Hi, class. Today, I want to talk about air. What is air?

Lilly: It's the stuff we breathe.

Olive: Yes. Tell me more.

Phinny: You can blow a bubble with it if you're chewing bubble gum.

Olive: Yes you can. I didn't realize you chewed gum, Phinny.

Phinny: That's the way I want to keep it.

Olive: You mean you chew gum in my class?

Phinny: On the record? No.

Archie: How about off the record?

Phinny looks at Archie and blows a big bubble that pops on his face.

Hattie: Have you lost all sense? Just because you say "off the record" doesn't mean Miss Olive can't see you!

Olive: She makes a good point, Phinny. Let me just say on the record: peel that gum off your face and put it in the trash can and no more gum in my class, on or off the record, okay?

Phinny: *still covered in gum.* Yes, ma'am...Sheesh. I was just trying to help.

Olive: Okay. It is true that bubbles are filled with air. Thank you for your participation, Phinny. When scientists talk about the form of something, they say it is a solid, a liquid, or a gas. What is air?

Hattie: A gas.

Olive: Right. A gas is something that expands to fill whatever container it's in. Let's use Phinny's bubble for an example. Did you all notice that the bubble grew in all directions until the skin got too weak to hold the air and it burst?

The air didn't all collect in one corner because air expands to fill whatever space it has. And when the bubble popped, all the air rushed out to fill the space in this room.

Does anyone know what we call the air that surrounds us on earth?

Phinny: The sky?

Olive: We can call it sky but a more scientific word might be "atmosphere." It is that part of the sky that is full of gases like oxygen, carbon dioxide, and nitrogen. And

believe it or not, air molecules are pulled towards earth, the same way that we are, by gravity. The bottom layers of the atmosphere contain the most oxygen and other gases. As you go up in altitude, the molecules are fewer and farther between. Hattie, I bet you know about altitude since you fly at different altitudes. Tell us what it is.

Hattie: Altitude is how low or high you are in the atmosphere. Sea level, where land and sea are at the same level is considered 0, and you start counting from there.

Olive: Good, Hattie. Altitude and elevation are two words with related meanings. We use altitude to talk about how high in the atmosphere something is. Altitude tells us something about how much air is available. We also use elevation to say how high or low different places on earth are compared to sea level. If land at sea level has an elevation of 0, it also has 0 altitude. Sea level is where we start counting. Does anyone know what the elevation of the highest spot on earth is?

Hudson: The highest point is the top of Mount Everest at 29,029 feet or 8,848 meters.

Olive: *Surprised.* That's right. How come you know that?

Hudson: It's easy. It has 2 29's and my birthday is on the 29th of December. Then 8,848 has all those 8's. It's easy to remember. Besides, I'm going to be a mountain climber.

Olive: Very impressive. So maybe you can tell us, Hudson. What's the difference between breathing at sea level and breathing on the top of Mount Everest?

Hudson: You get plenty of oxygen at sea level, but most climbers on Everest use oxygen tanks to get to the top. Humans aren't really cut out to breath the thin air up there.

Olive: Good. Have any of you felt sick from being at a high altitude?

Lilly: We went over a pass that was 10,000 feet once and I got a headache. My mom said it was from the altitude.

Olive: Yes. And yet you were barely over half the altitude of Mount Everest when you got your headache. Climbers without extra oxygen on Mount Everest get exhausted, can't remember and don't think as clearly at around 24,000 feet as they did when they started the climb. There is not quite enough oxygen to support good brain function at that altitude. And at that point, they still have another vertical mile to go.

Lilly: What's a vertical mile?

Hattie: It's a mile into the air.

Olive: Yes, it might take miles to arrive there but it's how much higher the top is from 24,000 feet. Mount Everest is around 5 1/2 miles from sea level to the top.

Phinny: *With an evil grin.* I bet Hattie couldn't do her math problems at that height. As a matter of fact, I'd love to see her Highness, Miss Know It All stumped for once. *Hattie warbles and threatens. Phinny covers his ears. Sheesh!*

Olive: *Looks on bemused.* Okay, you two. Now, if you go up not just 5 ½ but keep climbing another 10 Mount Everests stacked on top of each other, you'd be up 62 miles from sea level. At this point you'd be at the edge of the atmosphere. At this altitude, earth's gravity is too weak to pull on anything and there is no more air. That's why astronauts must wear special suits and use oxygen tanks to breathe if they go beyond the earth's atmosphere.

Archie: If there's not enough gravity to act upon air, is that why people float around in space?

Olive: Yes, it is. You made a good connection there. Thank you.

Archie: You're welcome. Just doing my job. Putting two and two together.

Hudson: And with your brain at this low altitude, you may even come up with the right answer.

Archie: *In a goofy voice.* You mean, 5, right?

Hattie: *Not getting the joke and having to be right.* 4.

Archie: *Innocent but mocking.* You're good Hattie. You're really good.

Phinny: *Disgusted.* Sheesh.

Olive: Now that we're into the subject of air, let's move on to another puzzle.

Phinny: I love puzzles.

Olive: Well, here you go then. What is it about soda that makes it fizzy? Anyone?

Hudson: It's carbonated.

Olive: Good. Tell me more. What does "carbonated" mean?

Hudson: *Smiling.* It means fizzy.

Olive: *Smiling back.* I see we're not going to get very far with this line of reasoning. Does anyone know what key ingredients all soda must have?

No answer.

To get its fizz, soda must have water and carbon dioxide. Carbon dioxide, you remember, is what plants need for photosynthesis, and it's what animals breathe out. It turns out carbon dioxide dissolves in water. Somebody tell me what I mean by dissolve.

Phinny: Disappears, like the Wicked Witch of the West did when Dorothy poured water on her?

Olive: Interesting answer, Phinny. Not quite, but you're on to something. Dissolving does mean a kind of disappearance when the molecules of one thing hook up with the molecules of another thing. That's different from a mixture, when the molecules of two things stay separate. Let's start with an example of a mixture. What happens when you put a teaspoon of oil into a cup of water?

Lilly: You get a mixture of oil and water. The oil is in the water but you can see the oil parts and you can see the water parts.

Olive: That's right.

Olive: But what if you take a teaspoon of salt and put that into a cup of water. Can you still see the salt particles inside the water?

Archie: No, the salt disappears.

Olive: That's right. Parts of the salt molecules hook up with parts of the water molecules and that's what we call a solution. Solutions are usually clear or at least translucent.

Phinny: I know what "translucent" means. It's something you can jump on.

Olive: I think you're thinking of "trampoline." Translucent means something else. Anybody?

Hattie: Translucent means some but not all light can get through. Stained glass is translucent if it glows in sunlight.

Phinny: She said *anybody*, not *anybirdy*. Mind your own business winged wonder.

Olive: When I say, "anybody" I, of course, mean *anybirdy*, and *anyfurry*.

Kids laugh.

And Hattie has the correct meaning of "translucent." Mixtures, on the other hand are usually opaque. What does "opaque" mean, *anybunny*?

Kids laugh.

Hattie: I can speak for the bunnies. "Opaque" is when no light can get through. Mud is opaque, as are bunnies. *Laughs at her own joke.*

Olive: Why Hattie, I don't think I've ever heard you make a joke before. Good one.

Phinny: *Disgusted.* Yeah, she's a regular Tina Fey.

Olive: Well, moving on. Solutions are usually clear or translucent, and mixtures are usually opaque. Except for the mixture of oil and water that I chose which is transparent. Who knows what "transparent" means?

Archie: You can see through it.

Olive: Yes. Now let's get back to the fizz in soda. The carbon dioxide dissolves in water to form a solution, but some of it stays gas in the form of bubbles. And what do we know about gas?

Hudson: Gas fills whatever contains it.

Olive: That's right. Anyone want to finish the explanation of fizz, or explain why a very hot can of soda might even explode when you open it?

Hudson: The gas rushes out when it has a chance to expand when you open the can. With a cold soda, you hear a hiss as the gas escapes the liquid. But with a hot soda, the gas molecules are speeded up and pressing against the can so if you give them an escape they're going to burst out of the opening. With that much pressure, they even carry the liquid in the can out with them.

Olive: You're exactly right. Gas wants to spread out and you can see how it behaves under pressure and when it's not under pressure. That's how air creates weather patterns in the atmosphere surrounding the earth. Has anyone heard people talk about low pressure or high pressure when talking about the weather?

Phinny: I've heard of peer pressure.

Olive: *Smiling.* Well, that's something else. Now, we're talking about air pressure.

Compared to other kinds of matter, air doesn't have much weight, but because there is so much air in the atmosphere, the air does push down on everything. We call that push, air pressure. There is more push at sea level than at the top of Mount Everest.

Like the carbon dioxide in the soda sealed inside a can, air pressure is caused by the weight of the atmosphere pressing down on the air beneath it. Opening a soda can releases the gas until the pressure inside the can equals the pressure outside of it. There are equal amounts of the air molecules everywhere.

If you were tiny enough you might feel a mighty wind as the carbon dioxide escapes the can. And in fact, that's what wind is. It is simply the flow of air spreading out from an area of high pressure to an area of low pressure.

Archie: Sometimes I feel a mighty wind when I pass gas.

Everybody laughs but Miss Olive.

Olive: *Ironically, looking at Archie.* I can always count on you for the deep insights. Moving on. What do we call someone who studies wind and weather?

Phinny: Metropolitists.

Olive: Close, Phinny. Meteor...

Phinny: Meteor showers.

Olive: Not quite. Meteorolo...

Phinny: Meterolopers...

Olive: Meteor-ol-ogists.

Phinny: Yeah, that's what I meant.

Hattie: *to herself*. Pitiful.

Phinny: *getting mad*. You're pitiful!

Olive: *bemused*. Moving on...

Meteorologists trace high and low pressure areas and base much of their weather predictions on pressure systems. In high pressure systems there is more air pressure than normal and the wind blows clockwise. They usually create good weather. Low pressure systems have less air than normal and the wind blows counterclockwise. Low pressure systems usually cause storms.

Meteorologists study wind direction and speed to predict storms. Besides weather prediction, people have tried to harness the energy of wind for a variety of purposes throughout time. Can anyone think of an example of using wind energy to do something?

Archie: Sailboats use wind energy to move in the water.

Olive: Good. Anyone else?

Hattie: We birds sometimes glide with the wind.

Olive: Good. Anyone else?

Lilly: Windmills use wind energy to do a lot of different things. Even create electricity.

Olive: That's right. Thanks for all your good thinking today. Tomorrow we have a special treat. We're going to consider how birds fly, and we have a special guest to help us.

Phinny: Oh no! Not... Hattie...

Hattie warbles proudly.

Olive: Yes, Hattie is going to help us understand how remarkable she is.

Phinny: She's been trying to do that every day since we began and some of us find it pretty annoying.

Olive: *Smiling*. Oh Phinny. What would we do without you?

Kids together: Yeah, Phinny.

Phinny: *getting embarrassed*. Aw, now you're just trying to make me feel good.

Archie: *Looking at Phinny with mock sincerity but good humor*. That's not true, Phinny. I...I...I love you, man!

Phinny: *blushing and pleased*. Cut it out, Archie. You're just saying that. *Covers his eyes*. Sheesh!

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