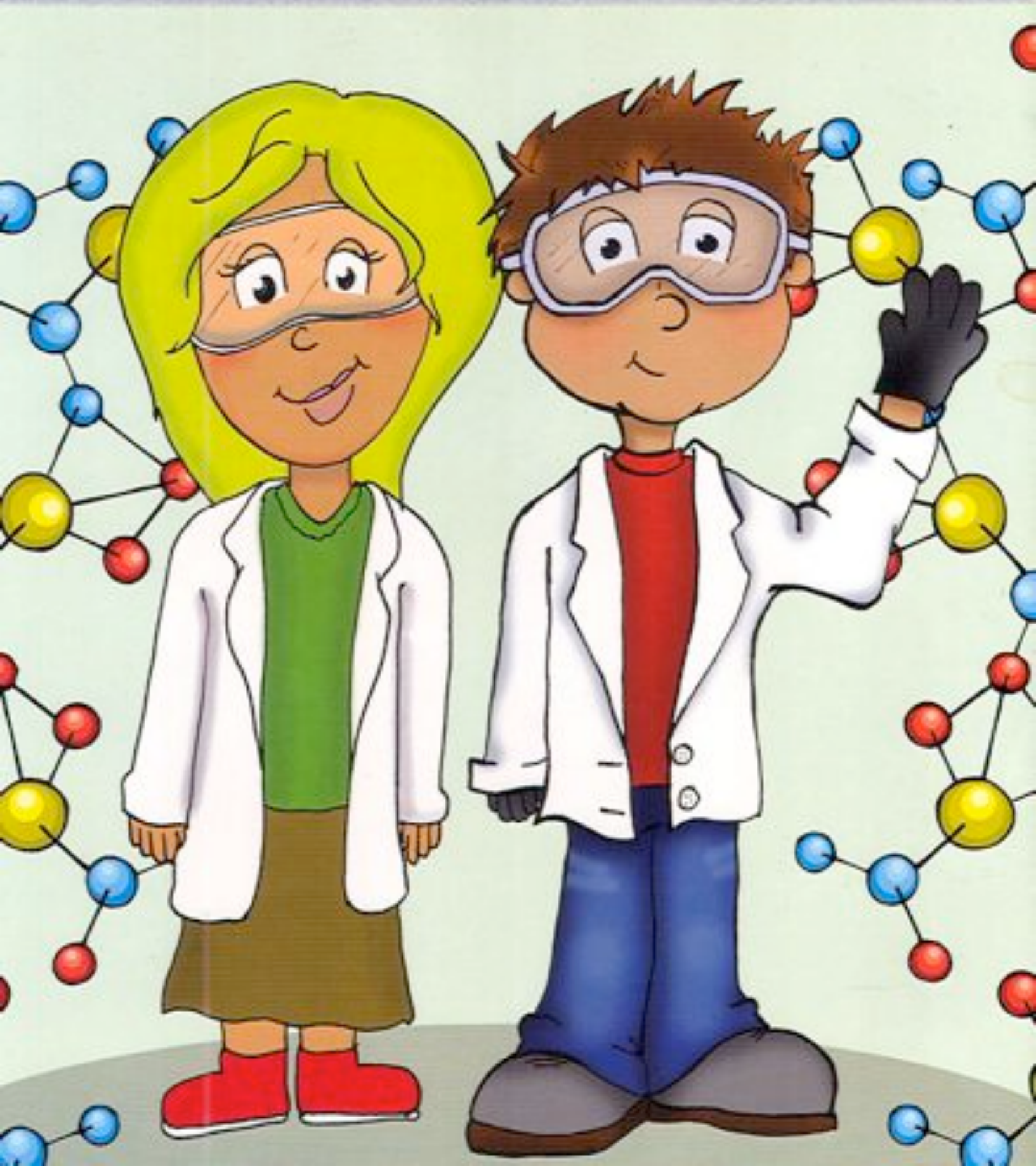
Let's Do Science!



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Special Thanks to the
Howard Hughes Medical Institute
and Baldomero M. Olivera, Larry
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What is the World Made of?

Everything in the world is made of molecules. **Living** and **non-living** things are made of molecules.

Can you identify the objects below that are **living** and **non-living**?



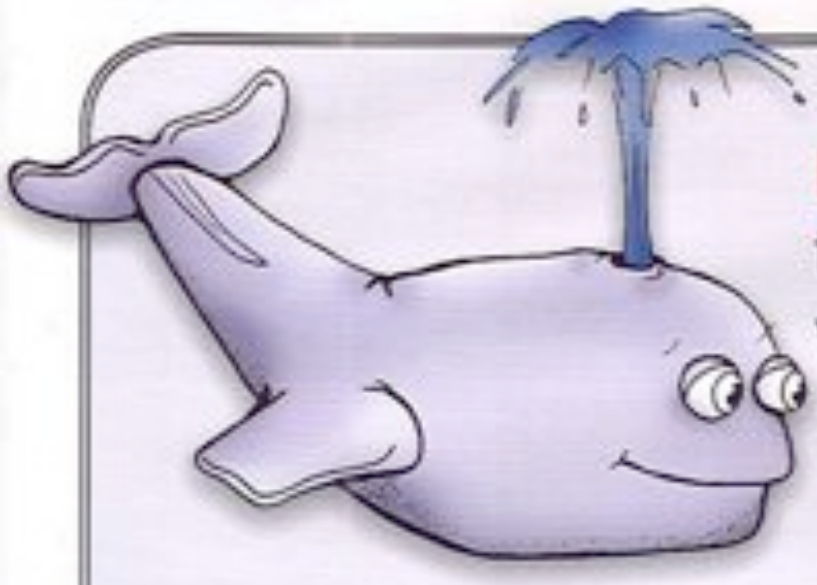








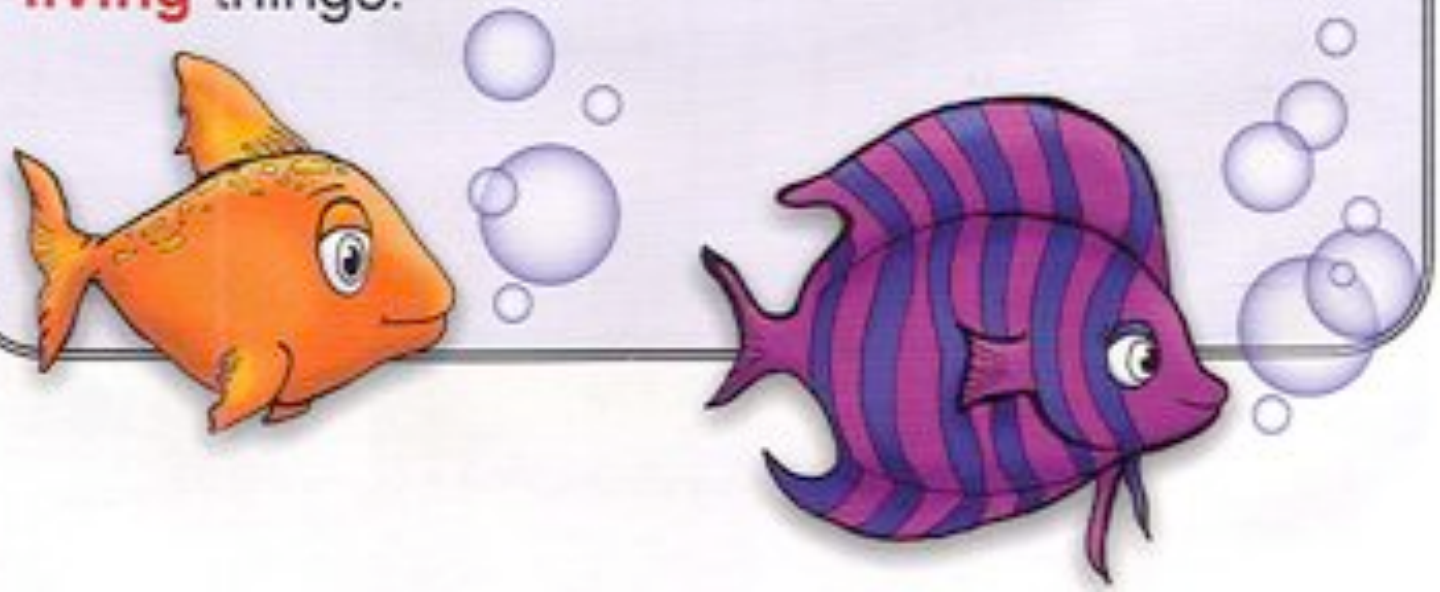

The Same or Different?



Living and **non-living** things are made of a variety of **molecules**.

We can do experiments to discover how things are similar or different.

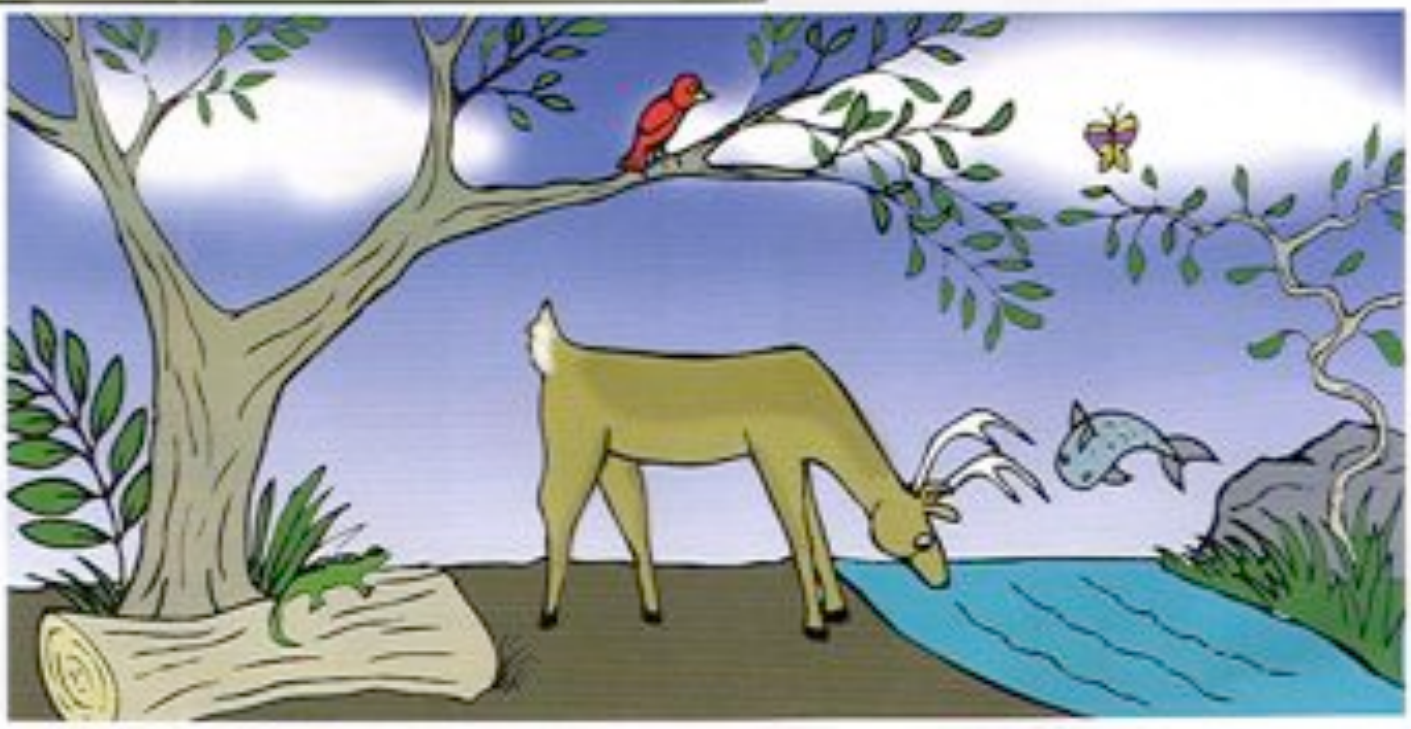
There are many ways a scientist can do an experiment. In this activity, we will discover some similarities in several **living** and **non-living** things.



Molecules are Everywhere!

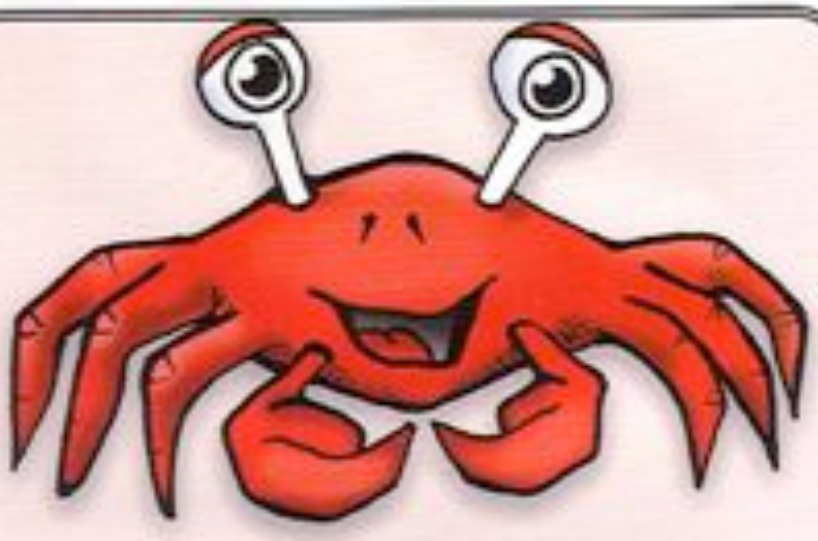
Examples of things made of molecules are water, sand, grass and fish. Even the fish bowl is made of molecules!

The world we live in is made of many different types of molecules. All molecules are made up of smaller parts called **atoms**. The size of the molecule depends on how many **atoms** it has.



All these things in nature are made of different molecules.

More on Molecules



Did you know that snails and crabs actually make the shells they live in! They use **molecules** to make up their hard shell. As the animal gets larger, the shell grows with them.

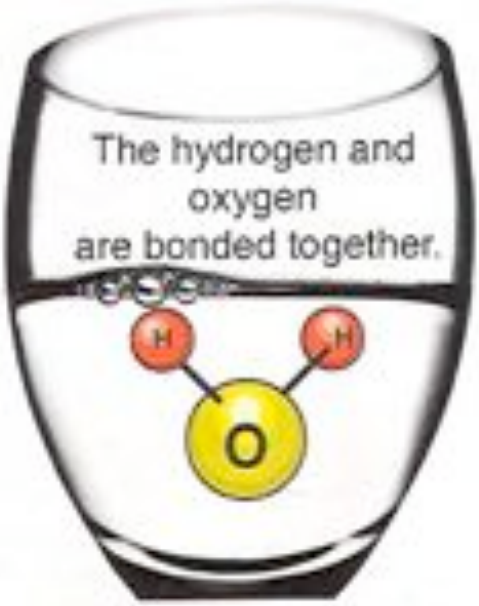
Many of them use the same molecules to make the shells they live in. These animals cannot survive without this **exoskeleton**, which is on the outside of their body. It protects their body. It is a part of them just like our **endoskeleton**, our bones.

A shell is like a suit of armor. It protects the snail from harm.

The Bonds that Bind Us!

Bonds form between molecules much like people holding hands. **Bonds** are very strong connections between **atoms** . When you break the **bond(s)** of a molecule, the molecule is broken down into its **atoms**.

If you break the bonds in water, you get hydrogen and oxygen.



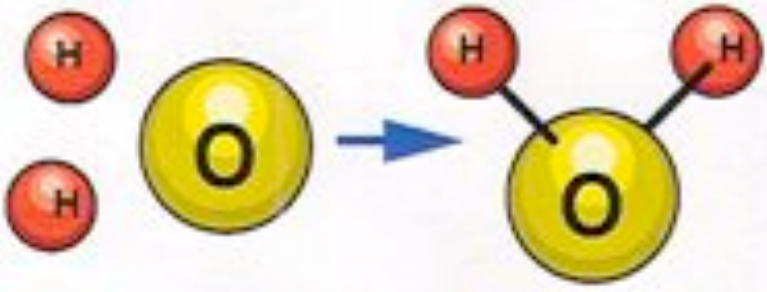
This is how a scientist might draw water.

Atoms

Scientists call the parts that make up molecules **atoms**. We already know that molecules make up everything in the world. Now we know that molecules are made of **atoms**.

So, now we can say that the world is made up of **atoms**.

Hydrogen and oxygen are both **atoms**. Two parts of hydrogen and one part of oxygen make up water.



Building Blocks

If we think of building blocks, a bond is how the blocks fit together. Some blocks have one circle. Some have two or more that fit into a matching piece.

A big block with eight circles is harder to pull apart than a small block with only two circles. The bonds in molecules have different strengths too. Some bonds are strong and some are weak. Would a strong bond be like a block with eight circles or two circles?

How Do Things Dissolve?

Things that **dissolve** get pulled apart when a liquid is present.

Have you ever seen sugar **dissolve** in lemonade? Where does the sugar go?

When sugar **dissolves** in water, the bonds between sugar get pulled apart. The sugar is still in lemonade, but the sugar doesn't look the same anymore. Each sugar part is surrounded by water.

The straw is also made up of molecules. Unlike sugar, their bonds do not get pulled apart in water. That's why the straw stays a straw and the sugar dissolves in water!

Love of Water

Sugar is made up of many sugar parts. A lot of very small sugar parts go together to make the sugar that you can see. When sugar is in water, it breaks into tiny bits of sugar you can't see. Sugar likes water more than it likes itself. That is why it **dissolves**.

A scientist says that sugar is **hydrophilic**, which means that it loves water.

Fear of Water

Oil does not **dissolve** in water. Oil has very strong attractive forces. It likes other oil parts better than it likes water. When you mix oil and water together, the oil floats on top of the water.

Scientists call this **hydrophobic**, which means it fears water.

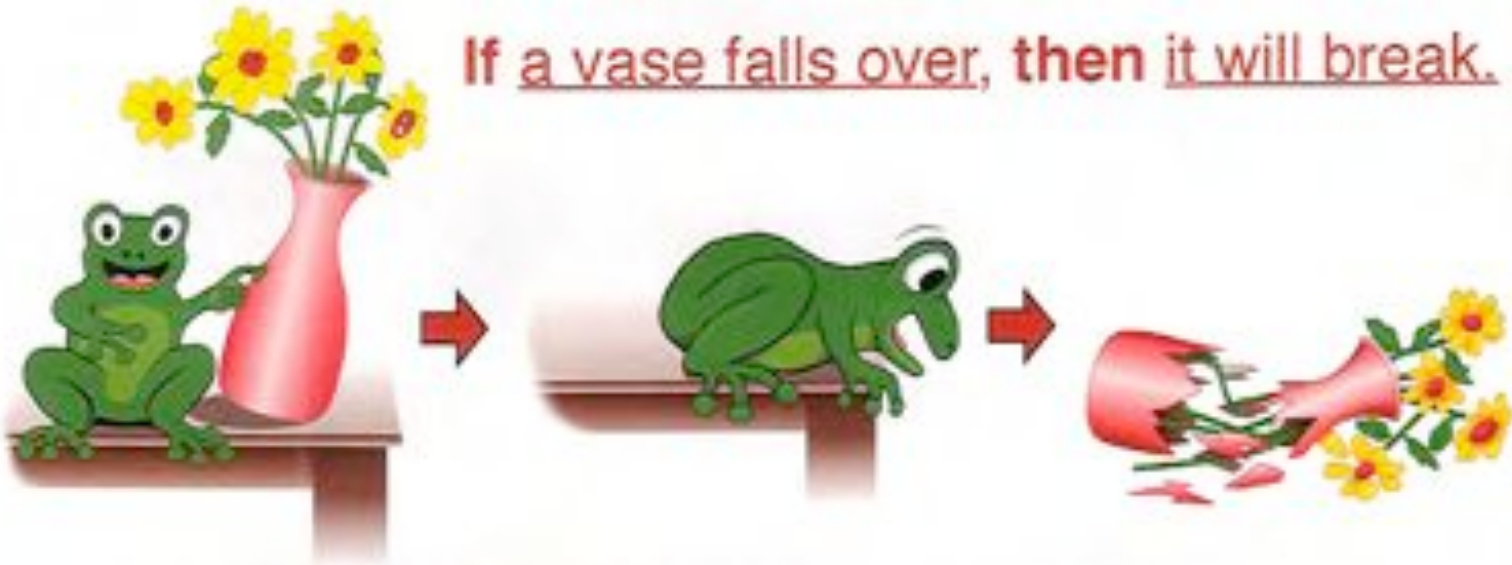
Can you think of other things that may or may not **dissolve** in water? What other things are like oil?

Research

Scientists often use a model when they do research. One model follows an "if, then" pattern.

Say to yourself "**If** _____, **then** _____.

If a vase falls over, **then** it will break.



Hypothesis: guess what you think will happen in your experiment.

Experiment: test your hypothesis.

Results: what you saw that happened. Make sure you write these down!

Conclusion: summarize your results.

Ask Questions

One of the most important things a scientist does is to ask questions. When scientists try to answer questions, they discover new things. When you are a scientist, you might ask some of these questions:

Was your hypothesis correct or incorrect?

Was there anything new that you learned because of the experiment?

Did something surprise you?

Can you think of another experiment you want to do now?

Did you know?
Most scientists repeat their experiment several times to make sure that their results are the same each time.

Lab Safety

Time to start experimenting!

Be sure to always wear your gloves, lab coat, and goggles.

We want to make sure nothing touches your skin or clothing, or splashes in your eye.

Future scientists at work!

Stinky!

The vinegar smells so make sure that after each time you use it, you close the vial!

Experiment One: Chemistry of Non-Living Materials

We will see how three **non-living** things behave in water and vinegar: sand, sugar, and chalk.

You will need:

- ☐ Plastic Vials
- ☐ Pipettes
- ☐ Water
- ☐ Vinegar
- ☐ Sand
- ☐ Sugar
- ☐ Chalk

1. Write down your **hypothesis.**
   Remember how we talked about things dissolving in water?

   What do you think will happen?

2. **Experiment!**
   Using your pipette, put three pipettes full of water into the vial with sand.

3. Record your observations!

4. **Now combine the following and record your observations:**
   - Vinegar and Sand
   - Water and Sugar
   - Vinegar and Sugar
   - Water and Chalk
   - Vinegar and Chalk

5. Make **conclusions** about your results.

6. Share your **results** with your classmates.

Lab Journal (Sugar)

Hint: Have you ever put sugar in a liquid before? What happened?

Q: If I put sugar and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Sugar and Water			Amount left: _____	

Q: If I put sugar and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Sugar and Vinegar			Amount left: _____	

Lab Journal (Sand)

Hint: Have you ever played with sand before? How do you think the location of sand will help you make your hypothesis?

Q: If I put sand and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Sand and Water			Amount left: _____	

Q: If I put sand and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Sand and Vinegar			Amount left: _____	

Lab Journal (Chalk)

Hint: Have you ever written with chalk before? What happened when the chalk got wet?

Q: If I put chalk and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Chalk and Water			Amount left: _____	

Q: If I put chalk and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Chalk and Vinegar			Amount left: _____	

Experiment Two: Biochemistry of Living Materials

We will see how materials from three **living** things behave in water and vinegar: crab shell, cone snail shell, and glass sponge.

You will need:

- ☐ Plastic Vials
- ☐ Pipettes
- ☐ Water
- ☐ Vinegar
- ☐ Crab Shell
- ☐ Glass Sponge
- ☐ Snail Shell

1. Write down your **hypothesis.**
   Remember how we talked about things dissolving in water?

   What do you think will happen?

2. **Experiment!**
   Using your pipette, put three pipettes full of water into the vial with crab shell.

3. Record your observations!

4. **Now combine the following and record your observations:**
   - Vinegar and Crab Shell
   - Water and Cone Snail Shell
   - Vinegar and Cone Snail Shell
   - Water and Glass Sponge
   - Vinegar and Glass Sponge

5. Make **conclusions** about your results.

6. Share your **results** with your classmates.

Lab Journal (Crab Shell)

Hint: Where do crabs live? How do you think the crab's habitat will help you design your hypothesis?

Q: If I put crab shell and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Crab Shell and Water			Amount left: _____	

Q: If I put crab shell and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Crab Shell and Vinegar			Amount left: _____	

Lab Journal (Glass Sponge)

Hint: Have you ever seen a glass sponge? Where is the glass sponge found?

Q: If I put glass sponge and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Glass Sponge and Water			Amount left: _____	

Q: If I put glass sponge and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
Glass Sponge and Vinegar			Amount left: _____	

Lab Journal (Snail Shell)

Hint: Where do cone snails live? How does the snail's habitat help you make a hypothesis?

Q: If I put cone snail shell and water together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
 Snail Shell and Water			Amount left: _____	

Q: If I put cone snail shell and vinegar together, then what might happen?

A: _____

	What happened? Did the color change?	Did you observe a chemical reaction? Describe what you saw or heard?	Did everything dissolve? If not, what was left over?	Was your hypothesis correct?
 Snail Shell and Vinegar			Amount left: _____	

Bubbles

You just saw chemical reaction! What living and non-living things did you mix together to cause this reaction?

1. ____Ex: Vinegar and Chalk_____
2. _____
3. _____

Note! You may have seen sand and vinegar bubble (release carbon dioxide). Not all sand contains $CaCO_3$. For example, sand from The Sahara desert is made from silica and will not react with vinegar. However, sand from the southern beaches of Guam contains many broken down shells and coral which all contain $CaCO_3$ and will therefore react with vinegar!

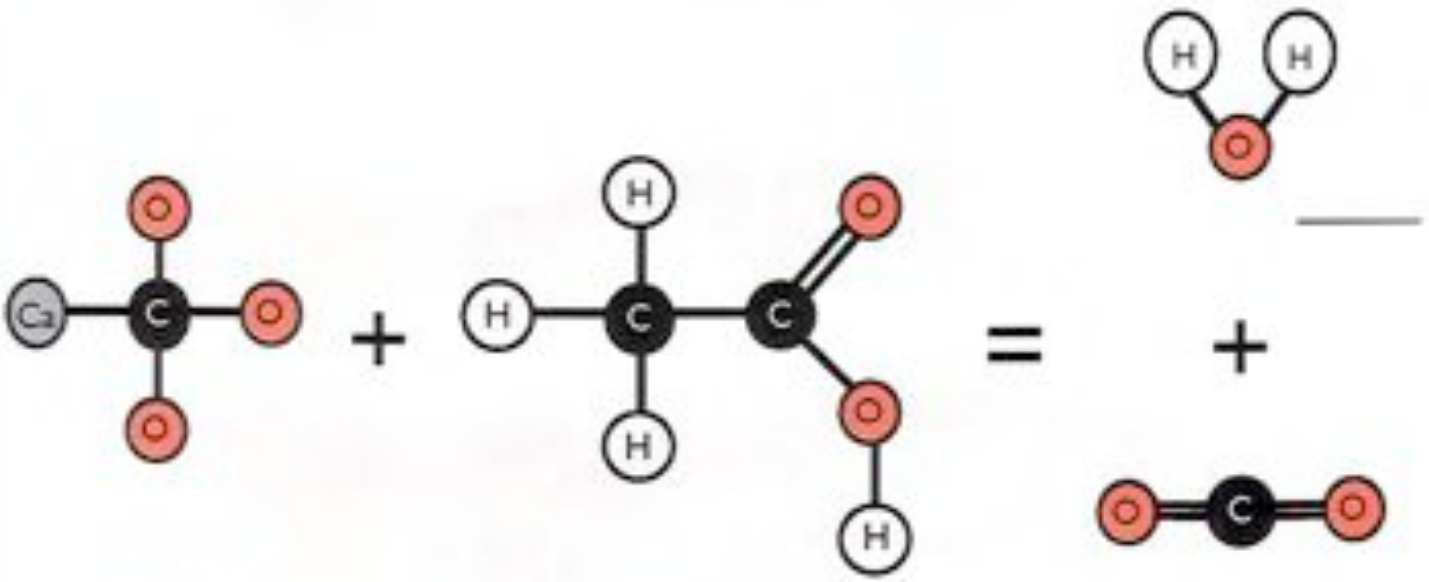
Mixing vinegar with some materials made a chemical reaction (bubbles!) This is because all of those things have the same molecule in them. This chemical is called _____ _____.

Calcium carbonate is also found in egg shells, bones, cement, and marble.

Chemical Reactions!

This is how a scientist draws a chemical reaction.

Each atom is represented by a circle.



$CaCO_3$

CH_3COOH
(Vinegar)

1. Q: How many molecules are in this chemical reaction?

   A. _____

2. Q: What atoms are present in this chemical reaction?

   A. _____

3. Q: Can you name the products (after the equal sign) of this chemical reaction?

   A. _____

Experiment Three: Classify

Scientists classify things to see how they may be related to each other. To do this, a scientist groups things based on similarities. A scientist calls this taxonomy.

1. With your classmates, group the shells. What similarities will you use to group them?

2. Experiment
   Look at the shells. Touch the shells. Talk about the similarities and differences you see.

3. Record what you saw. Group the shells and tape them to your whiteboard.

4. Make conclusions about your results.
   Do you think any of the shells are related?

5. Share your results with your classmates.

Shell Diversity

You just looked at a collection of shells.

There were many different kinds. How did you classify the shells?

Several were shaped like a cone. These are called cone snail shells.

There were also several shiny shells with an opening on the bottom of the shell. These are called cowries.

It is easy to separate cone snail shells from the cowries because of their different shapes and openings.

Herbivores

The cowries and the cone snail shells you classified are made by different kinds of snails. Most cowries are **herbivores**, they eat plant-like food found in the ocean. Just like cows and deer eat grass on land.

The opening on the bottom of the cowrie makes it easier for them to survive. Scientists call this an **adaptation**; it is different than other animals for a reason.

Carnivores

Cone snails are **carnivores**, they attack and eat other animals. They are like lions and wolves that eat other animals to survive.

Different kinds of cone snails eat different types of prey. Some cone snails eat worms. Other cone snails eat fish. Some cone snails even eat other snails. What they eat depends on where they live.

Cone Snail Adaptations

The opening of the cone snail shell is adapted for hunting animals. They use venom to capture their prey. The snail has a harpoon it uses to inject its prey with venom. This venom paralyzes the prey. A big mouth then opens up to swallow the prey.

The tip of the harpoon!

The big net is its mouth! It can swallow a fish that is as big as it is!

Medicinal Uses

Cone snails use their special venom to capture the prey they eat. The venom is being studied by scientists to help people. A special part of the venom is made into medicine and given to patients who have very intense pain.

Caution!

Special care is used when giving the medicine made from the venom to humans. Only a special part of the venom is prepared so that it protects the patient. Pure cone snail venom can hurt humans or even kill them.

Vocabulary

A

Adaptation: a change in something so it can survive better than it did before (p26)

Atom: the smallest part of an element (p3, 5, 6, 23)

B

Biodiversity: the variety of different species (p25)

Bond: the attraction between atoms in a molecule (p5-9)

C

Carnivore: an animal that survives by eating other animals (p 27)

Conclusion: a summary of your results (p11, 14, 18, 24)

D

Dissolve: to mix something with a liquid so that it all becomes a liquid (p8-10)

Diverse: different from other things (p25)

E

Endoskeleton: an internal skeleton, such as the bones in our body (p4)

Exoskeleton: a hard outer covering that protects an animal's soft body parts (p4)

Experiment: a procedure to test a hypothesis (p2, 11-14, 18, 24)

Vocabulary

H

Herbivore: an animal that survives by eating plants (p26)
Hydrophilic: a love of water (p9)
Hydrophobic: a fear of water (p10)
Hypothesis: when you make a smart guess about what you think will happen in an experiment (p11-12, 14-21)

L

Living: something that is alive (p1, 2, 18, 22)

M

Molecule: two or more atoms joined together (p1-8, 22, 23)

N

Non-living: something that is not alive (p1, 2, 14, 22)

R

Results: what happened in your experiment (11-21)

T

Taxonomy: what scientists call classifying different things into similar groups (p24)

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