

## LAWS OF THE UNIVERSE

### Introduction

In preparation for the Story of Creation, the Laws of the Universe experiments are presented. This sequence of twenty experiments is quite appealing to children.

Initially, the experiments are introduced on a sensorial level. That is to say, the experiment is performed and the children observe and record their observations. The principles underlying the experiments are not related to the beginning of the universe, nor the creation of the earth.

Additionally, the youngest child is capable of repeating the experiment after an initial introduction by the teacher. It is important to have the children record their observations.

The following pages contain:

1. A list of the experiments
2. Command cards to be cut to size:
  - A) 5 x 8: Experiments
  - B) 6 x 4: Statements
3. A complete list of materials to be used in the experiments
4. A record sheet for students to record their observations

## LAWS OF THE UNIVERSE: EXPERIMENTS AND STATEMENTS

### The Experiments (and Statements) Precede the Story of Creation

1. Cold - Freezing
2. The formation of the star
3. Solid - Liquid - Gas
4. Liquid - Viscous
5. Passing from solid to liquid to gas
6. Passing from gas to liquid to solid
7. Particles that attract each other and particles that do not attract each other
8. Mixture
9. Chemical combination of gas
10. Crystallization
11. Chemical reaction
12. Precipitation
13. Properties of solid, liquid, and gas
14. Elastic, plastic, and rigid
15. Matter changes its state at different temperatures
16. A) Law of gravity  
B) Density and the law of gravity
17. Rapidity of cooling depends on the mass of the bodies
18. Volcano
19. Matter expands when heated
20. Quick evaporation

## 1. COLD -FREEZING

**Materials:**

Ice, 1 lb. of salt, two 1-pint containers (beakers), two thermometers, water

**Command:**

In a container, put some small pieces of ice, some water and then a thermometer. Do the same in another container. Read the thermometers. Add a large amount of salt to one container. Stir. After a while, compare the temperatures of the two thermometers.

**Observe:**

Record your observations.

## 2. THE FORMATION OF THE STAR

**Materials:**

Olive oil, alcohol (pure alcohol), water in a little jug, a glass pie plate

**Command:**

Pour some water into the glass pie plate until it is 3/4 full. Add a few drops of olive oil (or another dense type of oil). Add slowly, pouring near the rim of the glass, a bit of alcohol.

**Observe:**

Record your observations.

### 3. SOLID - LIQUID - GAS

**Materials:**

A marble, some water in a small jug, three test tubes, a test tube holder, three slips of paper reading solid, liquid, and gas

**Command:**

Put the three test tubes in the holder. Put the marble in one test tube, some water in the second test tube, and leave the third test tube as it is. Apply the names: solid, liquid, and gas.

**Observe:**

Record your observations.

### 4. LIQUID - VISCOUS

**Materials:**

Sugar, some water in a little jug, two glasses (beakers), a little spoon

**Command:**

Take the two glasses and pour a small amount of water in them. Then add several teaspoons of sugar to one of the glasses, stirring the liquid, until the water thickens into a semi-liquid.

Apply the two terms: liquid, viscous. Viscous: a thickened liquid.

**Observe:**

Record your observations.

## 5. PASSING FROM SOLID TO LIQUID AND TO GAS

**Materials:**

A piece of wax (paraffin), a spoon, a candle, some matches

**Command:**

Take the match and light the candle. Put the piece of wax on the spoon and hold it over the flame. Keep the spoon on the flame until the wax disappears.

**Observe:**

Record your observations.

## 6. PASSING FROM GAS TO LIQUID AND TO SOLID

**Materials:**

A piece of ice, a pan and a lid, a spoon, a hot plate

**Command:**

Put the piece of ice in the pan and put it on the hot plate. As soon as the water boils, put the lid on it. Observe what happens on the lid. You can collect some drips on the lid and put them into the freezer.

**Observe:**

Record your observations.

## 7. PARTICLES THAT ATTRACT EACH OTHER AND PARTICLES THAT DO NOT ATTRACT EACH OTHER

**Materials:**

Some water in a little jug, sugar, some talcum powder, two glasses (beakers), two spoons

**Command:**

Put some water in a glass, pour in some sugar, stir it with a teaspoon. Put some water in another glass, pour in some talcum powder, and stir it energetically with the teaspoon.

**Observe:**

Record your observations.

## 8. MIXTURE

**Materials:**

Iron-filings, sand, a plate, a magnet, a handkerchief

**Command:**

Take the iron-filings and the sand. Mix them on a plate. Then, wrap a magnet in the handkerchief and bring it near the plate.

**Observe:**

Record your observations.

## 9. CHEMICAL COMBINATION OF GAS

**Materials:**

Vinegar, baking soda, a spoon, a beaker

**Command:**

Measure one teaspoon of baking soda into the beaker. Pour some vinegar into the beaker.

**Observe:**

Record your observations.

## 10. CRYSTALLIZATION

**Materials:**

Table salt, a spoon, a beaker, some water, black paper

**Command:**

Pour about 150 ml of water into the beaker. Add 3 teaspoons of salt and stir until the salt disappears (dissolves). Pour a small amount of the salt water on the black paper. Allow the water to evaporate.

**Observe:**

Record your observations.

## 11. CHEMICAL REACTION

**Material:**

Vinegar, a piece of white chalk, a bowl

**Command:**

Place the piece of chalk into the bowl. Cover the chalk with vinegar.

**Observe:**

Record your observations.

## 12. PRECIPITATION

**Materials:**

Calcium chloride, sodium carbonate solution, water in a little jug, a test tube, a little spoon

**Command:**

Take the test tube. Pour in it a pinch of calcium chloride and a little water. Stir it until it dissolves, then add some drops of sodium carbonate solution.

**Observe:**

Record your observations.



### 13. PROPERTIES OF SOLID, LIQUID, AND GAS

**Materials:**

A marble, a piece of wood, some containers of glass in different shapes, a small bottle of vinegar, water in a small jug

**Command:**

- A) Take the marble and the piece of wood and observe their form.
- B) Take the containers of different shapes; pour some water into one container; pour the water into another container.
- C) Open the bottle of vinegar and leave it open for a moment.

**Observe:**

Record your observations.

### 14. ELASTIC, PLASTIC, AND RIGID

**Materials:**

A marble, a rubber ball, and some plasticene or play dough

**Command:**

Take the marble, the rubber ball, and the plasticene. Using the hand, apply some pressure on each of them successively. Apply the term: plastic - rigid - elastic.

**Observe:**

Record your observations.

## 15. MATTER CHANGES ITS STATE AT DIFFERENT TEMPERATURES

### Materials:

A piece of wax, a piece of solder, a tin muffin plate, a glass, some ice, a hot plate

### Command:

Heat the hot plate. Put the piece of wax, the piece of solder, and the piece of ice into separate sections of the tin plate. Put the tin plate on the hot plate.

### Observe:

Record your observations.

## 16A. LAW OF GRAVITY

### Materials:

A large glass bowl, ping pong balls, some small iron or lead objects, dry sand, a towel

### Command:

Put the ping pong balls in the glass bowl. Cover them with the sand. Put the iron and lead objects on top. Cover the glass bowl with the towel and shake it vigorously. Take the towel away and see what has happened.

### Observe:

Record your observations.

**16B. DENSITY AND THE  
LAW OF GRAVITY****Materials:**

Four containers of salt with different colored water and different proportions of salt:

<u>Water</u>	<u>Salt</u>	<u>Color</u>	<u>Code</u>
1/2 gallon	2 cups	Green (3 drops)	G
1/2 gallon	1-1/3 cups	Red (10 drops)	R
1/2 gallon	2/3 cups	Clear	C
1/2 gallon	None	Blue (4 drops)	B

Test tubes and eye droppers

**Command:**

With eye droppers, put some drops of red liquid in the test tube. Then put in some drops of blue. Continue with the 12 possible variations of the four colors: GB, GC, GR, RB, RC, RG, CB, CR, CG, BC, BR, BG.

Then proceed to the possible combinations with three variables.

**Observe:**

Record your observations.

## 17. THE RAPIDITY OF COOLING DEPENDS ON THE MASS OF THE BODIES

**Materials:**

A hot plate, a small pan, a bowl, a smaller bowl, a jug of water, two thermometers

**Command:**

Put about half a liter of water into the pan and put it on the burner. When the water boils, pour a little bit of it into the small bowl and the rest of it into the other bowl. Let the bowls remain for a while. Then, put a thermometer into each bowl at the same time. Which of the two has cooled more quickly?

**Observe:**

Record your observation.

## 18. VOLCANO

**Material:**

Clay, bicarbonate of soda (baking soda), vinegar

**Command:**

Make a model of a volcano with moist clay. Pour some bicarbonate of soda and then a teaspoon of vinegar into the crater.

**Observe:**

Record your observations.

## 19. MATTER EXPANDS WHEN HEATED

**Materials:**

A metal rod made of two different metals fastened together and with a wooden handle, and a hot plate.

**Command:**

Turn on the hot plate. Place the metal rod on the hot plate. Observe. Remove the metal rod and allow to cool. Replace the metal rod on the hot plate with the other metal directly on the hot plate. Observe.

**Observe:**

Record your observations.

## 20. QUICK EVAPORATION

**Materials:**

An ice cube, a metal pan, a hot plate

**Command:**

Heat the hot plate. Put the metal pan on the hot plate and let it become very hot. Place an ice cube in it.

**Observe:**

Record your observations.

## 1. COLD - FREEZING

**Statement:**

The cold of the ice is not the coldest temperature. There are temperatures much colder (much lower) than that of ice.

## 2. THE FORMATION OF THE STAR

**Statement:**

The innumerable groups of stars are something like the drops of oil. They are spinning in space.

## 3. SOLID - LIQUID - GAS

**Statement:**

Matter can assume three states: solid, liquid, gas.

## 4. LIQUID - VISCOUS

**Statement:**

A substance is liquid when it is fluid. A liquid is viscous when it is thickened.

## 5. PASSING FROM SOLID TO LIQUID TO GAS

**Statement:**

When heated, matter passes from solid to liquid and then to gas or vapor.

## 6. PASSING FROM GAS TO LIQUID TO SOLID

**Statement:**

Matter, when cooled, passes from the gaseous or vaporous state to the liquid state and from liquid to the solid state.

## 7. PARTICLES THAT ATTRACT EACH OTHER AND PARTICLES THAT DO NOT ATTRACT EACH OTHER

**Statement:**

There are some particles that attract each other and they stay joined. There are others that do not attract each other very much and when joined may be separated.

## 8. MIXTURE

**Statement:**

There are certain substances we mix but they do not combine and, therefore, can be separated. These substances are called mixtures.

## 9. CHEMICAL COMBINATION OF GAS

**Statement:**

When vinegar and baking soda are combined, a gas is formed: carbon dioxide.



## 10. CRYSTALLIZATION

**Statement:**

Some matter, in passing from the liquid to the solid state, has the property of crystallizing.

## 11. CHEMICAL REACTION

**Statement:**

A chemical reaction has taken place. A new substance has been formed that did not exist before: carbon dioxide.

## 12. PRECIPITATION

**Statement:**

There are certain liquid substances that combine to form a solid called a precipitate. Calcium carbonate and salt were formed.

### 13. PROPERTIES OF SOLIDS, LIQUID, AND GAS

**Statement:**

The solids have a shape of their own. The liquids take the shape of the vessel that contains them, and when overflowing, they go in all directions except upwards. The gases have no shape. They have the tendency to occupy the maximum space. They expand in all directions, even upwards.

### 14. ELASTIC, PLASTIC, AND RIGID

**Statement:**

Matter that does not change form when put under normal pressure is called 'rigid'.  
Matter that does change form when put under normal pressure is called 'plastic'.  
Matter that changes form under normal pressure but takes back its original form once the pressure is taken away is called 'elastic'.

Note: Plastic does not take back its original form when pressure is removed.

## 15. MATTER CHANGES ITS STATE AT DIFFERENT TEMPERATURES

**Statement:**

All matter changes its state. Each has its own temperature at which it changes state.

## 16A. LAW OF GRAVITY

**Statement:**

The Earth attracts matter like a big magnet. Heavy bodies tend to move toward the bottom while lighter bodies tend to move to the top. The lighter matter remains more distant from the center of the Earth.

## 16B. DENSITY AND THE LAW OF GRAVITY

**Statement:**

Those liquids that are denser go to the bottom. Those liquids that are lighter come to the top.

## 17. RAPIDITY OF COOLING DEPENDS ON THE MASS OF THE BODIES

**Statement:**

The smaller masses cool off more quickly than the larger masses.

## 18. VOLCANO

**Statement:**

Inside the earth there are some substances that tend to come out. If they do not easily find their way, they create it. Thus, among other things, the volcano is formed.

## 19. MATTER EXPANDS WHEN HEATED

**Statement:**

All matter, including gaseous matter, expands when heated.

## 20. QUICK EVAPORATION

**Statement:**

When heated, all matter passes from liquid to gaseous. The greater the heat, the more rapidly the change from each state takes place.

## LIST OF EQUIPMENT AND CHEMICALS NEEDED FOR LAWS OF THE UNIVERSE EXPERIMENTS

salt, 1 pound	vinegar
1-pint containers or beakers (2)	baking soda
thermometers (2)	glass rod
olive oil	chalk
alcohol	calcium chloride
glasses	sodium carbonate
little pitchers	piece of wood
marbles (3)	3 differently-shaped glasses
test tubes	rubber ball
test tube holder	plasticine
sugar	ping pong balls
paraffin	towel
spoons	dry sand
candles	small glass bowls (2)
matches	small pans (2)
pan with lid	clay
talcum powder	two-metal rod
iron filings	plate (2)
magnet	handkerchief
hot plate	small tin muffin plate
ice	black paper
glass pie plate	eye droppers
solder	large glass bowls (2)
small iron or lead objects	4 half-gallon containers
water	

NAME \_\_\_\_\_ DATE \_\_\_\_\_

EXPERIMENT NUMBER \_\_\_\_\_

NAME OF EXPERIMENT \_\_\_\_\_

OBSERVATION: \_\_\_\_\_

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STATEMENT: \_\_\_\_\_

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## STORY OF CREATION

The experiments from the Laws of the Universe must be complete.

### Introduction

Where do we live? What do we see around us? What do we see during the day? What do we see during the night? Do you think that the things that exist now have always existed?

### Story of Creation

Fifteen billion years ago everything in the universe was crowded into an incredibly small space that was enormously hot. This hot denseness exploded. As the temperature rapidly cooled, neutrons and protons came together and formed the centers or nucleus of the hydrogen, helium, and lithium atoms. With further cooling, electrons passing by were attracted to the neutron/proton nucleus. The electrons began orbiting the nucleus of the atoms. The protons that had been with the electrons went rushing into space, giving off light. The pull of gravity caused the gaseous atoms to come together into gaseous clouds. As these early clouds formed and got bigger, galaxies were formed.

Show pictures of the Milky Way.

### Experiment 1. Cold - Freezing

As the universe cooled, gases became liquids and liquids became solids. Each atom and each molecule had a different temperature at which it would become liquid. With further cooling, each liquid had a temperature at which it would become a solid. For example, ice has one temperature at which it is a solid. With the addition



of salt, another substance is created with a different freezing temperature.

Gradually, these gases got so dense as to become a hot liquid. When substances unite, they always form a sphere, not a cube or triangle.

**Experiment 2.           The Formation of the Star**

As stars were formed from the gases, all atoms and molecules were formed. But all these substances were in the form of incandescent gas. (To show this, turn on the burner. The children see nothing. Then light the gas with a taper.)

The smaller stars began to travel around the larger stars. This is because there are in the universe certain laws that all things must obey, even the sun and stars. One of the laws is gravity.

**Experiment 3.           Solid, Liquid, and Gas**

**Experiment 4.           Liquid and Viscous**

**Experiment 5.           Passing From Solid To Liquid To Gas**

**Experiment 6.           Passing From Gas To Liquid To Solid**

When substances are incandescent, they are in the form of a gas. When they cool, they become liquid and then solid. This is why everything we know is a gas, liquid, or solid.

**Experiment 7.**

**Particles That Attract Each Other and Particles That Do Not Attract Each Other**

Not all the atoms are alike. In the incandescent masses there were various atoms. Some were attracted to one another, some were repelled. This is how the different molecules were formed.

**Experiment 13. Properties Of Solid, Liquid, and Gas**

**Experiment 14. Elastic, Plastic, and Rigid**

These atoms must obey other laws. When they are in the form of a solid, it is impossible to separate them. When they are liquid or viscous, they take the shape of the container. If they overflow out of the container, they spread all over. They always go down, never up. They are not as tightly joined as in a solid, i.e., we cannot put our hand into a table, but we can put our hand into water. Substances in the form of a gas move in all directions. They tend to move upward, occupying much more space than a liquid.

**Experiment 15.** *Matter Changes Its State At Different Temperatures*

But these are not all the laws. We have said that all matter, all bodies are in three different states and that they can change from one to another. But not all can change at the same temperature. Each substance changes state at a specific temperature.

**Experiment 16A.** *Law Of Gravity*

**Experiment 16B.** *Density and The Law Of Gravity*

Not all matter has the same weight. All matter takes a position through the layers of the earth according to weight, with the heaviest bodies toward the center of the earth and the lightest ones toward the surface of the earth.

**Experiment 17. Rapidity Of Cooling Depends On The Mass Of The Bodies**

We have said that gas, when it becomes cooled, becomes liquid, then solid. But some substances pass from gas to solid without passing through the liquid state. The cooling of substances depends not only on the substance itself but also on the quantity of the substance.

### **Experiment 18. Volcano**

Our earth also, when it was formed, was a ball of incandescent substances. Do you think the earth is smaller or larger than the sun? *Much* smaller.

As the earth's surface was cooled, a crust formed. But the heat within the earth needed to escape. Therefore, volcanoes erupted releasing the heat from below the crust of the earth.

### **Experiment 19. Matter Expands When Heated**

When a volcano erupts, the gases held within the surface of the earth expand and fill the air around the volcanic site.

### **Experiment 20. Quick Evaporation**

Because a volcano releases liquids at such a high temperature from beneath the crust of the earth, the liquid changes its state when it reaches the air.

The Clock of Eras is now introduced. The Story of the Creation of the Universe and the Experiments of the Laws of the Universe set the stage for the study of the Earth. The study of the Earth begins with the Clock of Eras.