Transcript: What Are Radioactive Substances? - Examples & Uses

https://study.com/academy/lesson/what-are-radioactive-substances-examples-uses-quiz.html

This lesson will explain what a radioactive substance is, give examples of radioactive substances and describe how radioactivity is used in everyday life.

What is Radiation?

When Bruce Banner gets angry, he turns into the Hulk. This happens due to a hefty dose of gamma radiation. But can radiation really turn you into the Hulk? Is the green glow of radioactivity real? And just what are radioactive substances anyway?

Radiation might sound like something dangerous, but that depends on what kind of radiation you're talking about. There are a lot of different types of radiation: the light coming from a household lamp is a type of radiation, and the microwaves that cook your food are radiation. But when we talk about **radioactive substances**, we're concerned with particular types of radiation.

Radiation Warning

Radioactive Substances

A **radioactive substance** is unstable and produces dangerous kinds of radiation. It is **unstable** because the strong nuclear force that holds the nucleus of the atom together is not balanced with the electric force that wants to push it apart. Because it's unstable, the atoms will **decay** into more stable ones.

Another way of thinking about radioactivity is in terms of **energy**. A radioactive atom has a higher energy than it needs to have. Energy in the universe tends to spread out, and so when something has more energy than it needs, it's only a matter of time until it loses that energy. When a radioactive atom loses its extra energy by decaying, that energy has to go somewhere -- energy in the universe is never created or destroyed, it is said to be always **conserved**.

Where does it go? It goes into the radiation that is produced. Radioactive substances are continually producing three kinds of dangerous radiation: **alpha particles**, **beta particles** and **gamma rays**. These types of radiation are invisible to the naked eye, and so you don't see a green glow. But sometimes they can interact with nearby phosphorescent or florescent materials that *will* glow green. This is why a green glow is associated with radioactivity.

Unfortunately for superhero fans, there is no evidence that even these three kinds of radiation can turn you into the Hulk. Radioactive substances produce alpha particles, beta particles and gamma rays. But what are these three types of dangerous radiation?

Alpha particles are the nuclei of helium atoms. They move slowly, don't penetrate the skin, but can cause a lot of damage if swallowed. **Beta particles** are high-energy electrons that can penetrate through paper and even part of the way into the human body, but cause less damage when they do. And **gamma rays** are extremely high-energy electromagnetic waves that can only be stopped with thick lead or concrete.

Uses of Radioactive Substances

Let's look at some different uses of **radioactive substances**.

- **Nuclear power plants**.

One example of a radioactive substance is uranium. In nuclear power plants, uranium is used to produce electricity. When radioactive substances like uranium produce radiation, they also create a lot of heat. That heat causes water in the power plant to boil, turning turbines and creating electricity.

Nuclear Power Plant

- **Killing Cancer**

Radium is another radioactive substance, and is used to treat cancer. Although the radiation produced by radioactive substances can be dangerous, it can also be used to kill cancer cells. A small amount of radium is encased in a gold 'seed' and implanted inside the tumor. This delivers radiation directly to the cancer cells, without destroying other tissues in the body.

- **Smoke Detectors**

Smoke detectors also contain a radioactive substance: Americium. Packaged inside the smoke detector is a tiny sample of Americium. This Americium produces alpha particles (radiation), which then collides with oxygen and nitrogen in the air to produce ions. Ions are charged particles, and can therefore conduct electricity. These ions allow electricity to flow between two electrodes. But when smoke enters the ion chamber, the smoke particles neutralize the ions and reduce the amount of electricity that flows. When the flow of electricity reduces, the alarm is triggered, and everyone in the kitchen has to cover their ears!

Household Smoke Detector

Lesson Summary

Let's review. A **radioactive substance** is unstable and produces dangerous kinds of radiation. Radioactive substances produce three types of dangerous radiation: **alpha particles** are the nuclei of helium atoms. They move slowly, don't penetrate the skin, but can cause a lot of damage if swallowed. **Beta particles** are high-energy electrons that can penetrate through paper and even part of the way into the human body, but cause less damage when they do. And **gamma rays** are extremely high-energy electromagnetic waves that can only be stopped with thick lead or concrete. Different uses for **radioactive substances** include nuclear power plants, cancer treatment, and smoke detectors.

Worksheet: What Are Radioactive Substances? - Examples & Uses

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1. Which of these materials will block gamma rays?

- Thin lead
- Paper
- Thick lead
- Human skin

2. Which of these is not a real-life use of a radioactive substance?

- Smoke detectors
- Creating electricity
- Turning into the Hulk
- Killing cancer cells

3. Which radioactive substance is used in smoke detectors?

- Radon
- Gamma rays
- Uranium
- Americium

4. Which of these is not a type of dangerous radiation produced by radioactive substances?

- Beta particles
- Gamma rays
- Alpha particles
- Light

5. A radioactive substance ______.

- Can produce three kinds of dangerous radiation
- All answers are correct.
- Has several uses, including nuclear power and cancer treatment
- Is unstable

Transcript: How Compounds are Broken Down: Heat & Electricity

https://study.com/academy/lesson/how-compounds-are-broken-down-heat-electricity.html

Compounds can be broken down into smaller compounds or their basic elements by chemical change. Sometime this breakdown requires energy. Learn how some compounds are broken down with heat or electricity.

Compounds

If you have a dime, you could break it down into smaller units, like two nickels. You could then take your nickels and break them down further into ten pennies. In chemistry, a **compound**, which is a substance made up of two or more different elements, is a lot like your dime. Compounds can be broken down into smaller units. Of course, compounds don't break down into nickels and pennies; instead, they break down into either smaller compounds or their basic elements.

Did you ever pop the cap off of a soda bottle and witness the fizz? That is an example of a compound being broken down. A closed soda bottle contains the compound carbonic acid, or H2CO3. When you pop it open, the carbonic acid decomposes into water (H2O) and carbon dioxide (CO2), which provides the bubbles. Water and carbon dioxide are simpler compounds than carbonic acid, but they are still compounds. Therefore, they can break down themselves to leave us with the basic elements hydrogen, oxygen, and carbon. Compounds break down through chemical changes. Sometimes this chemical change requires energy in the form of heat or electricity. In this lesson, we will look at how compounds are broken down using these energy sources.

Heat

If you spend any time in a chemistry lab, you will probably encounter a Bunsen burner, which is a gas burner that comes in handy when you are trying to create chemical changes. Heat is an energy source that can cause compounds to break down. This allows the compounds to split into smaller units. One example is the breakdown of mercuric oxide, which has the formula HgO. If you put this compound into a test tube and hold it over a lit Bunsen burner, it will decompose into the elements mercury and oxygen.

In this example, we see the heat caused the compound to break into its basic elements. These elements are like the pennies we discussed earlier, meaning they cannot be broken down any further. However, heat does not always cause compounds to break all the way down to elements. Some compounds break down into simpler compounds. For example, when you add heat to sodium hydroxide it breaks down into the simpler compounds sodium oxide and water.

Electricity

When you think of electricity, you probably think of it as the wonderful resource that allows you to run your computer and television. However, a chemist might look at electricity as a useful tool for breaking down compounds.

A great example is the use of an electric current to break down water. You recall that water is a compound that has a chemical formula H2O. You can break this compound into its elements, hydrogen and oxygen, by using **electrolysis**. Electrolysis is a chemical change produced by sending an electric current through a compound. Electrolysis works because the hydrogen and oxygen ions are held together by an electric attraction. When the electric current is introduced, the attraction is broken.

The funny thing is that when hydrogen and oxygen exist by themselves, they are highly flammable gases. Yet, join them back together, and they become the highly non-flammable compound, water. This demonstrates how much elements and compounds can differ in their properties.

Breaking down water to free up hydrogen is something that has piqued the interest of many green energy scientists. Because hydrogen has a lot of energy, it is being looked at as a possible source of fuel for things like your daily commute to work. Maybe someday hydrogen will take over for the fossil fuels that most of us rely on today.

Lesson Summary

Let's review. A **compound** is a substance made up of two or more different elements. Compounds can be broken down into smaller compounds, or their basic elements, by chemical change. Sometimes this chemical change requires energy in the form of heat or electricity.

For example, heat can be used to break down mercuric oxide into the elements mercury and oxygen. Heat can also be used to break down sodium hydroxide into the simpler compounds sodium oxide and water.

Electrolysis is a chemical change produced by sending an electric current through a compound. Using electrolysis, we can break down water into its elements, hydrogen and oxygen.

Learning Outcomes

Students who complete this lesson should be able to meet the following goals:

- Define compound
- Describe how compounds may break down with heat or electricity
- Give examples of some specific compound breakdowns

Worksheet: How Compounds are Broken Down: Heat & Electricity

https://study.com/academy/lesson/how-compounds-are-broken-down-heat-electricity.html

1. This is a substance made up of two or more elements.

- Compound
- Proton
- Atom
- Neutron
- Nucleus

2. Compounds can be broken down into which of the following?

- Only into their basic elements
- Into either atoms or elements
- Into either smaller compounds or their basic elements
- Only into atoms
- Only into smaller compounds

3. Compounds can be broken down into smaller units by this.

- Crushing
- Mixing
- Physical change
- Dissolving
- Chemical change

4. In order for mercuric oxide to be broken down into the elements mercury and oxygen, this is required.

- All of the answers are correct
- Dissolving
- Electricity
- Heat
- Pressure

5. Water can be broken down into hydrogen and oxygen using this chemical change involving an electric current.

- Electrolysis
- Elements
- Electrolytes
- Accelerants
- Electorates

Transcript: Creating Mixtures by Combining Elements & Compounds

https://study.com/academy/lesson/creating-mixtures-by-combining-elements-compounds.html

Do you really know what's in your tap water? It's not just water - it's a mixture of many different things. In fact, most things are mixtures of different elements and compounds that are physically joined together.
I had a really great dinner last night. There's a fantastic pizza place in town that gives you slices as big as your head. They also make awesome salads and have a super-secret recipe for their killer macaroni and cheese. We were pretty hungry, so we got a large veggie pizza, a Greek salad, and of course, an order of that mac and cheese.

When all of the food arrived and was set down on the table, it made me realize that each of the menu items was a **mixture**. A mixture is a combination of two or more substances that each retain their own properties. The pizza is a mixture of veggies, cheese, and sauce; the salad is a mixture of lettuce, tomatoes, olives, onions, and cheese; and the mac and cheese has noodles, cheese, and breadcrumbs in it.

When the items in each dish are mixed together, they don't change. The cheese on the pizza is still cheese, just like the mushrooms are still mushrooms, the onions are still onions, and the sauce is still sauce.

In fact, most materials are mixtures. Tap water is a mixture that is mostly water, but it also contains other things, like calcium, magnesium, and chlorine. Air is a mixture because it also contains many different things, such as oxygen, nitrogen, and carbon.

Mixtures Are Physical Combinations

Mixtures come about when elements and compounds combine through physical means. An **element** is a material that is made of only one atom, such as an atom of gold, helium, or mercury. Sometimes, elements chemically combine to form a **compound**, which is a group of two or more different atoms chemically bonded together. These are things like salt, which is sodium and chlorine, and methane, which is carbon and hydrogen.

While both compounds and mixtures are combinations, the main difference is that mixtures can be separated by physical means. In fact, you could separate a mixture of different compounds into its separate compound components, but you would have to chemically separate the compounds themselves. This is because they are chemically bonded together and don't necessarily retain their properties like the parts of mixtures do.

So, how do we physically separate a mixture? Well, with your pizza, you could just pick out certain ingredients with your fingers. But this isn't always a practical approach. Imagine trying to hand pick salt crystals out of a glass of saltwater - not so easy!

Instead, we can use a method like **filtration**. This method separates solids from fluids, which is how you might make coffee in the morning. You pour hot water over coffee grounds, and that water (along with the caffeine and flavor) flows through the filter but leaves the solid grounds behind.

For saltwater, you might prefer to use something like **distillation**. This method collects a separated, vaporized substance and is a very effective way to separate fresh water from saltwater. With distillation, the fluid is boiled and then collected as it turns to vapor. The other components of the mixture (like the salt in the water) are left behind, and your mixture is now separated!

If you've ever forgotten about a pot of boiling water on the stove, you likely came back to a pot with no water that was instead covered in white 'stuff.' You probably didn't know it, but you had separated the water from its other components through distillation. You just didn't collect the water vapor as it boiled off.

Two Kinds of Mixtures

You may have noticed by now that not all mixtures are the same. A salad is a mixture, but so is saltwater. The difference between these two is that with the salad you can see the individual parts of the mixture, whereas with the saltwater, you can't.

This is an important distinction that helps us identify the type of mixture we have. The salad is a **heterogeneous mixture**, which means that the different parts can be identified as individual substances. This makes sense because the prefix 'hetero' means 'different.' Your pizza is also a heterogeneous mixture, as is orange juice with pulp, vegetable soup, and a bag of trail mix.

The saltwater, on the other hand, is a **homogeneous mixture**, meaning that it has the same composition throughout ('homo' means 'same'). You can't necessarily tell that it's a mixture of different things because you can't see those individual components. As mentioned before, tap water is a mixture and a homogenous one at that. You can't see the chlorine, fluorine, or calcium in the water, but it's in there! Air is also a homogeneous mixture, made of different gases that can't be differentiated just by looking at them.

Single and Multiple Phase Mixtures

But not all homogeneous mixtures are the same either. Some homogeneous mixtures are **solutions**, meaning that all components of the mixture are in the same phase. This means that all parts of the mixture are solids, liquids, or gases.

Our saltwater is a solution because the sodium and chlorine that make up the salt are dissolved in the water and are all in a liquid phase. The same is true for the atmosphere around us, except the different components are all in a gaseous phase.

When the components of a mixture are not in the same phase, we have a **suspension**. For these mixtures, you might have a combination, like solids 'suspended' in liquids or liquids 'suspended' in gases. You still can't differentiate between the different components, though.

We use physical means to separate suspensions too, and this is usually done by spinning the mixture in a centrifuge. This machine spins at thousands of revolutions per minute, pushing the solids to the bottom and the liquid to the top.

Lesson Summary

Most things that you come across in life are not pure - they are combinations of different things. When the individual components of such combinations retain their properties, we have a **mixture**. Because mixtures are physical combinations of elements and compounds, they can be separated through physical means, like **filtration**, which separates solids from liquids, and **distillation**, which collects a separated, vaporized substance.

Not all mixtures are the same. Pasta salad and lemonade are both mixtures but are different types. The pasta salad is a **heterogeneous mixture** because the different parts can be identified as individual substances. The lemonade, however, is a **homogeneous mixture** because it has the same composition throughout (as long as it's pulp free!).

Homogeneous mixtures also come in different types. If, like saltwater, all components of the mixture are in the same phase, then we have a **solution**. But if the components of a mixture are not in the same phase then your mixture is called a **suspension**.

Learning Outcomes

Once you are done with this lesson, you could realize your ability to:

- Describe a mixture and give real-life examples
- Define and compare heterogeneous and homogenous mixtures
- Distinguish between single- and multiple-phase mixtures

Transcript: Comparing Solutions, Suspensions & Colloids: Properties & Examples

https://study.com/academy/lesson/comparing-solutions-suspensions-colloids-properties-examples.html

With a few simple observations, you can classify a mixture as a solution, suspension or colloid. Learn how we use properties, such as visibility of particles, how light is affected and the ability of particles to settle out to classify mixtures.

Mixtures

Here, we have three common kitchen ingredients: sugar, oil, and gelatin powder. We're going to mix these ingredients into three separate glasses of water to perform a kitchen-style science project. Before we create our mixtures, can you guess which ingredients will mix well and which will not? Will the oil mix with the water or separate into layers? Will the mixtures be clear or cloudy? Our observations about these mixtures will allow us to classify them as solutions, suspensions, or colloids. Did you make your predictions? Great, let's go ahead and start mixing.

Solution

One of our three mixtures is a **solution**, which is a homogeneous mixture of two or more substances. We describe a solution as homogeneous because the added components mix completely and are uniformly distributed throughout the mixture. With a homogenous mixture, like a solution, the particles are very small. This small size prevents them from being filtered out or separated. The small size also means that the individual particles cannot be seen, which is one of the properties that all solutions have in common. Another property that we can attribute to solutions is that the particles will not settle out, regardless of how long the solution sits.

With these tidbits of knowledge, we can eliminate one of the three mixtures from our kitchen experiment. Oil and water do not mix well. With that mixture, the added components remain separate and do not mix completely, so we call it a heterogeneous mixture.

That leaves us with the sugar and the gelatin mixtures. Which one of these is a solution? Well, to answer that, we need to know one more property of solutions, which is that solutions do not scatter light. If we were to place a flashlight behind the glass of sugar water, the light would pass through easily, but we cannot say that for the glass of gelatin and water. That mixture is cloudy, and if we were to shine the same flashlight through it, we would see that the light would get dispersed and not easily shine through. Congratulations! You just identified sugar water as a solution!

Suspension

Now, we have to decide which of our two remaining mixtures is a **suspension**. A suspension is defined as a heterogeneous mixture that contains large particles. I bet you can already guess that the oil and water mixture matches this description. When we stir the oil and water, the globs of oil get smaller, but they never completely mix. The particles are visible, and when we stop stirring, the particles settle out to form a separate layer.

With a suspension, it's easy to separate the particles using a filter, which is not something we can do with the other two types of mixtures. To complete our look at suspensions, we can try our flashlight test. When the light is shown through a suspension, it may scatter light, but sometimes suspensions are opaque, so the light might not be able to penetrate the mixture at all. For example, if we were to put mud in our water glass, we would create a suspension that would be so dark and murky that light would not be able to pass through.

Colloid

The only remaining mixture in our kitchen experiment is the gelatin mixture. So, by process of elimination, we see that this is a **colloid**. A colloid has properties that make it fall in between a solution and a suspension. For one thing, a colloid is a mixture of intermediate-sized particles. These particles are not quite as big as those found in a suspension and not quite as small as those found in a solution. We also see that colloids are typically thought of as heterogeneous mixtures but share some of the same qualities as homogeneous mixtures. Colloids also take the middle road with particle visibility. Their intermediate size means the particles are not easily seen, but we cannot rule out seeing them if we have a strong enough microscope.

With all of this middle ground, you might think it's hard to tell a colloid from the other two mixtures; but fortunately, there are a couple of properties shared by colloids that make them easily distinguishable from the other mixtures. One property that strongly differentiates a colloid from a suspension is the fact that with colloids the particles will not settle out. One property that strongly differentiates a colloid from a solution is that colloids do scatter light. Do you remember our first flashlight test? When light tries to pass through a colloid, it hits the intermediate-sized particles and gets dispersed.

Lesson Summary

Let's review.

In this lesson, we learned that mixtures can be homogeneous, which means that components mix completely and are uniformly distributed throughout the mixture, or heterogeneous, which means components remain separate and do not mix completely.

A **solution** is a homogeneous mixture of two or more substances. Solutions have small particles, which means that the individual particles cannot be seen and the particles will not settle out. We also see that solutions do not scatter light.

A **suspension** is a heterogeneous mixture that contains large particles. The large particle size means that the particles are visible and the particles settle out. Suspensions may scatter light if conditions are right.

A **colloid** is a mixture with intermediate-sized particles. With colloids, the particles are not easily seen, and the particles will not settle out. Colloids do scatter light.

Key Terms

Solution: a homogeneous mixture of two or more substances

Suspension: a heterogeneous mixture that contains large particles

Colloid: a mixture with intermediate-sized particles

Learning Outcome

Having studied the lesson, you could later confidently define and describe three types of mixtures.

Worksheet: Comparing Solutions, Suspensions & Colloids: Properties & Examples

https://study.com/academy/lesson/comparing-solutions-suspensions-colloids-properties-examples.html

1. With this type of mixture the particles settle out to form a separate layer.

- Compound
- Solution
- Suspension
- Colloid
- Homogeneous

2. This is a homogeneous mixture that contains very small particles.

- Compound
- Suspension
- Solution
- Gelatin
- Colloid

3. Which of the following is a TRUE statement concerning colloids?

- They scatter light
- Their particles will not settle out
- Their particles are not easily seen
- All of the answers are correct
- They contain intermediate sized particles

4. We know that sugar water is this type of mixture because light easily passes through it and the sugar particles do not settle out.

- Solution
- Colloid
- Heterogeneous
- Compound
- Suspension

5. This is a heterogeneous mixture that contains large particles.

- Solution
- Nucleus
- Suspension
- Colloid
- Element