



“What’s This Stuff?” Activity—Teacher’s Guide

In this activity, students will learn about the properties of materials by researching and identifying ten different mystery materials. Each mystery material has ten clues in the form of short videos or written facts and trivia. Students use the given clues to investigate and learn about the materials, using the Internet and other resources as needed. Be sure to give students guidelines on how to safely conduct online research and your school’s policies regarding Internet use.

There are different ways to use this activity in your classroom to best meet your instructional needs. Here are some ideas to help you in your planning.

1. Students can work individually or in groups on the activity.
2. Students can do the entire activity, or you can assign one or two mystery materials to each student or group of students and have them do a deeper investigation and report on their material(s).
3. You can have students read the background essay about materials science before they get started.
4. You can use the Materials Science Glossary at the end of this guide to assess gains in vocabulary.

Although there is a point system built into the activity for independent users, students should be instructed to disregard the points. Emphasize that they are not playing a game to win points but that they are using the game as a research activity. Have students use the accompanying activity booklet to take notes on their research process. Let students know in advance that you will be collecting the booklets to review their work.

How to Prepare the Student Activity Booklet

Print out the student activity guide onto standard 8 1/2” x 11” sheets of paper and arrange in a pile as follows:

1. Place the first sheet (page 1) face down.
2. Place the second sheet (pages 2 and 7) face up.
3. Place the third sheet (pages 3 and 6) face down.
4. Place the fourth sheet (pages 4 and 5) face up.
5. Fold all four sheets together in half from left to right.

If you are making copies, set the copier so that it copies back-to-back.

Quick Answer Key

Material 1 is Steel.

Material 2 is Kevlar

Material 3 is Bamboo.

Material 4 is Concrete.

Material 5 is Silicon.

Material 6 is Nylon.

Material 7 is Silver.

Material 8 is Titanium.

Material 9 is Fiberglass.

Material 10 is Teflon.

Activity Answers

Mystery Material #1: Steel is an alloy of iron and carbon that, like all metals, has a crystalline structure with an ordered pattern of atoms. The addition of carbon hardens the iron by locking the layers of iron atoms into a strong, rigid structure. Other possible alloying elements include manganese, chromium, nickel, zirconium, tungsten, and vanadium. Steel is one of the most commonly produced materials in the world and is used in many products that need strength and toughness, such as automobiles, ships, buildings, machines, and tools.

Mystery Material #2: Kevlar® (a registered trademark of DuPont) is a lightweight synthetic polymer with a highly ordered molecular structure that gives it very high tensile strength. Pound for pound, Kevlar® is five times stronger than steel. This high strength fiber is used in tires, parachutes, cables, personal armor, and many other products. Kevlar® is tough enough to stop the impact force of a bullet with a few layers of fabric, each only millimeters thick. Its chemical name is poly-paraphenylene terephthalamide.

Mystery Material #3: Bamboo is one of the fastest growing plants in the world and is a versatile natural resource. A member of the grass family, bamboo has hollow, cylindrical stems, and some species can grow to over 100 feet tall. Bamboo can grow in a range of regions, from the hot tropics to freezing mountain climates. It can be used in construction in its natural form, or it can be processed into sheets and planks. Applications for bamboo include paper, textiles, musical instruments, and water processing. Bamboo shoots are also edible and are especially popular in Asian cuisines. Bamboo is also the main food source for giant pandas.

Mystery Material #4: Concrete is a composite construction material made of cement and aggregate (particles such as crushed limestone, granite, or sand). Cement is commonly made from limestone and gypsum, fly ash, blast furnace slag, or silica fume. When water is mixed with the materials, they bind together to form concrete, which must then be properly cured under controlled conditions for temperature and humidity. Concrete hardens and gains strength over time, achieving most of its strength within a few weeks (although it can continue to grow stronger for years). Concrete is commonly used to make roads, bridges, foundations, and building structures.

Mystery Material #5: Silicon is a chemical element (symbol Si, atomic number 14). It is the second most abundant element on Earth; it makes up about one-third of the planet's crust and is found in clay, granite, quartz, and sand. Silicon is a metalloid—an element that can be classified both as a metal and a nonmetal. Silicon is an important component of modern technologies; it is used to make solar cells, transistors, and integrated circuits for computers, mobile phones, and other appliances. Many technology companies are located in a region of California that was named as Silicon Valley for this reason.

Mystery Material #6: Nylon is a lightweight synthetic polymer with high tensile strength, durability, and abrasion resistance, as well as good resistance to insects, molds, rot, and many chemicals. Developed by DuPont in the 1930s, it was the first synthetic fiber to be commercialized. In its early days it was used to make toothbrushes and women's stockings, and it was a silk substitute for parachutes and other military supplies during World War II. Nylon is one of the most commonly used polymers and can be found in many applications including clothing, musical instruments, carpets, automobiles, and sports equipment.

Mystery Material #7: Silver is a chemical element (symbol Ag, atomic number 47) with high ductility, malleability, and electrical and thermal conductivity. It is white in color and can be highly polished; it is valued as a precious metal and is used to make jewelry, tableware, and decorative items. Silver is also in electronics, mirrors, musical instruments, and dental fillings. Silver compounds (such as silver nitrate) are also used to make photographic film, food coloring, and disinfectants and microbicides.

Mystery Material #8: Titanium is a chemical element (symbol Ti, atomic number 22); it is a white metal that has a high strength-to-weight ratio and is resistant to corrosion. It is used in sports equipment, jewelry, mobile phones, and buildings, as well as for medical and dental purposes (such as in orthopedic implants and instruments). Titanium alloys are often used in aerospace, automotive, industrial, and military applications. Titanium dioxide is a white pigment that reflects light and is commonly used to make paints, cosmetics, toothpaste, sunscreen, paper, and plastics.

Mystery Material #9: Fiberglass is a material made of fine strands of glass. The term actually refers to two materials. One is a composite material made of fibers of glass embedded in a plastic matrix. This type of fiberglass is lightweight, strong in both tension and compression, weather resistant, and relatively inexpensive. It is stiff but easily shaped with molding processes, and is commonly used in swimming pools, boats, automobiles, sports equipment, storage tanks, and pipes. The term fiberglass can also refer to a material made entirely of glass fibers, also called glass wool, which is used as an insulating material.

Mystery Material #10: Teflon® (a registered trademark of DuPont) is a synthetic polymer made of carbon and fluorine. Its chemical name is polytetrafluoroethylene (PTFE) and it has one of the lowest coefficients of friction of any known solid material. It is so slippery that even geckos and insects cannot stick to it! It also is chemically unreactive, has a high melting point, and is an excellent electrical insulator. Teflon is commonly used as a coating for cooking pans and in many other industrial and commercial applications (such as in machine parts, wire wrap, surgical instruments, and clothing).

Materials Science Glossary

elastic deformation – change that is non-permanent; when the stress is released the material returns to its previous shape

elasticity – the ability for a material to lengthen under stress and then return to its original shape when the stress is removed

elongation – the amount the material lengthens while undergoing elastic deformation

failure – the rupture or breaking of a material, with no chance of returning to the way it was

plastic deformation – deformation, or change, that is permanent; when the stress is released the material does not return to its previous shape

polymer – large molecules made of long chains of repeating atoms; can be synthetic or natural

strain – the elongation divided by the original length

strength – a measure of how well a material can resist a force (or load) before failing

stress – force per unit area; types of stress include tension (pulling), compression (squeezing), impact (a sharp blow), torsion (twisting), and shearing (surfaces sliding past one another).

tensile strength – how much stress a material can withstand while being pulled apart