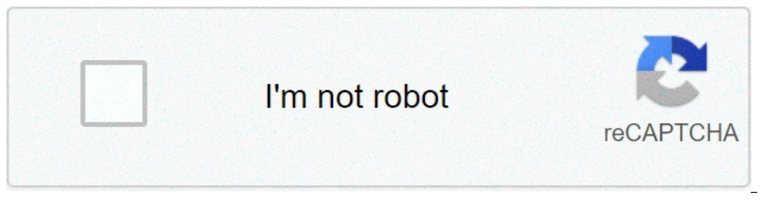

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Classification of matter lab answer key

A starting point for the scientific investigation of anything is to observe and find similarities and differences among things. Scientific work must be able to be understood and repeated by others studying the same thing in order to be useful. One way that scientists accomplish these goals is to classify things according to their traits. To help others to use their method of classification, scientists often construct a dichotomous key. A dichotomy is a division into two parts. In a dichotomous key there are a series of paired statements. If one is true about the thing you wish to classify, you go on to another pair of statements. The alternative answer leads you to a different pair of statements. In this way, by choosing one or the other of paired statements, you are led to a final category for the thing you are observing. This lab covers both the concept and use of a dichotomous key and the classification of matter. Using informational questions and vials containing various types of matter, you will classify the vials into mixtures; compounds; elements; etc. This flowchart provides a visual reference on how to classify matter and this flowchart provides a visual reference on all the properties of matter. Both of these charts must be included in the data section of your lab report (for a better printing, set your page setup to "landscape" and then print.) ~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~ ~~~~~ Procedure: This lab exercise uses a dichotomous key to help you classify the contents of small vials into the proper type of matter. The classification of matter is a fundamental step in physical science. As you cannot directly observe all of the traits you will be looking for, you must rely on previous knowledge; charts within the science lab room and any information that others may share with you during the classification procedure. As you make each choice for the contents of a vial, write the number and letter of each statement you choose in the column labeled "justification" on the line for that vial. Once you reach your final category, the statements you chose will be justification for your choice. The chart of your findings should look like this. Materials: A Dichotomous Key to the Classification of Matter Substances are composed of pure elements or chemically bonded elements, whereas mixtures are composed of non-bonded substances. Distinguish chemical substances from mixtures Matter can be broken down into two categories: pure substances and mixtures. Pure substances are further broken down into elements and compounds. Mixtures are physically combined structures that can be separated into their original components. A chemical substance is composed of one type of atom or molecule. A mixture is composed of different types of atoms or molecules that are not chemically bonded. A heterogeneous mixture is a mixture of two or more chemical substances where the various components can be visually distinguished. A homogeneous mixture is a type of mixture in which the composition is uniform and every part of the solution has the same properties. Various separation techniques exist in order to separate matter, including include distillation, filtration, evaporation and chromatography. Matter can be in the same phase or in two different phases for this separation to take place. : Something that consists of diverse, non-bonded elements or molecules. : A chemical substance that is made up of a particular kind of atom and cannot be broken down or transformed by a chemical reaction. : A form of matter that has constant chemical composition and characteristic properties. It is composed of one type of atom or molecule. Chemical Substances In chemistry, a chemical substance is a form of matter that has constant chemical composition and characteristic properties. It cannot be separated into components without breaking chemical bonds. Chemical substances can be solids, liquids, gases, or plasma. Changes in temperature or pressure can cause substances to shift between the different phases of matter. An element is a chemical substance that is made up of a particular kind of atom and hence cannot be broken down or transformed by a chemical reaction into a different element. All atoms of an element have the same number of protons, though they may have different numbers of neutrons and electrons. A pure chemical compound is a chemical substance that is composed of a particular set of molecules or ions that are chemically bonded. Two or more elements combined into one substance through a chemical reaction, such as water, form a chemical compound. All compounds are substances, but not all substances are compounds. A chemical compound can be either atoms bonded together in molecules or crystals in which atoms, molecules or ions form a crystalline lattice. Compounds made primarily of carbon and hydrogen atoms are called organic compounds, and all others are called inorganic compounds. Compounds containing bonds between carbon and a metal are called organometallic compounds. Chemical substances are often called ‘pure’ to set them apart from mixtures. A common example of a chemical substance is pure water; it always has the same properties and the same ratio of hydrogen to oxygen whether it is isolated from a river or made in a laboratory. Other chemical substances commonly encountered in pure form are diamond (carbon), gold, table salt (sodium chloride), and refined sugar (sucrose). Simple or seemingly pure substances found in nature can in fact be mixtures of chemical substances. For example, tap water may contain small amounts of dissolved sodium chloride and compounds containing iron, calcium, and many other chemical substances. Pure distilled water is a substance, but seawater, since it contains ions and complex molecules, is a mixture. Chemical Mixtures A mixture is a material system made up of two or more different substances, which are mixed but not combined chemically. A mixture refers to the physical combination of two or more substances in which the identities of the individual substances are retained. Mixtures take the form of alloys, solutions, suspensions, and colloids. Naturally occurring sulfur crystals: Sulfur occurs naturally as elemental sulfur, sulfide, and sulfate minerals and in hydrogen sulfide. This mineral deposit is composed of a mixture of substances. Heterogenous Mixtures A heterogeneous mixture is a mixture of two or more chemical substances (elements or compounds), where the different components can be visually distinguished and easily separated by physical means. Examples include: mixtures of sand and water mixtures of sand and iron filings a conglomerate rock water and oil a salad trail mix mixtures of gold powder and silver powder Interactive: Oil and Water: Explore the interactions that cause water and oil to separate from a mixture. Homogenous Mixtures A homogeneous mixture is a mixture of two or more chemical substances (elements or compounds), where the different components cannot be visually distinguished. Often separating the components of a homogeneous mixture is more challenging than separating the components of a heterogeneous mixture. Distinguishing between homogeneous and heterogeneous mixtures is a matter of the scale of sampling. On a small enough scale, any mixture can be said to be heterogeneous, because a sample could be as small as a single molecule. In practical terms, if the property of interest is the same regardless of how much of the mixture is taken, the mixture is homogeneous. A mixture’s physical properties, such as its melting point, may differ from those of its individual components. Some mixtures can be separated into their components by physical (mechanical or thermal) means. Classifying Matter (3 parts): Introduction to classifying matter as a substance or a mixture of substances. Mixtures are described as heterogeneous or homogeneous. Three common methods of separation are described. Elements and Compounds An element is a material that consists of a single type of atom, while a compound consists of two or more types of atoms. Differentiate between elements and compounds and explore separation techniques Elements are the simplest complete chemical substances. Each element corresponds to a single entry on the periodic table. An element is a material that consists of a single type of atom. Each atom type contains the same number of protons. Chemical bonds link elements together to form more complex molecules called compounds. A compound consists of two or more types of elements held together by covalent or ionic bonds. Elements cannot be divided into smaller units without large amounts of energy. Compounds, on the other hand, can have their bonds broken with practical amounts of energy, such as the heat from a fire. Matter can be broken down into two categories: pure substances and mixtures. Pure substances are further broken down into elements and compounds. Mixtures are physically combined structures that can be separated back into their original components. : Any one of the simplest chemical substances that cannot be changed in a chemical reaction or by any chemical means. Made up of atoms that all have the same number of protons. : Any of several attractive forces that serve to bind atoms together to form molecules. : A substance made from two or more elements. Consists of a fixed ratio of chemically bonded atoms. Has unique properties that are different from the properties of its individual elements. Elements A chemical element is a pure substance that consists of one type of atom. Each atom has an atomic number, which represents the number of protons that are in the nucleus of a single atom of that element. The periodic table of elements is ordered by ascending atomic number. The chemical elements are divided into the metals, the metalloids, and the non-metals. Metals, typically found on the left side of the periodic table, are: often conductive to electricity malleable shiny sometimes magnetic. Aluminum, iron, copper, gold, mercury and lead are metals. In contrast, non-metals, found on the right side of the periodic table (to the right of the staircase), are: typically not conductive not malleable dull (not shiny) not magnetic. Examples of elemental non-metals include carbon and oxygen. Metalloids have some characteristics of metals and some characteristics of non-metals. Silicon and arsenic are metalloids. As of November, 2011, 118 elements have been identified (the most recently identified was ununseptium, in 2010). Of these 118 known elements, only the first 98 are known to occur naturally on Earth. The elements that do not occur naturally on Earth are the synthetic products of man-made nuclear reactions. 80 of the 98 naturally-occurring elements are stable; the rest are radioactive, which means they decay into lighter elements over timescales ranging from fractions of a second to billions of years. The periodic table: The periodic table shows 118 elements, including metals (pink), nonmetals (blue), and metalloids (green). Hydrogen and helium are by far the most abundant elements in the universe. However, iron is the most abundant element (by mass) in the composition of the Earth, and oxygen is the most common element in the layer that is the Earth’s crust. Although all known chemical matter is composed of these elements, chemical matter itself constitutes only about 15% of the matter in the universe. The remainder is dark matter, a mysterious substance that is not composed of chemical elements. Dark matter lacks protons, neutrons, or electrons. Compounds Pure samples of isolated elements are uncommon in nature. While the 98 naturally occurring elements have all been identified in mineral samples from the Earth’s crust, only a small minority of them can be found as recognizable, relatively pure minerals. Among the more common of such “native elements” are copper, silver, gold, and sulfur. Carbon is also commonly found in the form of coal, graphite, and diamonds. The noble gases (e.g., neon) and noble metals (e.g., mercury) can also be found in their pure, non-bonded forms in nature. Still, most of these elements are found in mixtures. When two distinct elements are chemically combined—i.e., chemical bonds form between their atoms—the result is called a chemical compound. Most elements on Earth bond with other elements to form chemical compounds, such as sodium (Na) and Chloride (Cl), which combine to form table salt (NaCl). Water is another example of a chemical compound. The two or more component elements of a compound can be separated through chemical reactions. Chemical compounds have a unique and defined structure, which consists of a fixed ratio of atoms held together in a defined spatial arrangement by chemical bonds. Chemical compounds can be: molecular compounds held together by covalent bonds salts held together by ionic bonds intermetallic compounds held together by metallic bonds complexes held together by coordinate covalent bonds. Pure chemical elements are not considered chemical compounds, even if they consist of diatomic or polyatomic molecules (molecules that contain only multiple atoms of a single element, such as H2 or S8). Something that consists of diverse, non-bonded elements or molecules. Any one of the simplest chemical substances that cannot be decomposed in a chemical reaction or by any chemical means, and are made up of atoms all having the same number of protons. A form of matter that has constant chemical composition and characteristic properties. It is composed of one type of atom or molecule. Any of several attractive forces that serve to bind atoms together to form molecules. A substance made from two or more elements. Consists of a fixed ratio of chemically bonded atoms. Has unique properties that are different from the properties of its individual elements.