Applying the scientific method worksheet answers

What does it mean to conduct research? What are the distinct stages of the research process? What are the requirements of modern scientific research? How do you analyze a scientific article? This course will teach you how to conduct research according to scientific methodology. You will learn how to analyze scientific articles in engineering and science matters, and how to conduct scientific experiments. The course will help develop a scientist's core skill by giving you the research tools to succeed. The course material is suitable for anyone interested in the problems of discovering knowledge and science; giving you a methodology for carrying out educational and scientific activities. This course is for those who have said: Science is interesting. It will attract those who want to learn the processes behind modern scientific research. Understand the fundamental problems of science Ability to analyze scientific articles How to properly conduct scientific research and experiments Week 1: The philosophical aspects of scientific activity Introduction to philosophy of science. What is a scientific theory? The structure of a scientific theory. The methodology used to obtain scientific knowledge. Requirements to achieve scientific results. Week 2: Theory and practice of scientific research What is research? Doctoral requirements. Research planning. Research question. Mode queries. Induction and deduction in your research project. Week 3: Philosophical principles of ontology and epistemology research. Objectivity and subjectivity. Causality and correlation in your research project. Week 4: Literature review research process. Research questions and hypotheses. The structure of the paper and the investigation of the plan. Impact of the research. Week 5: Methodology of experiments in engineering studies The purpose and structure of the experiment. Planning. Analysis of results. Receive an instructor-signed certificate with the institution's logo to verify your achievement and increase your job prospectsAdd the certificate to your resume or resume, or post it directly to LinkedInGive yourself an additional incentive to complete the EdX course, a non-profit organization, relies on verified certificates to help fund free education for everyone worldwide. Part 1 Science is practical. Although science sometimes involves learning from textbooks or teachers in classrooms, its primary activity is discovery. Discovery is an active, practical process, not something done by scholars isolated from the world in ivory towers. It's both a search for information and a search to explain how the information fits significantly. And almost always seeks answers to very practical questions: How human activity affects global warming? Why are bee populations suddenly declining in North America? What allows birds birds to such long distances? How do black holes form? Advertising Science is based on observation. Scientists use all their senses to collect information about the world around them. Sometimes they collect this information directly, without tool or intervening apparatus. Other times they use equipment, such as a telescope or microscope, to collect information indirectly. Anyway, scientists will write what they see, hear and feel. These recorded observations are called data. Part 3 The data can reveal the structure of something. This is quantitative data, which describes an object numerically. The following are examples of quantitative data: The body temperature of a ruby-throated hummingbird is 40.5°C (105°F). The speed of light is 299,792,458 meters per second (670,635,729 mph). Jupiter's diameter is 142,984 kilometers (88,846 miles). The length of a blue whale is 30.5 meters (100 feet). Note that quantitative data consists of a number followed by a unit. The unit is a standardized way of measuring a particular dimension or quantity. For example, the foot is a unit long. Just like the meter. In science, the International System (SI) of units, the modern form of the metric system, is the global standard. Part 4 The data may also reveal behavior. They are qualitative data, which are written descriptions of an object or organism. John James Audubon, the 19th-century naturalist, ornithologist and painter, is famous for his qualitative observations on bird behavior, such as this: Generally, scientists collect quantitative and qualitative data, which also contribute to the body of knowledge associated with a particular theme. In other words, quantitative data is no longer important or more valuable because it is based on accurate measurements [source: Audubon]. Next, we will learn about science as a systematic and intellectual persecution. As further proof that there is no way to do science, different sources describe the steps of the scientific method in different ways. Some list three steps, some four and five others. Fundamentally, however, they incorporate the same concepts and principles. For our purposes, let's say that there are five key steps in the method. Advertising Almost all scientific research begins with an observation that arouses curiosity or raises a question. For example, when Charles Darwin (1809-1882) visited the Galapagos Islands (located in the Pacific Ocean, 950 kilometers west of the Equator, he observed several species of finches, each uniquely adapted to a very specific habitat. In particular, the finches' beaks were quite variable and seemed to play important roles in how birds obtained food. These captivated Darwin. He wanted to understand the forces that allowed so many different varieties of birds to successfully coexist in such a small geographical area. His observations caused to ask himself, and his wonder led him to ask a question that could be tested. Step 2: Ask a question The purpose of the question is to reduce the focus of the survey, identify the problem in specific terms. The question Darwin could have asked after seeing so many different finches was something like this: what caused the diversification of finches in the Galapagos Islands? Here are some other scientific questions: What causes the roots of a plant to grow down and the stem grows upwards? Which brand of mouthwash kills the most germs? Which form of car reduces air resistance more effectively? What causes coral bleaching? Does green tea reduce the effects of oxidation? What kind of building material absorbs the most sound? Addressing scientific issues is not difficult and does not require training as a scientist. If you've ever been curious about something, if you've ever wanted to know what caused something to happen, then you've probably asked a question that could start a scientific investigation. Step 3: Formulating a Hypothesis The great thing about a question is that it yearlongs for an answer, and the next step in the scientific method is to suggest a possible answer in the form of a hypothesis. A hypothesis is often defined as an educated guess because it is almost always informed by what you already know about a topic. For example, if you want to study the air resistance problem indicated above, you may already have an intuitive feeling that a bird-shaped car would reduce air resistance more effectively than a box-shaped car. You could use that intuition to help formulate your hypothesis. Generally, a hypothesis is declared as a if ... So. By making such a statement, scientists engage in deductive reasoning, which is the opposite of inductive reasoning. Deduction requires movement in logic from general to specific. Here is an example: If the body profile is related to the amount of air resistance it produces (general statement), then a car designed as a bird's body will be more aerodynamic and reduce air resistance more than a car designed as a box (specific statement). Note that there are two important qualities about a hypothesis expressed as if ... So. First, it is testable; an experiment could be created to test the validity of the declaration. Secondly, it is falsifiable; an experiment could be created that could reveal that such an idea is not true. If these two qualities are not fulfilled, then the question being asked cannot be addressed using the scientific method. Remember, this is an idealized methodology. Scientists don't sit down with a list of five steps that they feel compelled to follow. In fact, the process is quite fluid and open to interpretation and modification. A scientist spend much of his career in the observation phase. Other Other you can never spend a great deal of time designing and running experiments. Darwin spent almost 20 years analyzing the data he collected before acting on it. In fact, much of Darwin's work was an intellectual pursuit, trying to fit the pieces of a puzzle together. And yet no one would say that his theory of natural selection is less valuable, or less scientific, because he did not strictly follow a five-step process. It would also be appropriate to mention again that this method is not reserved for highly trained scientists - anyone who tries to solve a problem can use it. To illustrate, consider this example: You (or a family member) are driving to the store when the car begins to overheat. The problem is clear in this case, as well as the observation (a temperature warning light) that initiates the investigation. But what's making the car overheat? One hypothesis may be that the thermostat has stopped working. Another hypothesis may involve the radiator. Another may be that the fan belt has broken. Advertising The simplest solution is often a good place to start, and the easiest thing to test in this case is the condition of the fan belt. If you find that the belt is actually broken, then you can feel quite confident that it is the source of the problem. However, a test is still required to be sure. The test in this case involves replacing the belt and running the car to see if it overheats. If that doesn't work, you can accept your hypothesis about the fan belt. If the belt has not been broken to begin with, or if the car continues to overheat even after replacing the belt, you will need to review your hypothesis. Perhaps you have noticed that the example above did not contain a if ... then hypothesis. You may also have noticed that it contained no control and experimental groups. That's because day-to-day problem solving doesn't require as much formality. But it requires a logical approach and a progression of thought that results in a testable hypothesis. So if one can use the scientific method, why has it become so closely associated with fields like biology, chemistry and physics? Because pure researchers apply the scientific method with a rigor that non-scientists do not apply. Let's explore why in the next section. Section.