Scientific method testable questions worksheet

What does it mean to conduct research? What are the different stages of the research process? What are the requirements of modern scientific research? How do you analyze a scientific article? This course teaches you to conduct research in accordance with scientific methodology. You will learn how to analyze scientific articles in engineering and science subjects, and how to conduct scientific experiments. The course will help develop the core competence of a scientist, giving you the research tools to succeed. The course material is well suited for anyone interested in the problems of discovering knowledge and science; gives you a methodology for the attainment of educational and scientific activities. This course is for anyone who has ever said, Science is interesting. It will appeal to those who want to learn the processes behind modern scientific research. Understanding the Basic 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 Science Philosophy. What is a scientific theory? The structure of a scientific theory. The methodology used to obtain scientific knowledge. Requirements for achieving scientific results. Week 2: Theory and practice for scientific research What is research? Ph.D. requirements. Research planning. Research question. Modes request. Induction and deductionin your research project. Week 3: Philosophical Principles of Research Ontology and Epistemology. Objectivity and subjectivity. Causation and correlation in your research project. Week 4: Research process Literature review. Research questions and hypothesis. The structure of the paper and plan investigation. Research impact. Week 5: Methodology for experiments in engineering studies The purpose and structure of the experiment. Planning. Analysis of the results. Receive an instructor-signed certificate with the department logo to verify your performance 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 courseEdX, a nonprofit, relying on verified certificates to help fund free training for anyone globally Let's break down the definition of science. Part 1 Science is practical. Although science sometimes involves learning from textbooks or professors in lecture halls, its primary activity is discovery. Discovery is an active, practical process, not something done by scientists isolated from the world in ivory towers. It is both a search for information and an effort to explain how information fits together in meaningful ways. And it almost always seeks answers to very practical questions: How does human activity affect global warming? Why is of honey bees suddenly in North America? What enables birds to so long distances? How do black holes form? Science is based on observation. Scientists use all their minds to gather information about the world around them. Sometimes they collect this information directly, without intermediate tools or apparatus. Other times, they use equipment, such as a telescope or microscope, to gather information indirectly. Either way, scientists will write down what they see, hear and feel. These recorded observations are called data. Part 3 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. The speed of light is 299,792,458 feet per second (670,635,729 mph). Jupiter's diameter is 142,984 kilometers. 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 to measure a specific dimension or quantity. For example, the foot is a unit of length. So is the meter. In science, the international system (SI) of devices, the modern form of the metric system, is the global standard. Part 4 Data may also reveal behavior. These are qualitative data, which are written descriptions of an object or organism. John James Audubon, 19th-century naturalist, ornithologist and painter, is known for the qualitative observations he made about bird behavior, such as this: In general, researchers collect both quantitative and qualitative data, which contribute equally to the knowledge body in connection with a particular subject. In other words, quantitative data are not more important or valuable because they are based on precise measurements [source: Audubon]. Next we will learn about science as a systematic, intellectual endeavor. As more evidence 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 some five. For our purposes, we will say that there are five important steps in the method. Almost all scientific investigation 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 Ecuador, he observed several species of finches, each uniquely adapted to a very specific habitat. In particular, the beaks of the finches were quite varied and seemed to play important roles in how the birds were fed. These birds captivated Darwin. He wanted to understand the forces that allowed so many different varieties of finch to coexist successfully in such a small geographical area. His observations made him wonder, and his led him to ask a question that could be tested. Step 2: Ask a question The purpose of the question is to narrow the focus of the investigation, to identify the problem in specific terms. The question Darwin may 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 downwards and the stem to grow upward? What kind of mouthwash kills most bacteria? Which car body shape reduces air resistance most effectively? What causes coral bleaching? Does green tea reduce the effects of oxidation? What kind of building materials absorb the most sound? Coming up with scientific questions is not difficult and does not require training as a researcher. If you've ever been curious about anything, if you ever wanted to know what caused something to happen, then you've probably already asked a question that could initiate a scientific investigation. Step 3: Formulate a hypothesis The beauty of a question is that it craves 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 substance. For example, if you wanted to study the air-resistance problem above, you might already have an intuitive feeling that a car shaped like a bird would reduce air resistance more effectively than a car shaped like a box. You can use that intuition to formulate your hypothesis. Generally, a hypothesis is indicated as one about ... then statement. When the researchers make such a statement devote deductive reasoning, which is the opposite of inductive reasoning. Deductions require movement in logic from the general to the specific. Here's an example: If a car's body profile is related to the amount of air resistance it produces (general statement), then a car designed as the body of a bird will be more aerodynamic and reduce air resistance more than a car designed as a box (specific explanation). Note that there are two important characteristics of a hypothesis expressed as one about ... then statement. First it is testable; an experiment could be set to test the validity of the statement. Secondly, it is falsifiable; an experiment could be designed that could reveal that such an idea is not true. If these two qualities are not met, then the question posed by the scientific method cannot be addressed. Remember that this is an idealized methodology. The researchers do not sit with a checklist of five steps that they feel obliged to follow. In fact, the process is quite fluid and open to interpretation and modification. A scientist can spend much of his career in the observation stage. Another scientist may never spend a large scheduling 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 endeavor, trying to fit the pieces of the puzzle together. And yet no one would argue that his theory of natural selection is less valuable, or less scientific, because he does not strictly follow a five-step process. It would also be appropriate to mention once again that this method is not reserved for highly trained researchers - anyone trying to solve a problem can use it. To illustrate, consider this example: You (or a family member) drive to the store when the car starts to overheat. The problem is clear in this case, as is the observation (a temperature warning light) that initiates the examination. But what is it that causes the car to overheat? One hypothesis may be that the thermostat stopped working. Another hypothesis may involve the radiator. Yet another could be that the fan belt has broken. The simplest solution is often a good place to start, and the easiest to test in this case is the condition of the fan. If you find that the belt is really broken, then you can feel pretty sure that it is the source of the problem. However, a test is still required to be sure. The test in this case involves changing the belt and driving the car to see if it overheats. If it doesn't, you can accept your hypothesis about the fan belt. If the belt was not broken to begin with, or if the car continues to overheat even after you have changed the belt, you will need to revise your hypothesis. Maybe you noticed that the example above did not contain one if ... then hypothesis. You may also have noticed that it did not contain control and experimental groups. This is because the daily problem solving does not require such a formality. But it requires a logical approach and a progression of thinking that results in a testable hypothesis. So if anyone can use the scientific method, why has it become so intimately associated with fields such as biology, chemistry and physics? Because pure scientists apply the scientific method with a rigor that nonscientists do not. We'll investigate why in the next section. Section.