MATERIALS SCIENCE SELECTION OF MATERIALS pdf

1: Materials Science and Engineering | MIT OpenCourseWare | Free Online Course Materials

Materials Scienceâ€"Selection of Materials demonstrates how available physical data and knowledge of production methods can be combined at a sufficiently early stage in the design process so as to make a significant contribution toward optimum selection of materials.

See materials and instructions, below. The presentation includes basic information regarding material classes, material applications, and material behavior and serves as a foundation for acquiring basic knowledge for the remainder of the lesson. Allow minutes for the presentation. The class demo illustrates the different classes of materials and material behavior, and engages the students in a review of presentation content. What is material science? Listen to student ideas. What do I mean when I say "materials"? What are the different classes of materials? Why are they created? What are their characteristics? How do we test them? How are they used? Show the attached PowerPoint presentation, or alternative teaching resources. Then conduct the class demo. Show students the tile, Popsicle stick, paper clip and plastic bag. Which class of materials does each of these materials belong to? Wait for a response, then proceed. Bend the Popsicle stick slightly and release. What type of deformation has occurred? Continue bending until the wooden stick breaks. Describe the failure of this material on your worksheet. Is it ductile, brittle or a combination? Did any permanent deformation occur? Bend the paper clip or copper wire until there is permanent deformation. Continue bending the wire until it breaks. What type of failure occurred? Show the ceramic tile to students and try bending it. Will the ceramic permanently deform when I hit it with a hammer, or break? Place the ceramic tile into a plastic bag and seal the bag making sure all air is evacuated. Use the hammer to smash the ceramic tile until it breaks. Show students the remains and have them describe the failure on their worksheets. Show students the other plastic bag. What type of deformation, if any, will occur if the bag is stretched? Briefly stretch the bag until a small amount of permanent deformation is visible. What type of deformation occurred? Continue stretching the bag until it tears. Have students complete the remaining questions on the worksheet. Then conduct the associated activity. Lesson Background and Concepts for Teachers Material science has evolved during the last 40 years as different classes of materials became more and more competitive with one another. The four primary general classes of materials are metals, ceramics, polymers and composites. What makes these classes of materials unique is their composition, bonding and structure. Additionally, these distinct characteristics govern the applications for using each class of material. Following is a general summary of the four classes. Additional readings are suggested in the References section. Material science is defined as the relationship of properties to its chemistry composition and structure. Understanding these relationships involves interdisciplinary knowledge of chemistry, physics and metallurgy. Provided engineers and scientists understand the type of atoms present and their arrangement, many properties may be understood and optimized for practical use. Chemical composition is fundamental in understanding any material type. Composition is the amount of an individual element that makes up a material. For example, steel is composed of iron and carbon and glass is composed of silicon, calcium, sodium, aluminum and oxygen. The structure can be defined as the arrangement of such elements atoms , micro-features and macroscopic features. Atomic structure is, as the name suggests, a particular arrangement of atoms and the electron structure. From chemistry, three primary forms of bonding exist: It is the atomic structure and interaction between elements that dictates which type of bonding prevails. Of course, additional bonding, such as hydrogen and London dispersion forces van der Waals exist and become important for polymers. For instance, metal alloys are strictly metallic bonding. Two metal elements with incomplete valence shells combine, filling the sub-valence shells, with remaining electrons present as a cloud. Interestingly, this electron arrangement is why metals are good electrical conductors. Ceramics are primarily bonded by strong covalent bonds and a few ionic bonds. The difference between the two is a sharing of valence electrons and transfer of valence electrons, respectively. The nature of these bonding types is why most ceramics are electrical insulators. Additionally, the nature of bonding is the source for many physical material properties and eventual mechanical properties. Bond strength is highly correlated to melting point, elastic stiffness and thermal expansionâ€"meaning, the stronger the bonds the larger driving force is needed to separate such atoms. For most solid materials, these arrangements are periodic and possess long-range order, with the exception of polymers and amorphous glasses. These periodic structures are called crystal structures and are present in seven primitive arrangements: These "lattices" are what make up the microstructure. Also, additional packing sequences that exist within each primitive arrangement create a total of 14 unit cells; most notable are body-centered cubic BCC and face-centered cubic FCC. The microstructure also includes larger features such as an array of crystals or grains, or a multitude of different solid phases. These features can be viewed using optical methods that do not require diffraction techniques or high magnification. The macrostructure is the length scale that is comprised of a collection of microstructure features that show distinct characteristics. For example, collections of grains in a metal can be viewed at low magnification x10 and appear to be flow lines or stripes. This length scale can provide very important details and can influence mechanical behavior of materials. A banded structure of steel can provide insights to fabrication methods and material strength. All of these length scales and distinct material features collectively make a material strong, fracture resistant, corrosion resistant, temperature resistant and ductile. However, no one material can have all of these wonderful attributes. Pure Metals and Metal Alloys: Metal alloys are mixtures of two or more metallic elements. As mentioned earlier, metals are unique in that they are excellent electrical and thermal conductors. These physical properties are due to the nature of metallic bonding. Some metals also possess magnetic properties. Metals also possess a large capacity of mechanical deformation aka ductility. Some metal bars can be shaped easily at room temperature. Most metals also have distinct strength levels: To facilitate strength manipulation, metals have the capacity to be altered through mechanical, thermal or thermal mechanical treatments to achieve desired properties. Steel heat treatment for a hammer is different from that of a nail. Ceramics are typically covalent-bonded solids that have very high melting points and stiffness. However, typically these materials are regarded as brittle. Ceramics are also useful in super-high temperature and corrosive environments. One advantage to the chemical compositions and bonding nature of ceramics is their inertness to many different corrosive media and oxidation environments. High temperature applications are suitable because of high strength retention at operating temperatures. Typical metals are too soft to sustain any mechanical loads at temperatures greater than 0. Because of high stiffness, most ceramics are inherently hard and therefore abrasion- and wear-resistant. The hardest materials known are high-directional, covalent-bonded ceramics. Polymers are combinations of long-chained, covalent-bonded atoms that are mutually attracted by weaker bonding forces. Typically, polymers vary from very flexible, ductile materials to very hard and brittle materials. Polymers and their structures are dependent on the chemical composition of the base material and any fillers, extenders and plasticizers. Additionally, chemical composition also determines the degree of crystallinity in polymers. Typically, polymer chains are completely random and tangled. Depending on the chemistry, additives and stress state, these chains can obtain some periodic arrangement.

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2: CES Information Guide - Materials Science Engineering

Material Selection. Materials selection is an ordered process by which engineers can systematically and rapidly eliminate unsuitable materials and identify the one or a small number of materials which are the most suitable.

Nanomaterials research takes a materials science-based approach to nanotechnology , leveraging advances in materials metrology and synthesis which have been developed in support of microfabrication research. Materials with structure at the nanoscale often have unique optical, electronic, or mechanical properties. The field of nanomaterials is loosely organized, like the traditional field of chemistry, into organic carbon-based nanomaterials such as fullerenes, and inorganic nanomaterials based on other elements, such as silicon. Examples of nanomaterials include fullerenes , carbon nanotubes , nanocrystals , etc. Biomaterial The iridescent nacre inside a nautilus shell. A biomaterial is any matter, surface, or construct that interacts with biological systems. The study of biomaterials is called bio materials science. It has experienced steady and strong growth over its history, with many companies investing large amounts of money into developing new products. Biomaterials science encompasses elements of medicine , biology , chemistry , tissue engineering , and materials science. Biomaterials can be derived either from nature or synthesized in a laboratory using a variety of chemical approaches using metallic components, polymers , bioceramics , or composite materials. Such functions may be benign, like being used for a heart valve , or may be bioactive with a more interactive functionality such as hydroxylapatite coated hip implants. Biomaterials are also used every day in dental applications, surgery, and drug delivery. For example, a construct with impregnated pharmaceutical products can be placed into the body, which permits the prolonged release of a drug over an extended period of time. A biomaterial may also be an autograft , allograft or xenograft used as an organ transplant material. Electronic, optical, and magnetic[edit] Negative index metamaterial. These materials form the basis of our modern computing world, and hence research into these materials is of vital importance. Semiconductors are a traditional example of these types of materials. They are materials that have properties that are intermediate between conductors and insulators. Their electrical conductivities are very sensitive to impurity concentrations, and this allows for the use of doping to achieve desirable electronic properties. Hence, semiconductors form the basis of the traditional computer. This field also includes new areas of research such as superconducting materials, spintronics , metamaterials , etc. The study of these materials involves knowledge of materials science and solid-state physics or condensed matter physics. Computational science and theory[edit] With the increase in computing power, simulating the behavior of materials has become possible. This enables materials scientists to discover properties of materials formerly unknown, as well as to design new materials. Up until now, new materials were found by time-consuming trial and error processes. But, now it is hoped that computational methods could drastically reduce that time, and allow tailoring materials properties. This involves simulating materials at all length scales, using methods such as density functional theory , molecular dynamics , etc. In industry[edit] Radical materials advances can drive the creation of new products or even new industries, but stable industries also employ materials scientists to make incremental improvements and troubleshoot issues with currently used materials. Industrial applications of materials science include materials design, cost-benefit tradeoffs in industrial production of materials, processing methods casting , rolling , welding , ion implantation , crystal growth , thin-film deposition , sintering , glassblowing , etc. Besides material characterization, the material scientist or engineer also deals with extracting materials and converting them into useful forms. Thus ingot casting, foundry methods, blast furnace extraction, and electrolytic extraction are all part of the required knowledge of a materials engineer. Often the presence, absence, or variation of minute quantities of secondary elements and compounds in a bulk material will greatly affect the final properties of the materials produced. Thus, the extracting and purifying methods used to extract iron in a blast furnace can affect the quality of steel that is produced. Ceramics and glasses[edit] Main article: Ceramic Si_3N_4 ceramic bearing parts Another application of material science is the structures of ceramics and glass typically associated with the most brittle materials. Bonding in ceramics and glasses uses covalent and ionic-covalent types with SiO_2 silica or sand as a fundamental building block.

Ceramics are as soft as clay or as hard as stone and concrete. Usually, they are crystalline in form. Most glasses contain a metal oxide fused with silica. At high temperatures used to prepare glass, the material is a viscous liquid. The structure of glass forms into an amorphous state upon cooling. Windowpanes and eyeglasses are important examples. Fibers of glass are also available. Scratch resistant Corning Gorilla Glass is a well-known example of the application of materials science to drastically improve the properties of common components. Diamond and carbon in its graphite form are considered to be ceramics. Engineering ceramics are known for their stiffness and stability under high temperatures, compression and electrical stress. Alumina, silicon carbide , and tungsten carbide are made from a fine powder of their constituents in a process of sintering with a binder. Hot pressing provides higher density material. Chemical vapor deposition can place a film of a ceramic on another material. Cermets are ceramic particles containing some metals. The wear resistance of tools is derived from cemented carbides with the metal phase of cobalt and nickel typically added to modify properties. Filaments are commonly used for reinforcement in composite materials. Another application of materials science in industry is making composite materials. These are structured materials composed of two or more macroscopic phases. RCC is a laminated composite material made from graphite rayon cloth and impregnated with a phenolic resin. After curing at high temperature in an autoclave, the laminate is pyrolized to convert the resin to carbon, impregnated with furfural alcohol in a vacuum chamber, and cured-pyrolized to convert the furfural alcohol to carbon. To provide oxidation resistance for reuse ability, the outer layers of the RCC are converted to silicon carbide. Other examples can be seen in the "plastic" casings of television sets, cell-phones and so on. These plastic casings are usually a composite material made up of a thermoplastic matrix such as acrylonitrile butadiene styrene ABS in which calcium carbonate chalk, talc , glass fibers or carbon fibers have been added for added strength, bulk, or electrostatic dispersion. These additions may be termed reinforcing fibers, or dispersants, depending on their purpose.

3: Basic Facts to Consider for Material Selection in Engineering

Material selection is the foundation of all engineering applications and design. This selection process can be defined by application requirements, possible materials, physical principles, and selection.

This final year has three extended terms of 12 to 13 weeks and is 37 weeks in total so you will need to budget for higher living costs in the final year, as you will be required to be in Oxford for longer than the standard terms. During the project you will learn how to break down a complex problem, design an experiment or model, manage your time and project, maintain systematic records, present your work orally and write a substantial report. These research skills are transferable to other career paths and are valued highly by employers. On occasion significant scientific publications result from these projects. All candidates must follow the application procedure as shown in applying to Oxford. The information below gives specific details for students applying for this course. Candidates must make sure they are available to take the test at this time. Separate registration for this test is required and the final deadline for entries is Monday 15 October It is the responsibility of the candidate to ensure that they are registered for this test. We strongly recommend making the arrangements in plenty of time before the deadline. The test consists of maths and physics questions, which are mixed in sequence there are not separate maths or physics sections. Formula sheets, tables and data books are not permitted. Calculators will be permitted from Guidelines about the use of calculators along with details of the syllabus and links to supporting materials which candidates are encouraged to look at for preparation are available on the PAT page. Everything you need to know, including guidance on how to prepare, can be found on the PAT page. Written work You do not need to submit any written work when you apply for this course. What are tutors looking for? At interview, tutors are aware that students may not have encountered Materials Science at school or college. Tutors look for an ability to apply logical reasoning to problems in physical science, and an enthusiasm for thinking about new concepts in science and engineering. Suggested reading There is no set text and students should read widely around the subject. Introductory reading for prospective applicants to Materials Science can be found on the departmental website. Students may also wish to read the New Scientist magazine which may be available in your school or local library. Running an internet search on Nanoscience or Nanotechnology will give useful background information in the sciences. Watch a series of short videos of students talking about some aspect of their time at Oxford. It is challenging, and requires a lot of effort and perseverance, but we get to carry out fun experiments involving orange jelly, molten metal and bubbles, so all the effort seems worth it. Practical classes are particularly good for developing a hands-on approach, and then we also have industrial visits where you get to see where all the work is leading you. There are also opportunities to do voluntary summer placements, and an annual industrial tour abroad. Oxford is a beautiful place to study, and I can really tell that I am learning from the best when I leave a tutorial, exhausted, but with a much higher level of understanding. Everyone really gets to know each other, and personally I have made some amazing friends on the course. Everyone at Oxford seems to manage the balance between working hard, playing hard and making the most of the best University experience available. Current job I am now a consultant engineer at Frazer-Nash, a systems and engineering consultancy firm. I work on both materials engineering and software projects, focussing on helping our clients improve the performance, risk and cost profile of their physical assets and infrastructure. How did Oxford prepare you for this type of work? The course at Oxford was ideal preparation for my career: The tutorial system also required me to regularly deliver complex work: What was the most important thing your time at Oxford taught you? Not only did I learn a huge amount about my chosen subject, I learned how to independently go about finding out about a topic. This skill has been hugely valuable, and has routinely fired my imagination about a whole variety of diverse subjects including coding, philosophy and applied maths. The tutorial system is one of the most distinctive features of an Oxford education: A typical tutorial is a one-hour meeting between a tutor and one, two, or three students to discuss reading and written work that the students have prepared in advance. It gives students the chance to interact directly with tutors, to engage with them in debate, to exchange ideas and argue, to ask questions, and of course to learn through the discussion of the prepared work. Many tutors are world-leaders in their fields of research, and Oxford undergraduates frequently learn of new discoveries before they are published. Each student also receives teaching in a variety of other ways, depending on the course. This will include lectures and classes, and may include laboratory work and fieldwork. But the tutorial is the place where all the elements of the course come together and make sense. It helps students to grow in confidence, to develop their skills in analysis and persuasive argument, and to flourish as independent learners and thinkers. More information about tutorials The benefits of the college system Every Oxford student is a member of a college. The college system is at the heart of the Oxford experience, giving students the benefits of belonging to both a large and internationally renowned university and a much smaller, interdisciplinary, college community. Each college brings together academics, undergraduate and postgraduate students, and college staff. The college gives its members the chance to be part of a close and friendly community made up of both leading academics and students from different subjects, year groups, cultures and countries. The relatively small size of each college means that it is easy to make friends and contribute to college life. There is a sense of belonging, which can be harder to achieve in a larger setting, and a supportive environment for study and all sorts of other activities. It is the norm that undergraduates live in college accommodation in their first year, and in many cases they will continue to be accommodated by their college for the majority or the entire duration of their course. Colleges invest heavily in providing an extensive range of services for their students, and as well as accommodation colleges provide food, library and IT resources, sports facilities and clubs, drama and music, social spaces and societies, access to travel or project grants, and extensive welfare support. For students the college often becomes the hub of their social, sporting and cultural life.

4: Materials science - Wikipedia

Materials Science-Selection of Materials demonstrates how available physical data and knowledge of production methods can be combined at a sufficiently early stage in the design process so as to make a significant contribution toward optimum selection of materials.

LinkedIn Materials Science Materials science is the study of properties and the structures of the substances. Our assignments are of advanced level, which are composed by our experts. Materials science is an interdisciplinary area, crossing Materials Science Assignment Help chemistry and the physics of industrial manufacturing procedures, engineering uses and matter. What is materials science? It is anything that a person uses such as bike or skateboard. It is made of different types of things. Comprehending that how the stuff is put together, the way that it could be utilized, the way that it could be altered and made to do things that are incredible. Creating entirely new forms of material is what materials science is about. This is a major question that is because materials are the fundamental substances. A substance can be real such as human, wood, plastic. As materials scientists combines and create materials in ways that are new, the amounts practically endless. Individuals transformed them to meet what they needed to do, instead of simply letting their natural properties. Nowadays, metals are being used by material scientists in ways no one could have imagined even several years before. For instance, forming copper into miniature wires, which are a thousand times skinnier than an element of the hair! Ceramics Think about a china teapot that is one kind of ceramic. However, ceramics can be utilized to generate tooth and bone replacements, super-powerful cutting tools, or to conduct electricity. With the inclusion of nitrogen or oxygen, metal can also become ceramic. Silicon Silicon is the crucial substance that is used in an electronic computer processors. Rubber bands are made of polymers. In addition, every type of plastic and paints are made of polymers. The main mission of MSC has grown beyond development and fundamental research to contain transitioning its proprietary technologies into new products from the research lab. This commitment is demonstrated through increased staffing as well as a more than 3-fold growth of facilities to enable in-house production and testing of innovative composite materials and constructions. It covers innovative materials and technologies along with the areas of materials science that are concerning with the standard engineering material aiming at the business and execution uses. The selection of substances under consideration gives to the co-operation of scientists working in distinct areas of engineering, chemistry, materials science and applied physics. MS has an extensive and distinguished tradition in research and materials education, and our faculty continues to deal with the more significant and difficult problems at the frontline of science and technology nowadays. Materials science is an extremely comprehensive and comparatively new subject. It includes uses of a number of scientific disciplines that promote the creation of new material. This is because chemistry provides information about the arrangement and makeup of substances, in addition to the procedures to manufacture and use them. Chemists play a leading part in materials science. Materials Science is the study of the construction, properties and uses of all kinds of materials that include ceramics, metals, glasses and polymers. The program draws on the fundamental sciences of physics and chemistry and on more applied areas such as metallurgy, ceramics and polymer science. Materials science is an interdisciplinary area that include the properties of matter and its own applications to different areas of engineering and science. This scientific discipline investigates the connection between the arrangement of materials at molecular or atomic scales and their macroscopic properties. This program prepares graduates for various professions in areas such as nanotechnology, computing, electronics, the biomedical, aerospace and automotive sectors, along with government agencies and research laboratories. Finding new materials and incorporating it into engineering layout is a daunting, however a rewarding job. Metals, ceramics, glasses and polymers can be used for various functions in space shuttle tiles, semiconductors, cars, planes, tennis rackets, bicycles, mobile phones or surgical implants. Therefore, engineered substances play an important role in well-being technology as well as the wellbeing of society. Materials science and engineering majors examine the way the arrangement of substances at even the smallest quantity Nano, micro, atomic drastically changes properties and behavior of substances. Material scientists and engineers bring quality, improved layout and operation of large and small engineering parts and systems. Material scientists examine the links between the inherent arrangement of its properties, a substance, its processing systems and its own functionality in uses. Materials science examines creation and the design of the material. The subject is associated with engineering and chemistry. All the top universities in the world for materials science, predicated on research and their standing in the area. Materials Science is an exciting, multidisciplinary area that inquires substances and matter across a wide array of scales, interactions, and uses. From nanotechnology to biomaterials, Materials Scientists enhance existing ones and develop new materials and techniques. It is designed for graduates of engineering or science programs who would like a career in research. The Materials Science graduate programs enables student to come up with wisdom and research expertise in the interface of biology, physics, chemistry and engineering. Students may also engage in essential material research. The focus on fundamental science will give graduates the flexibility to go into emerging areas of research and to keep in addition to their area.

5: 2: Materials Selection and Processing | School of Materials Science and Engineering

The interdisciplinary field of materials science, also commonly termed materials science and engineering is the design and discovery of new materials, particularly solids. The intellectual origins of materials science stem from the Enlightenment, when researchers began to use analytical thinking from chemistry, physics, and engineering to.

Material selection is the foundation of all engineering applications and design. This selection process can be defined by application requirements, possible materials, physical principles, and selection. The application requirements are specific given the application. The possible materials are simply the only materials that can be used in the application. Possible Materials are defined by the application requirements. For an example you cannot use clothe to build a bicycle. Physical principles are methods of changing a material that are learned through material science techniques. Using material science physical principles we can change material properties. Three common physical principles we can use for functional material strengthening are densification, composites, and alloying. There many manufacturing techniques used to strengthen and form materials as well. Densification is the most common and necessary way to strengthen any material. In general, this increases the tensile strength by reducing the porosity of the material. One the major reasons for the prevalent use of composite materials in construction is the adaptability of the composite to many kinds of applications. The selection of mixture proportions can be aimed to achieve optimum mechanical behavior of the harden product. Selection can result in the change of the strength, consistency, density, appearance, and durability. The alloying of metals is one of the oldest and most fundamental material processing techniques. An Alloy is a solid solution that is composed of two or more elements. There is a solvent majority composition and a solute. The Solute element can strengthen the overall solid solution by different element size, density, and other material properties. Given the application requirements, possible materials, and physical principles we can select the best material. Thus in the selection of a material: First, we decide on the requirements of the application. Second, we decide on the possible materials we can use in the application. Third, we decide what changes in the material properties are needed. Lastly, we decide which material out of the possible materials best fulfills the requirements of the application given possible changes in the material properties.

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6: Materials Engineer Salary | PayScale

Massachusetts Institute of Technology Cambridge, Massachusetts Materials Systems Laboratory Â©Jeremy Gregory and Randolph Kirchain, Materials Selection I - Slide 2.

If the preceding capabilities are not available, you will need more resources for as many capacity-building activities as possible. Be sure that you have provided funds for the staff required for the extensive preparation and facilitation of the review and selection processes. Also plan for the time and associated costs required for community outreach activities. Obtaining and organizing the materials to be reviewed can be very time consuming. Your budget should adequately allow for this task and any shipping or storage fees that may be necessary. Coordination with other science education initiatives. Contact those persons responsible for curriculum and instruction inside and outside your immediate program. Use their advice to compile a broad account of local science education efforts, including a history of recent professional development in science, sources of current funding, and projects and programs in science teaching and learning that are under way or planned. Research new science education initiatives being discussed or to be launched soon in the region or state. Coordination with the plans and proposals of others involved in science education in your area may enable you to share resources for recruiting and training reviewers, developing community support for the science program, and planning for the successful implementation of the new program. Become familiar with the processes used and lessons learned by colleagues in other disciplines who have recently completed instructional materials selection. Make a written summary of these findings. These will be useful later in training reviewers and making presentations to administrators and community groups. Compile and analyze evidence on current student achievement in science, teacher opinions on what is working, elements of the science program in need of revision, and community perceptions of the science program. An anonymous survey of the materials that teachers are actually using may be necessary, since the curriculum prescribed by current policies may not be the one that has been implemented in the classroom. A Guide for K Science. The National Academies Press. In addition to the basic reporting of standardized test scores, a study of the item analyses can provide useful data on student achievement. This information is usually provided along with the overall scores to school administrators. Professional development in how to interpret and apply the test-item analysis information is useful for principals and teachers, who are then better prepared to provide information on student achievement. In regions that disaggregate the test scores in a number of ways â€" by gender, race, courses, or classrooms â€" it is possible to further pinpoint needs that should be taken into consideration in selecting instructional materials. Another source of data related to student science achievement is enrollment data in upper-level science courses, in which students enroll by choice or by meeting prerequisites. Improvements in the science courses should show a trend to increased demand and enrollment for advanced courses, as well as an increased participation of currently underrepresented minorities. The information collected before the review will help influence final selection decisions and provide compelling background information in support of your recommendations during the approval process. Identification and involvement of community stakeholders. Support from influential members of the community will be critical when recommendations for the ultimate selections need to be approved and when the new materials are introduced into schools. Selected local scientists and engineers from industry, faculty of local colleges and universities from both the education and science departments, and leaders of science education programs can be made members of an advisory board, along with teachers, students, and parents. Some members of this board may become reviewers and trainers. Participation in the advisory board and in the review and selection process will help educate community members about the curriculum, standards, classroom needs, and available instructional materials. Involve the community in learning about the science program through district, school-level, and community activities such as open house events, community meetings, and newsletters. Educate participants about program goals and the science standards and gather opinions and suggestions. Keep community members informed through periodic updates using all of the news media available in your community. Page 47 Share Cite Suggested Citation: Choose highly qualified people whose judgments can be trusted to help increase student achievement in science. Selection criteria should include science content knowledge, demonstrated knowledge of effective teaching practices, and depth of knowledge of science standards. Individuals who have participated in professional development in science will have a common base of experience. Recruitment will be enhanced by including a description of the training to be provided and the professional growth benefits of participation. Science subject matter knowledge is the most fundamental requirement for reviewers. Therefore, be sure to collect background information on all potential reviewers, including their college majors, previous experience, and summer internships, through an application process. To identify a pool of potential teacher reviewers, obtain information on participants in past professional development for science teachers. This may also be a useful exercise for identifying scientists and university faculty who could serve as reviewers. Community advisory groups and partnership activities may also yield potential reviewers, such as practicing scientists and engineers. By all means, try to identify those who have had experience working with school personnel. Consider requesting information from each potential reviewer on possible conflicts of interest and sources of bias, such as participation in professional development sponsored by publishers, past and present consultant agreements, or experience in publisher field tests. Reviewers need not necessarily be excluded because of these activities: Build the capacity of the reviewers. The success of your review and selection process depends on the depth of knowledge of the reviewers â€” of science subject matter, standards, and effective science teaching. Invest as much as possible in building this knowledge and experience. These professional growth opportunities need not be limited to the reviewers. Wider participation will not only build capacity to review new materials but, more broadly, to accept and implement them. Resources outside your immediate locale can help you build the necessary capacity. Various organizations provide leadership development opportunities, Page 48 Share Cite Suggested Citation: For example, Project offers extensive training in the review of instructional materials, which makes for excellent facilitator preparation even when not possible for all reviewers. National or state organizations may offer professional development on the Standards, Benchmarks, and state standards. Universities may offer seminars on how children learn and the efficacy of various assessment strategies. Partnership programs with local science and technology organizations can provide important information on current scientific knowledge and practices. If there is sufficient lead time at least six months , plan to have reviewers and others actually use materials in their classrooms. This is particularly valuable when innovative instructional strategies are represented in the materials or when the materials use new technology. Provide training and support for the use of the materials to help ensure that the pilot is a fair test of the quality of the instructional materials. Initially, pilot teachers will be strongly biased by their experiences â€” good or bad â€” with the new instructional materials. Sufficient time and frequent opportunities to discuss their experiences with others can moderate the effects of this bias on the review and selection processes. Constraints and Cautions If you are short on time, use the policy information and science program effectiveness data that you have on hand. Depend on existing and experienced advisory bodies and educators who are interested in science. Because short timelines are unlikely to produce much of a change from the status quo, consider seeking approval for a postponement of the deadline, if necessary. If you are short on money, give existing advisory boards preparation tasks or at least seek their help in finding resources. If policy will allow, consider confining the scope of the instructional material review to those areas identified as most in need of improvement. If you cannot recruit reviewers according to the criteria suggested here, plan to spend more time in training the reviewers. Sometimes members of the review and selection team are political appointees, a situation helpful in gaining eventual approval of the instructional materials recommended. Adequate training will be even more important in developing a common understanding of the task and a common background knowledge about science program goals, if the members of your team have an uneven knowledge about science education standards, effective instruction, and local policies. If the community lacks knowledge about your science program, consider Page 49 Share Cite Suggested Citation: If your community has contradictory ideas about the need for science program improvement, do not skimp on this initial step of preparation. A well-planned and well-executed review process ultimately can be annulled by lack of community support. Schedule frequent progress discussions with other administrators to obtain their advice and commitment as well. If you arrange for publisher representatives to make presentations to reviewers, try to provide a level playing field for large and small publishers. Give all presenters a common format to follow and forbid the offering or accepting of gifts which is usually prohibited by local policy anyway. Remember that reviewers can be inappropriately influenced by these presentations, even if they involve only an overview of the program and its components. Caution reviewers to look for evidence to support the claims made by the publishers. To save time and money, a common impulse is to narrow the field of materials to be reviewed by some kind of prescreening. Various scenarios were examined during the development of this guide, and each carries some risk of undermining a valid review process. The most promising current resources for prescreening are those reviews of science materials published by organizations that have made a large investment in developing both detailed review criteria and the reviewer expertise. The National Science Resources Center has produced two books of recommended instructional resources, one for elementary school science, and one for middle school science NSRC, , The criteria used are provided as appendixes in both books, with the full text available on the Internet See Chapter 5 "Resources for Training". Another source of middle school science review information is the Ohio Systemic Initiative Ohio Systemic Initiative, If there is community-wide agreement on the success of some elements of the current science program e. Only a careful review will reveal the degree to which the content of Page 50 Share Cite Suggested Citation: Do not reject too quickly instructional materials packages without certain accessories e. Instructional materials with a great deal to offer can be too easily discarded in this way. The most appropriate time to compare such support materials is during the subsequent selection process. Page 51 Share Cite Suggested Citation: The goals include developing an understanding of the purpose of the reviews, establishing a common understanding of the role of standards in the review, and fully defining the key terms and criteria to be used in the review. Mock reviews provide the necessary practice, allowing the process outlined in this guide to be adjusted to reflect local needs and values. The training of the reviewers can also serve to broaden the experiences and background knowledge of the participants, enabling them to envision science education as it could be in local schools, not only as it is. Reviewers should be exposed to recent research in science education content and pedagogy, as well as to outstanding science education programs elsewhere in the nation. The training process recommended here has been developed through iterative field-test processes. Although the elements have been carefully selected to be those critical for producing a successful review, the facilitator may need to adapt them to meet local needs. Sample agendas, examples, and resources are provided in Chapter 5 "Resources for Training. The purpose of the review process is improved student science achievement in the near future. The more detail reviewers can bring to their reviews, the more they will be able to make the best choice of instructional materials to meet local needs. In order to provide relevant detail, reviewers will need to develop a common understanding of their work.

7: Material selection - Wikipedia

The nature of the selection process Selecting the optimum combination of material and process cannot be performed at one certain stage in the history of a.

There are number of engineering design criteria and facts have to be considered when selecting a particular material for a certain design. Material selection is one of the foremost functions of effective engineering design as it determines the reliability of the design in terms of industrial and economical aspects. A great design may fail to be a profitable product if unable to find the most appropriate material combinations. So it is vital to know what the best materials for a particular design are. How we are going to get an idea about the best materials for a design? In this aspect engineers use several facts of materials to come to the most reasonable decision. They are mainly concentrated on the properties of the materials which are identified as the potential materials for that specific design. Mechanical properties When a certain design is going to be actually produced it must be subjected to a number of manufacturing practices depending on the material and the design process. At the completion of production it must be totally fit for the service phase, too. In order to predict the reliability of both of these requirements, the materials must be able to withstand a certain load. Therefore the material must possess a certain strength and stiffness. Selected materials are examined for strength and stiffness values, and then potential materials are further inspected for other desired properties. Material selection is one of the prime concerns in mechanical engineering design as mechanical engineers possess great deals with various loads and temperature variations. Material selections in engineering designs such as civil engineering structures also are very crucial. Wear of materials Wear is a problem when the materials are contacting each other in a product. So it must be ensured that the selected materials have sufficient wear resistance. One of the best examples for this is designing gears to cope with wear. There are many production techniques available to improve the wear resistance and make the material is more suitable for the application. This is also very important factor to consider when selecting a material for a particular design. In the engineering design process this has to be considered with great care. Corrosion The importance of material selection in engineering is clearly visible in corrosive environments. Also it is an important engineering design criterion for designs open to the environment for a longer period of time. Some materials are very likely to be corroded in the service depending on the service environment. Metals like iron are heavily prone to corrosion if it not prepared to resist corrosion. Therefore it must be assured that the material is capable of being employed for the particular design before selecting it. Painting or any other surface coating method, cathodic protection, etc. Ability to manufacture Although the material is well capable of using for the design, it may be difficult to manufacture. This is particularly applicable in mechanical engineering design. If this selection criteria is neglected the manufacture process might be very costly making it unprofitable as a commercial product. So before selecting the materials this fact also must be considered. These facts are widely varied with the type of manufacturing method. For an example, when producing a gear its dimensions must be very accurate. Otherwise the application may not provide the expected performance. To make the dimensions more accurate it has to be machined in the production. So the selected material must able to be machined with a minimum cost. Otherwise there is no point of selecting that material for that particular gear. Cost Cost is a critical fact to consider when selecting materials for a certain design for most products because they are facing a severe competition in the market. So you may see that most of the metal or other valuable materials are replaced by plastics in most of the designs which they are applicable such as mechanical engineering designs. The cost factor can be neglected when performance is given the top priority. When estimating costs, all the associated cost factors must be considered to get a more reasonable value. It may involve the transportation, processing, etc. These are the main facts to consider when selecting a material for a design , but there are a number of other factors which become essential depending on the particular product. In some occasions particular properties of the material may become the dominant factor over other properties. For example, electrical conductivity is vital for an electrical application so it must be given the priority. In mechanical engineering, designing for light weight is important for certain body parts of vehicles where aluminum is used instead of steel. An inability to meet the maximum operating temperature may be the reason to exclude the most profitable material for a certain high temperature design. Once a short list of materials is selected, the best possible candidate that gives the maximum performance with minimum cost must be determined. The end of material selection is not the end of the design process. The best material may be yet to come. Also it has to perform desired functions satisfactorily, not for just one or two days, but for a long period of time. In this tough test, the design may fail comprehensively. Therefore the designer has to consider the ways to improve the performance in all possible aspects. So the design process and the material selection is a continuous process unless the manufacturer has no intention to survive the ever-challenging market battleground.

8: Materials Science Assignment Help and Homework Help

Students, professors, and researchers in the Department of Materials Science and Engineering explore the relationships between structure and properties in all classes of materials including metals, ceramics, electronic materials, and biomaterials.

9: What is Materials | Drexel Engineering

Materials Science is the study of the construction, properties and uses of all kinds of materials that include ceramics, metals, glasses and polymers. The program draws on the fundamental sciences of physics and chemistry and on more applied areas such as metallurgy, ceramics and polymer science.

MATERIALS SCIENCE SELECTION OF MATERIALS pdf

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