Scientific Literacy:

Scientific and Technical Vocabularies in Media Coverage

Dominique Brossard*, Jim Shanahan, Joanna Radin and Bruce Lewenstein

Department of Communication, Cornell University

Paper Presented to the

6th International Conference on Public Communication of Science & Technology

CERN, Geneva (CH) 1-3 February, 2001

---

* To whom correspondence should be addressed: 336, Kennedy Hall, Department of Communication, Cornell University, e-mail: db36@cornell.edu. Brossard is a Ph.D. candidate, Jim Shanahan and Bruce Lewenstein are associate professors, and Joanna Radin is an undergraduate student in the department of Communication at Cornell University

Theme 1: The Contribution of Social Sciences – Focus on Impact

Workshop 1: Research and Practice in Science Journalism

Scientific Literacy: Scientific and Technical Vocabularies in Media Coverage

Scientific literacy is a topical issue. In western Europe as well as the United States, institutional actors have expressed concerns about the level of scientific knowledge of the general population (for a review and discussion on why public understanding of science matters, see Gregory & Miller, 1998; Laugsch, 2000). In the United States, the National Science Foundation, the National Academy of Sciences and various academic scholars have in particular pointed out that a scientifically literate population is needed for democratic processes to properly take place in a society that is more and more technologically demanding. But, if consensus exists on the need for civic scientific literacy, debate still exists on what constitutes it, and by extension on how to measure it. Numerous scholars have attempted to review the state of the debate, and to propose adequate conceptualizations (for a conceptual review of scientific literacy, see Miller, 1983; for more recent discussions, see DeBoer, 2000; Laugsch, 2000). Although debate on conceptualization is still active, a review of the research shows that a number of scholars tend to agree that "civic" scientific literacy is a multidimensional construct that includes 1) a vocabulary of basic scientific constructs dimension, and 2) a scientific process dimension (a third dimension, focusing on the social impact of science, has generated less consensus) (Miller, 1998).

The goal of the present paper is to propose a completely different approach to the conceptualization and measure of a specific dimension of scientific literacy: the understanding of scientific and technical terms, or the mastery of scientific and technical vocabulary. After briefly reviewing how this dimension has been conceptualized and measured in the past, we will present a new conceptualization and a proposed measurement instrument. As we will explain, the novel aspect of our research is that instead of focusing on what people *should* know, normatively, in terms of science and technology vocabulary (based on an ideal knowledge defined by experts), we focus on what people *can be expected* to know in the United States, on the basis of the collective social decision making of the media, to reveal which scientific constructs are important.

The Scientific and Technological Vocabulary Dimension

As we have noted earlier, scientific literacy, and by extension the vocabulary dimension, has been conceptualized and measured in a number of ways. Laugksch (2000) has noted that approaches have varied among the three main interest groups involved in scientific literacy: sociologists of science or scientific educators using a sociological approach to scientific literacy (e.g. Wynne. 1991); social scientists and public opinion researchers (e.g. National Science Board surveys); and mainstream science educators. We will focus in this section on social science and public opinion research on adult scientific literacy. (We do not dispute the validity of the sociological approach that relies on small-scale, context specific, qualitative studies. However, the method that we develop in this study fits more squarely within the public opinion research realm).

Public opinion and social science research on knowledge of scientific vocabulary use standardized questions and survey methodology to assess respondents' understanding of scientific constructs. These literacy measures have focused on how well people can report and reproduce knowledge in specific areas defined by experts (experts specifying a few dimensions along which people are expected to be knowledgeable). To the degree to which respondents’ knowledge matches that which the experts think they should have, they are deemed scientifically literate. But what constitutes this knowledge experts think the general public should master? The benchmarks for scientific literacy proposed by the American Association for the Advancement of Science (AAAS, 1989, 1993) are often put forward as representative of this ideal knowledge.

Miller (1998, p. 208) argued that "the range of constructs developed by project 2061 provides a useful approximation of the range of substantive concepts that might constitute the universe of relevant constructs [for scientific construct understanding]."[1] Noting however that for obvious reasons a survey cannot include a lengthy list of items, Miller and his collaborators identified in the late 1980s "a set of basic scientific constructs, such as atomic structure or DNA, that are the intellectual foundation for reading and understanding contemporary issues but which will have a longer durability than specific terms." (Miller, 1998, p. 205). The original set of knowledge constructs was refined later on (Miller, 1998). Laugsch and Spargo (1996) have pointed out that Miller's framework has served as the basis of almost all recent surveys in scientific literacy. Test of knowledge of the core set of constructs has been included in the biennial U.S National Science Board Science and Engineering Indicators surveys since the late 1980s (National Science Board 1989; 1991, 1993; 1996, 1999) and was used in a number of other countries as well (Miller, 1996, cited in Miller, 1998). Such surveys used open-ended questions, True/false format items, and multiple choice items to assess scientific construct understanding (Miller, 1998). The more recent Science and Engineering Indicators study included 20 items pertaining to construct understanding (NSF, 2001). Although Miller (1998) pointed out that potentially more than 100 constructs developed in Project 2061 could be included in a construct understanding measurement instrument, he does not specify how the 20 final items were selected. We can assume with reasonable confidence that their selection was left to experts' discretion.

Extending Miller's work in the science education realm, Laugksch and Spargo (1996) have used AAAS' "Science for All Americans" more methodologically as a basis for the development of 472 true-false test-items measuring different dimensions of scientific literacy, among them the vocabulary dimension. These items were validated by panels of experts that included Fellows of the Royal Society of South Africa and university lecturers. Here again, experts were used to define the ideal knowledge the population was supposed to achieve, and choices had to be made in order to define which items would be included in a questionnaire, which obviously couldn't cover 472 items.

---

[1] Miller;s conceptualization of scientific literacy includes scientific construct understanding and scientific process understanding.

The assessment of public knowledge of scientific vocabulary has been included in a number of studies of public scientific literacy. We noted that such measures relied on an "ideal" knowledge for the definition of the terms people should be expected to know, subjectivity remaining in the selection of the limited number of terms that would be included in the questionnaire. When experts decide what the appropriate vocabulary to test is, there is the possibility that biases and prejudices of the scientific community can influence the overall definition of literacy. One of the interesting problems in the vocabulary research is therefore how to select a limited number of terms people should be expected to know. A novel way to approach the issue is to think not about what citizens *should ideally* know, but what they do know relative to what they *can be expected* to know.

Mass media are the main source of scientific information for the general public (Friedman, Dunwoody & rogers, 1986; Nelkin, 1987). Mass media are also very often seen a substitute "symbolic site" for a public debate activity (Gumpert & Drucker, 1994). If citizens know scientific and technological terms they see frequently in the media, we could argue that they are scientifically literate within the bounds of normal civic discourse. If, on the other hand, people do not show familiarity even with terms that are frequently covered in the media, their literacy can be termed low. The method for selecting terms for a literacy test that is reported in the present study therefore relies on an analysis of media coverage to determine which terms are the ones that citizens would be exposed to frequently, terms that will constitute a “civic literate” scientific vocabulary.

Media as a Source for Individual Scientific Knowledge

Koelsche (1965) developed an approach to define what people needed to know about science based on extracting terms from the mass media. He simply gathered terms from a series of subscriptions taken to a variety of magazines, both technical and general. He used these terms merely to show what a scientifically literate person might be expected to understand.

… scientific literacy is a level of science education achieved by people when their backgrounds in science are such that they can understand, interpret, and interrelate scientific phenomena with facility, and form relevant and independent conclusions from information acquired through the mass media of communication. (p. 723)Because most people receive scientific information through general mass media, it makes little sense to test whether people understand concepts that are not discussed frequently in such media. Of course, there are other sources that people might tap, including science education, interpersonal discussion, and specialized media. But the bulk of people will assess science concepts through exposure to mass media.

Given these assumptions, and following Koelsche’s definition, we decided to develop a scientific vocabulary instrument by using terms that appear frequently in the mass media. Our first step was to go to a standard source for scientific terminology. We chose the Oxford *Dictionary of Science* (1999); though there are many other sources, this presented a manageable initial list of about 9000 terms while comprehensively covering biology (including human biology), chemistry, physics, the earth sciences and astronomy. We decided to leave strictly mathematical terms and concepts out of our analysis.

We used a systematic sampling method based on a random series of 10 numbers to select a term from every page of the dictionary. This yielded a list of 896 terms.

With this overall list, we counted the number of articles in which each term appeared in the total available Lexis-Nexis database (for the remainder of this paper, we will call the number of articles in which each term appears the "level of appearance" of a term). Using the “general news” category, we were able to assess how much each term appeared in the total corpus of major newspapers. After eliminating ambiguous or broad terms, we selected the top 10% of these terms as the most frequently mentioned scientific terms from our sample. Of course, our sampling procedure missed many important concepts; the goal was to create randomly a list of terms with significant media presence. Rather than relying on the subjective decisions of scientific experts to obtain our terms, we relied on the collective social decision making of the media, it sources, and its audiences to reveal which terms were important. We excluded from the list terms that might be used in contexts other than scientific (i.e. these were usually terms with significant ambiguities such as Euclid, which could refer both to the geometer or to a location in Ohio), obtaining a final total number of 72 terms. In order to have a comparable view of the level of appearance of each of these terms in the media, we calculated the appearance of each term for an average randomly constructed week between 1985 and 2000 (1985 was chosen since most of the general newspapers available through Lexix-Nexis do not have online access for issues prior to 1985). Using a randomly constructed week would limit the impact a particularly important event could have on the level of appearance of a term.

The resulting list of vocabulary terms sorted by descending corresponding appearance level is presented in Table 1 in Appendix 1. Figure 1 next pageshows the overall distribution of the terms, and the level of appearance of selected terms.

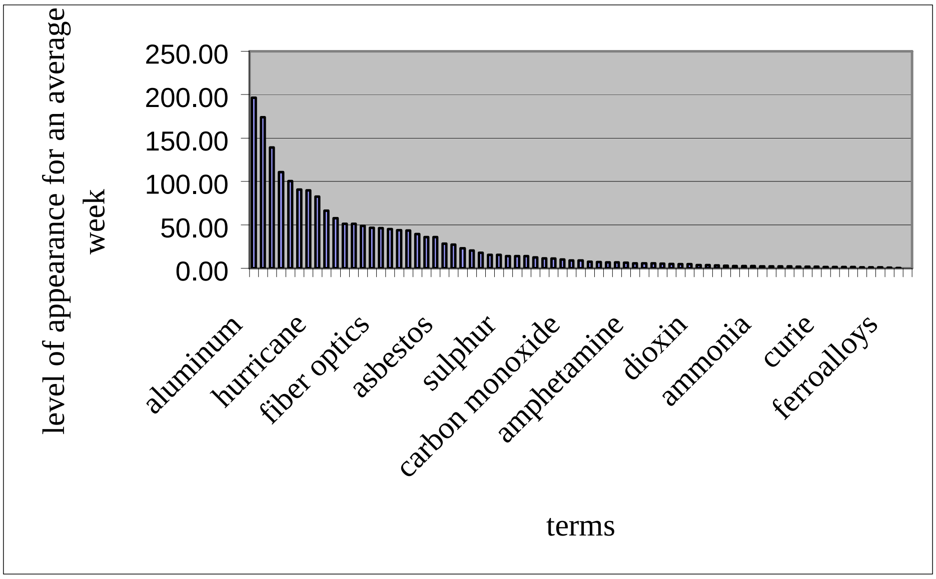

Figure 1: Level of Appearance of Top 10% Most Frequently Used Scientific Terms in an Average Constructed Week

Figure 1 represents a classic type of word frequency distribution; it follows Zipf's law of word frequency distribution, as any distribution would. The reader should keep in mind that even the terms in the above figure that appear less often were however among the 10% most cited scientific terms in the general news category in the Lexis-Nexis database, for all the available dates. For example, the term "ammonia" (which was used in 2.29 articles during the constructed week), was used in 418 articles in the past 2 years, compared with the term “oleic acid” that we discarded, that was used in only 21 articles for a period over 15 years.

The next step was to develop an instrument for the measure of public knowledge of the terms included in the vocabulary list that we had created through an analysis of general printed media.

We decided to choose a "fill in the blank" format for the following reasons. First, although open-ended questions have been shown to provide a better measure of understanding that close-ended questions (Miller, 1998), the complexity of certain of our terms rendered difficult the use of such format. "Fill in the blank" items seemed like a good compromise. Second, the use of such format would eliminate correct responses due to chance.

The wording of the items was based on the Oxford *Dictionary of Science* (1999). We are aware that such a procedure could be criticized for falling within a "deficit model" (Irwin & Wynne, 1996) that assumes that scientists' knowledge is "better" than common sense or lay knowledge. However, since we needed agreed-upon definitions that could be systematically be used for all the terms, we did use experts' definitions as the framework for the correct responses. Further studies might look for ways to assess understanding of the terms outside of the conventionally accepted dictionary definitions. Two examples of items are listed below:

- The large body embedded in the cytoplasm of all plant and animal cells (but not bacterial cells) that contains the genetic material DNA and functions as the control center of the cell is called the ___(nucleus)__.

.

- ___(Genetic Engineering)__ is the technique involved in altering the characters of an organism by inserting genes from another organism into its DNA.

The 72 items that used the same format as above (with slight differences between items in terms of length of the items and type of information provided) were randomly ordered in the instrument (see Appendix 2 for the complete instrument).

The final step of our study was the pilot test of the instrument. The goals of the pilot test were to test individual items to identify potential problems; to perform basic statistical analysis to test our model (testing whether media use is positively correlated to knowledge, and whether knowledge is higher for items with higher level of appearance in the media); to assess reliability; and to discuss wording and formatting issues with the respondents. We also wanted to compare scores obtained with our instrument to scores obtained with other vocabulary measures. Since we were testing a relatively large number of items, we did not want to include a long measure. We therefore chose to use the 9 items included in the Index of Scientific Construct Understanding used for the 1999 Science and Engineering Indicators (NSF, 2001). The index includes 3 true/false items; 3 short-answer items; and 3 open-ended questions.

Sixty undergraduate students of a Communication class at a large Northeastern University were asked to complete the questionnaire. Unfortunately, results of the pilot test were not available at the time this paper was written.

Conclusion

The purpose of this study was to use a novel approach for the conceptualization and measurement of a specific dimension of scientific literacy: the knowledge of scientific and technical vocabulary. Our conceptualization of this dimension was based on an analysis of media use of randomly selected scientific and technical terms of a scientific dictionary. We argue that the 72 terms most often used in the media that were obtained with our method represents what an individual is expected to know within the bounds of normal civic discourse. The vocabulary list that was obtained therefore represents a conceptualization of a "civic literate" scientific vocabulary that avoids the possible biases that could be associated with a selection of terms based solely on experts' views. Of course, our method has limitations. First, with scientific knowledge rapidly evolving, new terms may appear in the media, or the level of appearance of certain terms may completely change. This shouldn't however impact the durability of our measure. We could imagine that the instrument be updated every year, longitudinal studies using only a media scientific literacy total score as level of comparison. The overall conceptualization relying on the concept of media scientific literacy would imply that knowledge of individual items themselves are of little interest. Second, it could be argued that media is not the only source of scientific information. However, even if it is the case for a small fraction of the population, media still represents the space where public debate takes place, and therefore the measure still makes total sense. Future research should explore the potential of our measure, by using the instrument with a large sample of the general population. We will more particularly test whether media use is positively correlated to knowledge, and whether knowledge is higher for items with higher level of appearance.

Appendix 1

Table 1: 10% Most Frequently Used Scientific and Technical Terms, and Level of Appearance for an Average Constructed Week.

Terms	Average Week	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
aluminum	196.57	1000	93	39	83	15	67	79
petroleum	173.86	301	213	91	145	108	197	162
satellite	139.14	204	162	114	227	52	86	129
moon	110.86	123	144	133	144	33	82	117
solar energy	100.57	33	654	0	6	5	4	2
temperature	90.57	96	93	122	109	44	80	90
nuclear weapons	89.57	70	60	39	115	168	57	118
hurricane	82.43	77	197	61	82	6	76	78
lightning	66.29	17	158	124	55	10	45	55
infection	57.57	67	62	78	75	15	58	48
earthquake	51.29	39	58	40	66	15	33	108
electronic mail	51.29	96	24	9	207	2	9	12
watt	48.71	53	43	37	57	28	59	64
nova	46.71	55	55	44	59	16	42	56
fiber optics	46.14	107	39	17	80	8	25	47
bacteria	45.14	135	35	30	50	11	26	29
genetic engineering	43.71	112	19	6	143	11	6	9
World Wide Web	43.57	34	123	83	55	0	0	10
protein	39.29	62	46	19	51	6	16	75
gill	36.00	46	40	27	39	15	39	46
microprocessor	35.86	49	43	20	25	12	31	71
asbestos	28.43	26	29	20	23	13	51	37
x-rays	27.29	21	31	22	26	6	44	41
compact disk	23.00	18	37	19	18	8	26	35
gram	20.57	28	24	19	22	3	19	29
vaccination	17.86	21	14	5	19	5	32	29
flora	15.57	15	18	12	33	6	13	12
beetles	15.29	22	29	17	21	4	10	4
sulphur	14.14	13	32	8	19	5	9	13
irrigation	13.86	19	20	10	31	4	7	6
tornado	13.86	16	9	12	26	2	13	19
mirage	12.57	13	12	11	15	9	14	14
LSD	11.43	2	17	9	12	4	10	26
atomic energy	11.00	3	11	4	18	12	12	17
virtual reality	10.00	27	8	11	3	0	1	20
carbon monoxide	8.86	1	19	9	7	0	8	18
nuclear fuel	8.86	8	9	12	9	11	9	4
turbine	7.57	12	11	3	12	1	8	6
aspirin	7.29	6	9	11	10	2	4	9
embryo	6.86	16	4	11	4	2	3	8

Table 1: 10% Most Frequently Used Scientific and Technical Terms, and Level of Appearance for an Average Constructed Week (Continued).

Terms	**Average Week**	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**
food poisoning	6.71	2	1	13	14	4	5	8
binoculars	6.29	12	5	6	5	4	7	5
amphetamine	5.71	2	14	3	3	1	4	13
methane	5.71	6	3	2	5	3	19	2
kerosine	5.57	6	7	7	5	0	9	5
chromosome	5.29	5	6	2	4	3	3	14
nitrogen	4.86	0	7	5	2	3	12	5
fauna	4.57	5	4	4	8	0	7	4
ozone layer	4.57	0	10	3	2	3	10	4
dioxin	3.71	3	2	1	3	5	3	9
nucleus	3.71	4	5	5	4	1	5	2
sulphuric acid	3.14	11	1	0	0	1	0	9
greenhouse effect	3.00	4	3	5	1	0	3	5
timbre	2.57	0	3	3	8	0	1	3
birth rate	2.43	2	5	2	2	0	4	2
cornea	2.43	4	1	2	4	1	2	3
ammonia	2.29	5	0	3	2	1	4	1
chemical engineering	2.29	2	1	4	4	1	1	3
radioactivity	2.00	1	1	1	1	3	6	1
Rh	1.86	5	4	0	4	0	0	0
tuber	1.71	4	1	0	3	1	1	2
uterus	1.71	1	0	2	0	0	1	8
curie	1.57	4	0	2	1	1	2	1
microbiology	1.57	1	1	1	5	1	2	0
earth sciences	1.43	2	1	3	1	0	2	1
silicon chip	1.43	3	1	0	4	0	0	2
molecular biology	1.14	2	1	1	2	0	0	2
Teflon	1.14	1	0	5	0	1	0	1
isotope	1.00	2	1	1	1	1	0	1
ferroalloys	0.86	0	2	1	0	0	0	3
hydrogen bomb	0.29	0	1	0	0	0	0	1
fructose	0.00	0	0	0	0	0	0	0

Appendix 2: A Science and Technology Questionnaire

A. Please complete the following statements to the best of your knowledge, with one or two words.

We expect that you will have trouble with many of the statements. If you do not know the answer, just write “don’t know.”

1. When atoms of the same element have the same number of protons in their nucleus but different numbers of neutrons, it is called an __(isotope)______.

2. A star that over a period of only a few days becomes 100 – 1000 times brighter than it once was, is called a __(nova)________.

3. The study of the structure and function of large molecules associated with living organisms, in particular proteins and the nucleic acids DNA and RNA, is called
__(molecular biology)________.

4. ___(Genetic Engineering)___________ is the technique involved in altering the characters of an organism by inserting genes from another organism into its DNA.

5. The device that is the central processing unit of most smaller, personal computers is also called a ___(microprocessor)________

6. A 120 mm disk on which there is a digital recording of audio information, providing high quality recording and reproduction of music, speech, etc., is called a ____(compact disk)_______.

7. The spontaneous disintegration of certain atomic nuclei, accompanied by the emission of alpha particles, beta particles, or gamma radiation is called __(radioactivity)______.

8. ____(Sulphuric Acid)____________ is a colorless, oily liquid, also called “oil of vitriol.” It is extensively used in industry, the main applications being fertilizers, chemicals, paints and pigments, detergents and fibers.

9. __(Fructose)__________ is a simple sugar that occurs in green plants, fruits and honey, and tastes sweeter than sucrose, of which it is a constituent.

10. ________(Nuclear fuel)___ is a substance that will sustain a fission chain reaction so that it can be used as a source of nuclear energy.

11. __(LSD)__________ is a chemical derivative of lysergic acid that has potent hallucinogenic properties.

12. An optical phenomenon that occurs as a result of the bending of light rays through layers of air having very large temperature gradients is called a _(mirage)______.

13. A machine in which a fluid is used to produce rotational motion is called a __(turbine)___________. The most widely used ones use water or steam.

14. A ____(Gill)_____________ is the respiratory organ used by aquatic animals to obtain oxygen from the surrounding water.

15. ___(Microbiology)______________ is the scientific study of microorganisms.

16. The large body embedded in the cytoplasm of all plant and animal cells (but not bacterial cells) that contains the genetic material DNA and functions as the control center of the cell is called the ___(nucleus)____________.

17. __(Carbon monoxide)______ is a colorless, odorless gas that is flammable and highly toxic. It is formed by the incomplete combustion of carbon and is present in car-exhaust gases.

18. All the animal life normally present in a given habitat at a given time constitutes the _____(Fauna)___________.

19. The layer of the earth's atmosphere that absorbs most of the solar ultraviolet radiation, protecting living organisms on earth, is the ___(ozone layer)__.

20. The energy obtained as a result of nuclear fission or nuclear fusion is called __(atomic energy)_______.

21. ___(Aluminium)____________ is a silvery-white lustrous metallic element which is highly reactive, lightweight, strong (when alloyed), corrosive, resistant, and electrically conductive. These features make it suitable for a variety of uses, including vehicle and aircraft construction, building and overhead power cables.

22. _____(Fiberoptic)__________ systems use threads that conduct light to transmit information in the form of coded pulses or fragmented images, from a source to a receiver.

23. A ___(chromosome)________________ is a threadlike structure, several to many of which are found in the nucleus of plant and animal cells. It is composed of chromatin and carries genes in a linear sequence.

24. The quality of sound., and the quality a musical note has as a result of the presence of harmonics, is the ___(timbre)________________.

25. The diverse group of ubiquitous microorganisms all of which consist of a single cell which lacks a distinct nuclear membrane and has a cell wall of a unique composition is referred to as _______(bacteria)______________.

26. ___(Ammonia)___________ is a colorless gas with a strong pungent odor that is very soluble in water and soluble in alcohol.

27. The invasion of any living organism by disease-causing microorganisms which proceed to establish themselves, multiply and produce various symptoms in their host is called an __(Infection)_________________.

28. The provision of water for crops by artificial methods; for example by constructing pipe systems, ditches, and canals is called ___(irrigation)_____________.

29. Either of the two instants at which the center of the sun appears to cross the celestial equator is the _____(equinox)______________.

30. ____(Nitrogen)_____________is a colorless, gaseous element that occurs in the air and is an essential constituent of proteins and nucleic acids in living organisms.

31. The group of sciences that is concerned with the study of the earth is called __(Earth Sciences)__. The chief sciences in that group are geology, geography, oceanography, meteorology, geophysics and geochemistry.

32. A ___(hydrogen bomb)___ is a nuclear weapon that relies on a nuclear-fusion reaction.

33. This is a colorless, odorless gas. It is the simplest hydrocarbon and a main constituent of natural gas and as such is an important raw material for producing other organic compounds. It is called __(methane)____________.

34. A sudden movement or fracturing within the earth's lithosphere causing a series of shocks is called a(n) ___(earthquake)____________. It can range from a mild tremor to a large scale earth movement, causing extensive damage over a wide area.

35. A tropical cyclone with surface wind speeds in excess of 64 knots that occurs in the North Atlantic Ocean, Caribbean Sea, or the Gulf of Mexico is a(n) __(hurricane)_____________.

36. This is a fibrous mineral with widespread commercial use because of its resistance to heat, chemical interness and high electrical resistance. The fibers may be spun and woven into fireproof cloth for use in protective clothing and curtains or molded into blocks. In the 1970's it was discovered that the short fiber form of this mineral can cause serious lung disorders which has in turn limited its use. This mineral is ____(asbestos)___________.

37. The earth's only natural satellite is the _____(moon)_________.

38. An acute illness caused by food that may be naturally poisonous or contaminated by certain types of pathogenic microorganisms is called ___(food poisoning)_________.

39. All the plant life present in a given habitat at a given time constitutes the ___(flora)_______ of that habitat.

40. ____(Proteins)_________are any of a large group of organic compounds found in all living organisms. They comprise carbon, hydrogen, oxygen, and nitrogen, and most also contain sulphur. Their molecules consist of one or several long chains of amino acids linked in a characteristic sequence.

41. Weapons in which an explosion is caused by nuclear fission, nuclear fusion or a combination of both are called __(nuclear weapons)___.

42. _____(Rh)________ is an antigen whose presence or absence on the surface of red blood cells forms the basis of the rhesus blood group system.

43. A(n) _____(Amphetamine)____________ is a drug that stimulates the central nervous system by causing the release of the transmitters noradrenaline and dopamine from nerve endings. It inhibits sleep, suppresses the appetite, and has variable effects on mood. Prolonged use can lead to addiction.

44. _____(Aspirin)____________ is a drug that reduces inflammation, combats fever, and alleviates pain. It is also used to maintain blood flow following heart and respiratory disorders.

45. Alloys of iron with other elements made by smelting mixtures of iron ore and the metal ore are _(ferroalloys)______. They are used in making alloy steels.

46. Any optical instrument designed to serve both the observer's eyes at once is called _____(binoculars)______________.

47. A violently rotating column of air, usually made visible by a funnel cloud, which may reach the ground surface., is called a ____(tornado)____________.

48. __(Lightning)______________ is a high-energy luminous electrical discharge that passes between a charged cloud and a point on the surface of the earth, between two charged clouds, or between oppositely charged layers of the same cloud.

49. An animal in the earliest stages of development, from the time when the fertilized ovum starts to divide while it is contained in the egg or reproductive organs of the mother, until hatching or birth is an ______(embryo)______________.

50. ___(Birth rate)__ is the rate at which a particular species or population produces offspring. It is an important factor in controlling the size of a population

51. The yellow non-metallic element, whose symbol on the periodic table of elements is S, is __(Sulphur)____________.

52. The study of the design, manufacture, and operation of plant and machinery in industrial chemical processes is called ______(chemical engineering)_________.

53. A __(tuber)__ is a swollen underground stem or root in certain plants. It enables the plant to survive the winter or a dry season and is also a means of propagation. In some plants, these structures are edible.

54. The SI unit of power, defined as a power of one joule per second is the __(watt)___, widely used in electrical contexts. What is SI??

55. The transparent layer of tissue that forms the front part of the vertebrate eye over the iris and the lens is called the ___(cornea)_________.

56. ___(Dioxin)_________ is a toxic solid, formed in the manufacture of the herbicide 2,4,5-T and present as an impurity in Agent Orange. It can cause skin disfigurement and severe fetal defects.

57. The __(WWW)__ is a computer based information service. It is a hypermedia system distributed over a large number of computer sites that allows users to view and retrieve information from documents containing links.

58. Individuals use ______(electronic mail)______________ to send messages, documents, etc., between computer systems.

59. One thousandth of a kilogram. is a ______(gram)____.

60. __________(greenhouse effect)___________ is an effect occurring in the atmosphere because of the presence of certain gases that absorb infrared radiation. The effect is that the temperature of the earth is higher than what it would otherwise be without the atmospheric absorption.

61. A(n) __(Curie)______ is a formerly used name for a unit of radioactivity, named after a famous French woman who discovered radioactivity.

62. _ (Kerosine) __ is a mixture of hydrocarbons having 11 or 12 carbon atoms. It is a fuel used for jet aircraft and most commonly for oil-fired domestic heating.

63. __(Petroleum)___ is a naturally occurring oil that consists chiefly of hydrocarbons. In it's unrefined form it is known as crude oil.

64. ____(X-Rays)__ are electromagnetic radiations of shorter wavelength. They are used medically and industrially to examine internal structures.

65. A relatively small natural body that orbits a planet or a man-made spacecraft that orbits the earth, sun, moon or a planet is called a(n) ___(satellite)___

66. The organ of female mammals in which the embryo develops is the __(uterus)__.

67. The electromagnetic energy radiated from the sun is called __(solar energy)___

68. A thermosetting plastic with a high softening point that has "anti-stick" properties It is used for coating cooking utensils and nonlubricated bearings. It is called __(teflon)__

69. The property of a body or region of space that determines whether or not there will be a net flow of heat into it or out of it from a neighboring body or region and in which direction the heat will flow is called the __(temperature)__

70. The production of immunity in an individual by artificial means is called __(vaccination)_.

71. A single crystal of a semi-conducting silicon material, typically having millimeter dimensions, fabricated in such a way that it can perform a large number of independent electronic functions, is a __(silicon chip)___.

72. A form of computer simulation in which the user has the impression of being in an artificial environment is referred to as ___(virtual reality)__. Typically the used wears a visor into which are built two small screens, one for each eye – giving a 3-D view of a computer generated environment.

References

A dictionary of science. (1999). Oxford: Oxford University Press.

American Association for the Advancement of Science (1989). Science for all Americans. A project 2061 report on literacy goals in science, mathematics, and technology. Washington: AAAS.

American Association for the Advancement of Science, Project 2061 (1993). Benchmarks for Science Literacy. New York: Oxford University Press.

DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. Journal of Research in Science Teaching, 37(6), 582-601.

Friedman, S. M., Dunwoody, S., & Rogers, C. L. (1986). *Scientists and journalists: reporting science as news*. New York: The Free Press.

Gregory, J., & Miller, S. (1998) Science in public: Communication, culture, and credibility. Cambridge, MA: Perseus.

Gumpert, G. & Drucker, S. (1994). Public space and urban life: Challenges in the communication landscape. Journal of Communication, 44(4), 169-177.

Irwin, A. & Wynne, B. (1996). Misunderstanding science? The public reconstruction of science and technology. Cambridge, U.K: Cambridge University Press.

Koelsche, C. L. (1965). Scientific literacy as related to the media of mass communication. School Science and Mathematics, 65(8), 719-725.

Laugksch, R. C. (2000). Scientific literacy: a conceptual overview. Science Education, 84, 71-94.

Laugksch, R. C., & Spargo, P. E. (1996). Development of a pool of scientific literacy test-items based on selected AAAS literacy goals.

Miller, J.D. (1983). Scientific literacy: A conceptual and empirical review. Daedalus, 112(2), 29-48.

Miller, J. D. (1996). Public understanding of science and technology in OECD countries: A comparative analysis. Paper presented to the OECD Symposium on the Public Understanding of Science and Technology, Tokyo, Japan, November 1996.

Miller, J. D. (1998). The measurement of civic scientific. Public Understanding of Science, 7, 203-223.

National Science Board (1989). Public science literacy and attitudes toward science and technology. In Science and engineering indicators—1989. Washington DC: U.S. Government Printing Office, 161-176.

National Science Board (1991). Attitudes toward science and technology: the United States and international comparisons. In Science and Engineering Indicators—1991. Washington DC: U.S. Government Printing Office, 165-190.

National Science Board (1993). Science and technology: public attitudes and public understanding. In Science and Engineering Indicators—1993. Washington DC: U.S. Government Printing Office, 193-214.

National Science Board (1996). Science and technology: public attitudes and public understanding. In Science and Engineering Indicators—1996. Washington DC: U.S. Government Printing Office, 7.1-7.21.

National Science Foundation (2001). Science and engineering indicators - Chapter 8: Science and Technology: Public attitudes and public understanding. [Online]. Available: http://www.nsf.gov/sbe/srs/seind00/access/c8/c8s1.htm

Wynne, B. (1991). Knowledges in context. Science , Technology, & Human Values, 16(1), 111-121.