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ABSTRACT

The purpose of this study was to determine if a Web site evaluation tool can be developed based on the standards articulated by Association of College and Research Libraries and Project 2061 that could effectively assess science education Web sites. The study took place at Kent Roosevelt High School in ninth grade biology classes. Students were given a lesson on science Web site evaluation, shown an example of a science Web site, and asked to evaluate a science Web site. Two of the classes evaluated a Web site that exemplified information and science literacy, while the other two classes evaluated a Web site that did not. The Alpha (Cronbach) reliability scores indicated that the evaluation tool did provide a moderately accurate measurement of content, authority, and scientific standards. T-test results indicated that the evaluation tool is useful at evaluating the content of a science Web site; however, it is unclear at this time if the evaluation tool was an accurate measure of authority, appearance and navigability, or scientific standards because the results could have been because of chance. Appendices include an example of a Web site that does not support information and science literacy, the science Web site evaluation tool, a printout of "Becky's Science Resource Center" Web pages, and a printout of Web pages from the Genetic Science Learning Center with information and activities dealing with the subject of genes. (Contains 22 references.) (AEF)

Science and Information Literacy on the Internet: Using the Standards Created by the Association of College and Research Libraries and Project 2061 to Create a Science Webpage Evaluation Tool.

A Master's Research Paper submitted to the Kent State University School of Library and Information Science in partial fulfillment of the requirements for the degree Master of Library and Information Science.

By

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Chapter 1: Introduction/Problem Statement

Rationale/Need for Study

The Internet is quickly becoming one of the most important teaching tools found in the classroom today. Shrock (1998/1999) notes that about 75% of all K-12 schools have Internet access. The Office of Educational Research and Improvement (1999) reports that between the Fall of 1994 and Fall of 1998, Internet access in public schools increased from 35% to 89%. Public school instructional rooms with Internet access also increased during this time period from three percent in 1994 to 51% in 1998. As a result of this widespread accessibility, students are becoming increasingly dependent on the resources available on the Internet to complete assignments. With the rapid proliferation of information available on the Internet, the increased reliance of teachers who employ the web as a teaching tool, and the elevated amount of students who use the web to complete assignments an important question arises: are students equipped with the necessary tools to evaluate the good from the bad on the Internet?

In response to this question educators and school librarians have devised a set of standards that students need to posses to be considered information literate. According to the Final Report of the American Library Association Presidential Committee on Information Literacy (1989), information literacy is a set of skills that enable one "to recognize when information is needed and have the ability to locate, evaluate, and use it effectively." The Association of College and Research Libraries (2000) maintains that information literacy is the foundation of lifelong learning and enables learners to "master content and extend their investigations, become more self-directed, and assume greater control of their own learning."

ACRL also contends that the information literate individual is able to do the following: “determine the extent of information needed; access the needed information effectively and efficiently; evaluate information and its sources critically; incorporate selected information into one's knowledge base; use information effectively to accomplish a specific purpose; understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally."

ACRL has identified standards so that educators and librarians can pinpoint the level of information literacy of students. Each of the five standards is comprised of performance indicators and outcomes that can be used by educators and librarians for assessing the progress students make towards information literacy. Schools across the country are implementing programs based on these standards, performance indicators, and outcomes to ensure that all students are information literate in the future.

While the standards for information literacy are valuable, they fail to address the specific needs of science literacy. Science literacy has been defined in a variety of ways. Some define it as having knowledge of "basic facts" that one would need in order to be scientifically literate (Raymo 1998, Trefil 1996). Others such as Hurd (1998) feel that science literacy is based on "behaviors that serve as guidelines for interpreting the functions of science/technology." Sapp (1992) suggests that science literacy is "successful information seeking behavior."

Project 2061, a project sponsored by the American Association for the Advancement of Science, consists of a panel of scientists, mathematicians, and technologists who are committed to a long-term effort to reform mathematics and science education. In *Science for All Americans,* which articulates the ideas endorsed by Project 2062, Rutherford and Ahlgren (1990), define a science literate person as "one who is aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understand key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific thinking for individual and social purposes.".

The thinking skills that science, mathematics, and technology students must learn are essential tools for learning and participation in society. These skills, they assert, can be thought of as habits of mind because they all influence an individual's outlook on knowledge, learning, thinking, and behavior. These habits of mind have been broken down into two categories: values and skills. Within the values category, four specific areas are addressed: the values inherent to science, mathematics, and technology; the social value of science and technology; the reinforcement of general social values; and people's attitudes towards their own ability to understand science and mathematics. The skills category addresses the proficiency related to computation and estimation, to manipulation and observation, to communication, and to critical response arguments.

Welborn and Kanar (2000) in their discussion of how to build websites for science literacy suggest that there is a strong connection between information literacy and science literacy. They have developed the concept of science information literacy based on the writing of Shapiro and Hughes (1996) who contend that information literacy, in addition to having the skills to access information, is the ability to participate in "critical reflection on the nature of information itself, and its social, cultural, and even philosophical context and impact." Welborn and Kanar use the previous definition to define science information literacy, but emphasize "the ability to access the information of a scientific nature and to analyze it critically."

Because the number of students who rely on the Internet to complete assignments is so great, it is imperative to ascertain if they have the ability to distinguish the differences between websites that support the goals of information and science literacy and those that do not. Therefore, an evaluation tool must be developed based on the standards and habits of mind created by ACRL and the American Association for the Advancement of Science that enable students to evaluate science-related websites. If the evaluation tool can effectively measure the quality of a website, then it will also allow researchers to measure the quality of the information on the Internet and be able to see if current science-related web sites are supporting the goals of information and science literacy.

Purpose of the Study

The purpose of this study is to determine if a web site evaluation tool can be developed based on the standards articulated by ACRL and Science for All Americans which can effectively be used by students to asses science education websites.

Definition of Terms

Science Educators: Any teacher who teaches Biology, Chemistry, Math, or Physics to students in grades 7-9.

Science Related Site: A web site used for educational purposes by students in grades 7-9 in the science disciplines mentioned above.

Evaluation Tool: An instrument used to assess the quality of a web site.

Limitations

This study only reflects those web pages evaluated by the classes tested for this study and the evaluation tool can only be applied to science-related web sites. In addition, this study only reflects the definitions of information and science literacy established by Project 2061 and ACRL. The evaluation tool addresses only of the standards created by these organizations.

Chapter 2: Review of the Literature

After a comprehensive search of literature available in print and online, it is evident that there is very little literature available on the specific subject of science educational website evaluation. However there is no shortage of general tools, that are not specific to any subject discipline, for web site evaluation developed by educators. It is important to note that none of the following evaluation tools indicate that they are based on any standards at the state or national level.

There have been many evaluation tools that have been developed for elementary and secondary educational purposes. Shrock (1998/1999) writes about specific criteria for educators to look for when looking at education sites. She has incorporated those criteria into a qualitative evaluation tool that is to be used by middle school students and teachers (1997). The problem with this evaluation tool is it is long and asks questions that are not relevant to the quality of the content of the website. Too much emphasis is placed on the technical and aesthetic components. For example, she asks how long the page takes to load, what sort of Internet connection the student is using, and if there is an image map.

Others have developed quantitative evaluation tools to measure the quality of a website. Payton (No date) and McLachlan (1999) have developed similar tools that ask the evaluators to rank certain criteria on a scale between 1 to 5, where 1 equals poor and 5 equals excellent. The strongest aspect of McLachlan's tool, which is meant for educators, is the breakdown of the scores that enables the evaluator to not only determine the quality of the website, but also shows the instances where its use in the classroom is appropriate. Its only fault is, like Shrock's evaluation tool, it places too much emphasis on issues that are not relevant to the quality of the information on the site, such as the download speed.

Although Payton's evaluation tool, like McLaughlin's, employs a numeric score, it does not have a breakdown to determine what the score means. In addition, the tool is littered with terms and phrases which are ambiguous or unclear to students. For instance, she asks if the site is "aesthetically courteous" and if the site offers "interactivity," but she does not give adequate descriptions of what these terms mean.

The Speed-0'-Light Website Evaluation Guidelines at Ed's Oasis web site, is a tool meant to be quickly used by students. It has a scale to help determine the quality of a site. The language found on the site effectively communicates ideas and standards in a way that is easy for students to understand. But like the other aforementioned sites, it places too strong of an emphasis on insignificant features like colors and technological "bells and whistles" like Java Animation.

Two universities have addressed the notion of web site evaluation at the post-secondary level. The UCLA College Library and Cornell University have developed sets of criteria that are intended to help undergraduate students to think critically about the World Wide Web. Neither of these sites have a score or a web evaluation tool accompanying their criteria. However, both examples offer in-depth, age appropriate explanations of the important factors to look at when assessing a website.

In addition to web site evaluation tools developed specifically for educational purposes there has been some literature published on how any user, student or not, can evaluate a web site. The vast majority of this literature identifies the same standards of evaluation. Sowards (1997) and Smith (1997) both feel that authority, content and the quality of links should be standards for evaluation.

Chapter 3: Methodology

This study took place at Kent Roosevelt High School in four of Keith Benjamin's 9^{th} grade Biology classes. A presentation about the nature of website evaluation and its importance was given to the students. The students were shown an example of a website that does not meet the goals of information and science literacy (see Appendix A). After the lesson and examination of a poor website, the students were asked to evaluate a science website. Two classes evaluated a website that supports the goals of information and science literacy, while the other classes evaluated a website that did not. The website was displayed on an overhead projector and students also received a photocopy of the website.

The evaluation tool (see Appendix B) encompasses the standards and habits of mind established by ACRL and Project 2061, which are broken down into four categories: content, authority, appearance and navigability, and standards. Content relates to the quality of the text of the website and its currency. Authority refers to the qualifications of the individual or individuals responsible for creating the website. The questions used in the content and authority portion of the tool are based on the third ACRL standard: "The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system." The questions also were created based on the critical response habits of mind established by Project 2061.

The appearance and navigability and standards portions of the tool are also based on the third ACRL standard and Project 2061 habits of mind. Appearance and navigability relates to the overall organization of the website and the use of graphics, sounds, or special programming other than HTLM found on the website. Scientific standards refer to a set of guidelines or benchmarks established by a specific group of researchers or educators. Both categories of questions, like the content and authority categories, are based on the ACRL Standard 3 and the critical response habits of mind. They are also derived from the computation, estimation, and communication habits of mind.

The websites evaluated for this project are actual websites posted on the Internet. The website that does not exemplify information and science literacy, Becky's Guiding Resource Center (see Appendix C) http://www.geocities.com/Heartland/Acres/6690/index.htm, was found by doing a general search on biology experiments on the search engine, Alta Vista. This particular site was chosen because of its lack of scientific authority. One assumes that Becky is the author of the webpage, but it is not explicitly stated anywhere on the website. The only credential listed on the page is that she is a leader for the Canadian Girl Scouts. Based on this credential alone, Becky or whoever the author is, is not a reliable source for scientific material suitable for a classroom assignment or project. Also lacking on this page is a bibliography of related scientific material. The language on the page may be too juvenile for some 9th grade students and there is a lack of scientific terminology.

The website that supports science and information literacy was Natural History of Genes http://gslc.genetics.utah.edu/ (see Appendix D). This website has been included in The Science Net Links Website, which was created by The American Association for the Advancement of Science. Each of the websites included on Science Net Links has been evaluated by science professionals based on strict guidelines. The Natural History of Genes is also included on The Eisenhower Clearinghouse for Math and Science Education (ENC) website. ENC, according to its website, "is a national repository of current mathematics and science resources available to educators, students, parents, and others." This website was chosen primarily because the authority of the site is highly visible. The developer of the portion of this website evaluated for this study, Louise A. Stark, and her academic credentials and professional affiliations are identified on the experiment. Based on Stark's credentials, she is a reliable source of information on genetics. In addition, there is a bibliography of print and electronic sources on the website. All of the measurements are scientific and the experiment follows a detailed protocol.

After the data was collected, it was entered into the statistical program SPSS for analysis. An Alpha (Cronbach) reliability test was conducted to measure internal consistency, based on the average inter-item correlation. This test was preformed to determine if the survey can measure content, authority, appearance and navigability, and standards in a meaningful way. This test indicates the repeatability of the scale as a whole and can indicate any potential problem questions that should be eliminated from the scale. Please note that when reliability is tested, any incomplete surveys are omitted from the results; therefore group one is comprised of 47 cases and group two is comprised of 40 cases. Alpha scores under .6 are considered low. In addition to alpha (Cronbach) reliability testing, frequency analysis was used to determine the number and percent of responses to each individual question. The number of respondents to each question was calculated and the percent was determined.

Finally, T-Tests were conducted to compare the mean scores of each of the four categories of the tool: content, authority, appearance and navigability, and scientific standards. For this test, each of the four categories of the evaluation tool scores were summed and the mean scores of group 1 and group 2 were tested. The differences between the two means are calculated. Next the standard error is computed. Finally the difference between the two means is divided by the standard error. Based upon this test the significance is determined to indicate if the results are not just the result of chance.

Chapter 4: Analysis of Data

Alpha (Cronbach) Reliability

Table 1 identifies the reliability coefficient for the Alpha (Cronbach) testing that was conducted. The scales for content in Group 1 and Group 2 had modest validity at .6 and .7 respectively. The scales for authority in both groups were higher than the content scales. In this category Group 1's alpha score was .7 and Group 2's was .8. Scales for appearance and navigability category of the evaluation tool had the lowest scores in Group 1 at .4, which may be due in part to the fact that this category of the tool contained only three questions. Group 2's score of .7 in this category is higher than Group 1. Perhaps if this category were expanded with more questions, the score in Group 1 would rise to an acceptable level. Scales for scientific standards are nearly identical for Group 1 and Group 2 at .6 and .7 respectively. Overall, the alpha scores indicate that the evaluation tool does provide a moderately accurate measurement of content, authority, and scientific standards.

Table 1 - Alpha (Cronbach) Reliability

Scales	Group 1	Group 2
Content	.6	.7
Authority	.7	.8
Appearance and Navigability	.4	.7
Scientific Standards	.6	.7

Analysis of Content Scales

The following tables provide a breakdown of how the respondents in Group 1 and Group 2 answered each question on the evaluation tool in the content category. The number of respondents and the percent of each group are given.

Table 2 – Group 1 Content Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/3**	**4 n/%**	**5 n/%**
The information on the page is current	15/31%	22/46%	9/19%	2/4%	0
The content is free from factual errors	18/38%	16/33%	11/23%	3/6%	0
The language is appropriate for someone my age	30/63%	14/29%	2/4%	2/4%	0
The title of the website describes the content	32/67%	15/31%	0	1/2%	0
The sites linked to and from the website add value	28/58%	11/23%	6/13%	2/4%	0
The content is free from bias	27/56%	16/33%	4/8%	0	0
There is a bibliography of print and electronic sources	23/48%	8/17%	12/25%	3/6%	2/4%
All of the links work	36/75%	3/6%	9/19%	0	0

Table 3 - Group 2 Content Frequency Distribution

Question	1 n/%	2 n/%	3 n/%	4 n/%	5 n/%
The information on the page is current	10/24%	15/37%	15/37%	1/2%	0
The content is free from factual errors	9/22%	18/43%	12/29%	2/5%	0
The language is appropriate for someone my age	28/68%	10/24%	0	3/7%	0
The title of the website describes the content	20/49%	15/37%	0	2/5%	2/5%
The sites linked to and from the website add value	14/34%	15/37%	8/20%	4/10%	0
The content is free from bias	15/37%	13/32%	8/20%	4/10%	1/2%
There is a bibliography of print and electronic sources	11/27%	6/15%	13/32%	6/15%	5/12%
All of the links work	20/49%	8/20%	9/22%	4/10%	0

The majority of students in both groups agreed with the questions posed in the content category of the tool. Well over half of the respondents felt that the content of the good and bad websites was current, free from errors, the websites linked to and from the original website add value, and that all of the links worked. Over 90% of the respondents in Group 1 and Group 2 felt that the language on the website was appropriate for someone their age and that the title of the website they viewed described the content. 92% of the students in Group 1 felt that the content was free from bias, compared to 68% of the students in Group 2. The website that Group 1 viewed contained a bibliography of print or electronic sources and 66% of the students agreed that there was a bibliography on the website. However, 42% of the respondents in Group 2 agreed that there was a bibliography on the website they viewed even though there was not one present.

The following table illustrates the T-Test conducted on the content category of the evaluation tool. The mean score of Group 1, 13.3, compared to Group 2's score of 16.31 suggests that more students in this group agreed with the questions posed on the evaluation tool. The p score of .001 indicates that the results are not simply the result of chance.

Table 4 – Content T-Test

	N	$\bar{X}$	SD
Group 1	48	13.3	3.4
Group 2	41	16.31	4.67

P=. 001 t= -3.48

Analysis of Authority Scales

The following tables illustrated the frequency distribution for the respondents' answers to the authority questions posed on the evaluation tool. The number of respondents and the percent of each group are indicated.

Table 5 - Group 1 Authority Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/%**	**4 n/%**	**5 n/%**
The author's name is marked	28/58%	9/19%	5/10%	4/8%	2/4%
The author can be contacted	21/44%	12/25%	5/10%	9/19%	0
The author's credentials are stated	26/54%	12/25%	3/6%	6/13%	1/2%
The institution with which the author is affiliated with is indicated	39/81%	6/12%	3/6%	0	0
Based upon the author's credentials, he or she is reliable	24/50%	15/13%	5/10%	4/8%	0
The publication date is given	6/13%	4/8%	22/46%	4/8%	11/23%
Updates are stated	2/4%	4/8%	18/38%	11/23%	13/27%

Table 6 – Group 2 Authority Frequency Distribution

Question	1 n/%	2 n/%	3 n/%	4 n/%	5 n/%
The author's name is marked	17/42%	7/17%	4/10%	6/17%	7/17%
The author can be contacted	28/68%	7/17%	4/10%	1/2%	1/2%
The author's credentials are stated	9/22%	12/29%	12/29%	3/7%	5/12%
The institution with which the author is affiliated with is indicated	16/39%	5/12%	12/29%	4/10%	4/10%
Based upon the author's credentials, he or she is reliable	7/17%	11/27%	16/39%	5/12%	2/5%
The publication date is given	12/29%	5/12%	10/25%	4/10%	9/22%
Updates are stated	14/34%	4/10%	12/29%	6/15%	5/12%

For the authority portion of the tool, the respondent's answers were not as similar as was the case in the content portion of the evaluation tool. Around 70% of the respondents in Group 1 agreed the author's name was marked, the author could be contacted, and the author's credentials were indicated. Over 90% of the respondents in Group 1 agreed that the institution with which the author is affiliated was indicated and only 18% of the respondents did not feel that based on the author's credentials, she is a reliable source for information. Very few students in Group 1 agreed that there is a publication date indicated and update notification on the website they viewed, which makes sense because this information was not included on the website they viewed. The percent of respondents in Group 2 who agreed with the majority of questions in the authority category of the tool are not as high as Group 1. About half of the students in Group 2 agree that the author's name is marked, the credentials are stated, and the institution the author is affiliated with is indicated. While 85% of the respondents in

Group 2 agreed that the author could be contacted, only 43% agreed that the author is a reliable source.

The results of T-Test conducted on the authority portion of the evaluation tool were very similar to the results of the content category. The below chart illustrates the results of the T-Test for authority. Like the content results, the mean scores for Group 1 were lower than the scores of Group 2 at 15.42 and 16.98 respectively. Despite the similarities of the mean scores in the content and authorities, the p score of .188 indicates that unlike the content category, the results may be the result of chance.

Table 7 – Authority T-Test

	N	$\overline{X}$	SD
Group 1	48	15.42	4.49
Group 2	41	16.98	6.54

P=. 188 t= -1.3

Analysis of Appearance and Navigability Scales

The below tables illustrated the frequency distribution for the respondents' answers to the appearance and navigability portion of the evaluation tool. The number of respondents and the percent of each group are indicated.

Table 8 – Group 1 Appearance and Navigability Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/%**	**4 n/%**	**5 n%**
The site is well organized	34/71%	12/25%	0	11/23%	13/27%
You can move around the site easily	31/65%	16/33%	0	1/2%	0
The sounds and the graphics are used Effectively to convey information	11/23%	16/33%	11/23%	8/16.7%	2/4%

Table 9 – Group 2 Appearance and Navigability Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/%**	**4 n/%**	**5 n%**
The site is well organized	29/71%	9/22%	1/2%	2/5%	0
You can move around the site easily	24/59%	14/34%	0	2/5%	1/2%
The sounds and the graphics are used effectively to convey information	9/22%	14/34%	6/15%	10/24%	2/5%

The frequency distribution for the appearance and navigability category of the evaluation tool was nearly identical in Groups 1 and 2. Over 90% of the respondents agreed in both groups that the website they viewed was well organized and was easy to move around. Likewise, about half of the respondents in both groups agreed that the sound and the graphics of the websites viewed were used effectively to convey information. The similarity in frequency distribution can be attributed to the similar layout and organization of both websites.

The table below is the results of the T-Test conducted on the appearance and navigability portion of the evaluation tool. The mean scores for this portion of the tool do not follow the same trends of the previous categories. Unlike the mean scores for content and authority, the mean scores of Group 1 and Group 2 are identical. Like the authority category, the p score (.443) indicates that the results may be based on chance.

Table 10 – Appearance and Navigability T-Test

	N	$\overline{X}$	SD
Group 1	48	5.23	1.75
Group 2	41	5.56	2.30

P= .443 t= -.771

Analysis of Scientific Standards Scales

The following tables depicted the frequency distribution for the respondents' answers to the scientific standards questions posed on the evaluation tool. The number of respondents and the percent of each group are displayed.

Table 11 – Group 1 Scientific Standards Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/%**	**4 n/%**	**5 n/%**
After reviewing the website, you are able to predict and test the effects of influences on objects	17/35%	14/29%	11/23%	4/18%	2/4%
After the viewing the site, from the data given you are able to explain how or why the event occurred.	10/21%	16/33%	7/15%	12/25%	3/6%
The website uses scientific terminology	23/48%	18/38%	1/2%	4/8%	2/4%
The experiment followed procedures in step-by-step instructions	35/73%	10/21%	0	0	2/4%

Table 12 – Group 2 Scientific Standards Frequency Distribution

Question	**1 n/%**	**2 n/%**	**3 n/%**	**4 n/%**	**5 n/%**
After reviewing the website, you are able to predict and test the effects of influences on objects	14/34%	16/39%	7/17%	4/9.8%	0
After the viewing the site, from the data given you are able to explain how or why the event occurred.	21/51%	12/29%	3/7%	5/12%	0
The website uses scientific terminology	12/29%	13/32%	3/7%	8/20%	5/12%
The experiment followed procedures in step-by-step instructions	27/70%	9/22%	3/7%	1/2%	1/2%

Like their perceptions of authority, the frequency distribution in the scientific standards category was noticeably different between groups. The only major similarity between the Group1 and Group 2 was that the vast majority of respondents agree that the websites they viewed followed step-by-step instructions. 80% of the students in Group 2 agreed that from the data on the website, they were able to explain how or why the events in the experiment occurred compared to 69% in Group 1. In addition, 85% of the students in Group 1 agreed that the website they viewed employed scientific terminology, while 61% agreed in Group 2. Perhaps more students in Group 2 understood the website they viewed because there was not as much scientific terminology used to explain the experiment.

The following chart displays the results of the T-Test for scientific standards. The means of the groups in this category are identical at 7.9, as was the case with the appearance and navigability category. In addition to having identical means, the standard deviation of both groups is also practically identical. Finally, like previous two categories of the evaluation tool the p score of .119 forces one to conclude that the results may be based on chance.

Table 13 – Scientific Standards T-Test

	N	$\bar{X}$	SD
Group 1	48	7.98	2.94
Group 2	41	7.90	3.14

P=.119 t=.906

Chapter 5: Summary and Conclusions

The information age is in its infancy. Each day new advances in Internet technology are created that will have a profound effect on the future. Soon it is likely that every classroom will be connected to the Internet. As a result of this widespread accessibility, there will be dramatic changes in how students are taught and learn. Therefore, it is imperative that all students become information and science literate. Achieving this goal should be the top priority of all educators, especially school librarians and science educators.

One way to promote information and science literacy in the classroom is using the standards created by notable research institutions such as ACRL and the American Association for the Advancement of Science as a way of measuring the quality of a website. The frequency distribution testing conducted for this study showed that students are able to distinguish websites that support the goals of information and science literacy. Based on the reliability testing conducted on each of the four categories of the evaluation tool, it is evident that the questions posed on the tool can moderately measure content, authority, appearance and navigability, and standards on the websites evaluated. In addition, the t-test conducted on the mean sum scores of the content category is not the result of chance.

Clearly this is an area that needs further exploration in the future and there are many possibilities for further research. To obtain more meaningful statistical information, this study should be conducted again with more students. Having the students evaluate the websites individually at a computer would also be another way to conduct this study. This scenario would allow for greater interaction between the students and the websites. In this situation, the appearance and navigability portion of the tool should be expanded. Students would be able to get a better indication of the overall organization of the websites. For example, students would be able to test if all of the links work and if they links add value to the site.

In addition to expanding the appearance and navigability category, the scientific standards category could be expanded as well. On this evaluation tool, this area was only composed of habits of mind created by the American Association for the Advancement of Science and ACRL; however, there are many other institution's standards that could also be included in this area. For example, the Ohio Department of Education has its own set of science competency standards that have been developed to prepare student for the Ohio high school graduation test which will be implemented in the year 2005. Including these standards would be useful in preparation for passing this examination. At the national level, the National Academy of Sciences (1995) has developed its own set of standards that "spell out a vision of science education that will make scientific literacy for all a reality in the 21st century" (Klausner and Alberts).

Bibliography

American Library Association. *Presidential Committee on Information Literacy. Final Report*. 10 January 1989. Available [Online]: http://www.ala.org/acrl/nili/ilit1st.html [15 April 2000].

Association of College and Research Libraries. *Information Literacy Competency Standards for Higher Education*. 18 January 2000. Available [Online]: http://www.ala.org/acrl/ilstandardlo.html [16 April 2000].

ED's Oasis. *The Speed-o'-Light Website Evaluation Guidelines*. No date. Available [Online]: www.edsoasis.org/guide3.html [16 April 2000].

Eisenhower National Clearinghouse for Mathematics and Science Education. No date. Available [Online]: http://www.enc.org/fr_index.htm [16 April 2000].

Grassian, Esther. *Thinking Critically about Discipline Based World Wide Web Resources*. 10 October 1997. Available [Online]: http://www.library.ucla.edu/libraries/college/instruct/web/discp.htm [21 April 2000].

Hurd, Paul DeHart. "Scientific Literacy: New Minds for a Changing World." *Science Education*. 82, no. 3(1998): 407-416.

Klausner, Richard and Bruce Alberts. *National Science Education Standards Call to Action*. 1995. Available [Online]:http://books.nap.edu/html/nses/html/action.html [16 April 2000].

McLachlan, Karen. *WWW Cyberguide Rating for Content Evaluation*. 1999. Available [Online]: http://www.cyberbee.com/guide1.html [16 April 2000].

Office of Educational Research and Improvement. *Condition of Education*. 1999. Available [Online]: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=1999022 [28 April 2000].

Ormondroyd Joan, Michael Engle, and Tony Cosgrave.. *How to Critically Analyze Information Sources*. 28 June 1999. Available [Online]: http://www.library.cornell.edu/okuref/research/skill26.htm [21 April 2000].

Payton, Tammy. *Web Evaluation for Secondary Grades*. No date. Available [Online]: http://www.siec.k12.in.us/~west/edu/rubric3.htm [21 April 2000].

Raymo, Chet. "Scientific Literacy or Scientific Awareness?" *American Journal of Physics* 66(1998): 752.

Rutherford, F. James and Andrew Ahlgren. *Science for All Americans*. 1990. *Available* [Online]: http://www.project2061.org/tools/sfaaol/sfaatoc.htm [16 April 2000].

Sapp, George. "Science Literacy through Popularization: Problems and Potential." *Science and Technology Libraries* 12, no. 2 (1998): 43-57.

Shapiro, Jeremy J. and Shelly K. Hughes. "Information Literacy as a Liberal Art: Enlightenment Proposals for a New Curriculum." *Educom Review* 31, no. 2 (March/April 1996). Available [Online]: http://www.educause.edu/pub/er/review/reviewarticles/31231.html [16 April 2000].

Shrock, Kathy. *Critical Evaluation Survey: Middle School Level.* 7 July 1997. Available [Online]: http://discoveryschool.com/shrockguide/evalmidd.html [21 April 2000].

Shrock, Kathy. "Teaching Media Literacy in the Age of the Internet." *Classroom Connect* (1998/1999): 4-6.

Smith, Alastair G. "Testing the Surf: Criteria for Evaluating Internet Information Resources." *The Public-Access Computer Systems Review* 8, no. 3 (1997). Available [Online]: http://info.lib.uh.edu/pr/v8/n3/smit8n3.html [21 April 2000].

Sowards, Steven W. "Save the Time of the Surfer: Evaluating Web Sites for Users." *Library Hi Tech.* Issue 59-60 (1997): 155-158.

Trefil, James. "Scientific Literacy." *Annals of the New York Academy of Science* 775 (1996): 543-550.

Genetics Science Learning Center at the Eccles Institute of Human Genetics. No date. *Natural History of Genes* .Available [Online]: http://gslc.genetics.utah.edu/ [16 April 2000].

Welborn, Victoria and Bryn Kanar. "Building Websites for Science Literacy." *Issues in Scientific & Technological Librarianship* 25 (Winter 2000). Available [Online]: http://www.library.ucsb.edu/istl/00-winter/article2.html [April 16, 2000].

Appendix A: Example of a Website that Does Not Support Information and Science Literacy

Cool Sceince Projects By Lynn Murwood

This is the science project I used in my 9th grade science fair in 1976.

Photosynthesis in the Dark: How to Grow a Plant With A Flashlight

Here's how it works:
1. Get a Plant
2. Measure from the bottom of the pot to the top of the tallest leaf
3. Put the plant in a closet
4. Turn off the lights
5. Shine a flashlight on your plant for 1 hour
6. Measure the plant to see if it grew

Here are the results of the 5 plants i performed this experient on:

Plant NUmber	Start	Finish
1	10 inches	10 inches
2	9 inches	8.5 inches
3	13.3 inches	11 inxes
4	10inches	42 inches
5	9 inches	9 inches

If you likes this website, be sure to link to my other pages:
The World Is Really Flat
The Sun Revolves Around the Earth

This page was last updated May 19, 1985.

If you have a question about this website, too bad. DO NOT E-MAIL ME!

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Appendix B: Science Website Evaluation Tool

Science Website Evaluation Tool

1=Strongly Agree 2=Somewhat Agree 3=Strongly Disagree 4=Somewhat Disagree 5=Not Sure

A. Content:

The information on the page is current	1○2○3○4○5○
The content on the page is free from factual errors	1○2○3○4○5○
The language is appropriate for someone my age	1○2○3○4○5○
The title of the website describes the content	1○2○3○4○5○
The sites linked to and from this website add value to the website	1○2○3○4○5○
The content is free from bias	1○2○3○4○5○
There is a bibliography of print or electronic sources provided	1○2○3○4○5○
All of the links work	1○2○3○4○5○

1=Strongly Agree 2=Somewhat Agree 3=Strongly Disagree 4=Somewhat Disagree 5=Not Sure

B. Authority:

The author's name is marked	1○2○3○4○5○
The author can be contacted	1○2○3○4○5○
The author's credentials are stated	1○2○3○4○5○
The institution with which the author is affiliated with is indicated	1○2○3○4○5○
Based upon the author's given credentials,he or she is reliable	1○2○3○4○5○
The publication date is given	1○2○3○4○5○
Updates are stated	1○2○3○4○5○

1=Strongly Agree 2=Somewhat Agree 3=Strongly Disagree 4=Somewhat Disagree 5=Not Sure

C. Appearance and Navigability:

The site is well organized	1○2○3○4○5○
You can move around the site easily	1○2○3○4○5○
The sounds and graphics are used effectively to convey information	1○2○3○4○5○

1=Strongly Agree 2=Somewhat Agree 3=Strongly Disagree 4=Somewhat Disagree 5=Not Sure

D. Scientific Standards

After reviewing the website, you are able to predict and test the effects of influences on objects	1O2O3O4O5O
After the viewing the site, from the data given you are able to explain how or why the event occurred.	1O2O3O4O5O
The website uses scientific terminology	1O2O3O4O5O
The experiment followed procedures in step-by-step instructions.	1O2O3O4O5O

Appendix C: Becky's Guiding Resource Center

Guides Canada

Becky's Guiding Resource Centre

I have been an active member of the Girl Guides of Canada for many years now. I can't think of a better way to spend my spare time and my volunteering hours. We do all sorts of great activities -- everything from games, crafts and campfires to rock climbing, wilderness camping, canoeing, and horseback riding!

So check out my pages and links! If you like what you see, why not contact the Girl Guides of Canada for more information? Guiding is for all women ages 5 to 95 (and beyond)... everyone is welcome!

A Selection of Fantastic Resources for Your Unit

NEW Do you have something to contribute? Please read this first!!

- CM'99 Manitoba - were you there? Do you have memories to share? Come join the CM'99 Manitoba Mailing List!
- My Campfire Songbook has tons of songs, skits and stories for your singing pleasure!
- My Great Games Page will guarantee you always have something new to play with your girls.
- Going Camping? Check here for kit lists, camping tips, recipes and more.
- Come visit my Program section for all sorts of fun ideas and links!
- I have Links to Girl Guiding and Girl Scouting websites all over the world!
- The Cool Guiding Tip of the Moment - Check here regularly for tips and tidbits on all sorts of subjects!
- Download "colorized" versions of the official Girl Guides of Canada clipart!

Please come and Sign My Guestbook!
(You can also come and see what others have written...)

Like what you see?
Pass this website on to others!

I've won a couple of awards! (I've moved 'em onto a page of their own to make this one load faster!)

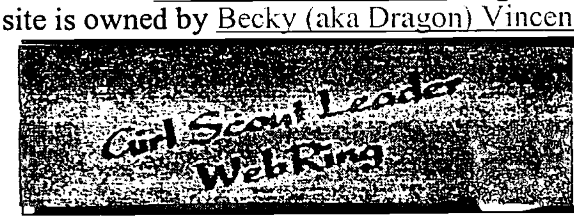
Having trouble downloading something from one of my pages? Click here for help!

Thanks a Million!

...to all the people who have helped me by submitting stuff either directly to me, to the 453rd Toronto Guides' Mailing List, or to the WAGGGS-L Mailing List. This site certainly wouldn't be the same without you!! Here are just a few of my major contributors (in no particular order):

Catherine Bryant, Anne Wellington, Kristen Byrnes, Gail Branum, Andrea Cho-Chu, Sandra O'Keeffe, Julian Ashcroft, Pam Burnham, Wendy Baker, Margret Jones, Sue Douglas, Katherine Town, Michelle Berry, Jane Maddin, Shelagh Walsh, Susan Lait, TiGeR (aka Dooreen) Rousseau, Jean Agra, Karen Hobson, Neil and Lucia Savage, Leslie Bown, Kathy Pechmann, Nora McColl, Janet Brickhouse, Micki Pagan, Diana J.!

This Girl Scout Leader WebRing
site is owned by Becky (aka Dragon) Vincent .



[Previous 5 Sites | Previous | Random Site]
[Next | Next 5 Sites | List Sites]

My site's also on the Scouting SPIDER

Questions? Comments? Please, e-mail me at nice_dragon@geocities.com, and I'll be happy to write you back!!

Do you have something to contribute? Please read this first!!

63365

Thank you, everyone, for visiting my site! (The visits are very much appreciated...)

Becky's Guiding Resource Centre was last updated on February 13, 2000.

This page hosted by Get your own Free Home Page

Biology Experiments

Flashers

Materials:

fire flies in a jar
flashlight

Directions:

1) In a darkened room hold the flashlight in front of the jar of fireflies.
2) Turn the light on and off at 1-second intervals.
3) Flash the light at least 10 times.
4) Change the intervals to 2, then 3, then 4 seconds; flashing the light at least ten times for each interval.
5) Do the fireflies respond to any of the intervals?

Explanation: Fire flies use the flashes to attract a mate. The interval of the flashes depends on the species of the firefly. The flashes are caused by layers of cells that produce light on their abdomen. The cells contains luciferin, which produces light when combined with oxygen.

The Shrinking Egg

Materials:

1 Ziplock sandwich bag
clear corn syrup
shell-less egg
1 glass

Directions:

1) Fill the Ziplock bag about half-full of corn syrup.
2) Place the egg in the bag. It will float, so don't be surprised. Take careful note of the size of the egg, then place it in the glass.
3) Check the egg in a few hours, then again the next morning. Did it look bigger or smaller? Let the egg sit for 3 days, by now you should see a size difference.
4) Remove the egg from the corn syrup, and gently wash it. The egg should look shriveled, and you can feel the yolk.
5) Half-fill another Ziplock bag with water, and put the egg in it. Let it sit supported by the glass for a few days. Are you surprised to see it back to normal?

Explanation: This experiment shows osmosis. Osmosis is the movement of water through cells. The water flows from where there is water to where there isn't, so the water went out of the egg and into the corn syrup. The corn syrup could not go into the egg, so the egg looked shriveled. When you put the egg into the bag of water, the water could move in and out freely. The membrane acts as a filter, with tiny hole that let the water in and out, but corn syrup and other things can't get through.

Two Eyes are Better Than One

Materials:

1 cup
1 penny
1 friend

Directions:

1) Put the cup on a table and stand 9 feet away.
2) Cover one eye. Have the friend hold the penny at arm's length above the cup, but slightly in front.
3) Watching only the cup and penny, tell your friend where to move her arm so that the penny will fall into the cup when dropped.
4) Tell him to drop the penny, then see how close you are.

Explanation: Your eyes don't see things the same. They see the same thing but at a slightly different angle. Your brain takes both views and combines them into one 3-d image. This kind of vision is called stereoscopic vision. When you cover one eye, you no longer see with stereoscopic vision, instead you see things two-dimensional, like a photo. This makes it hard to judge distances. People who lose sight in one eye learn to cope, but it is harder.

Two-Tone Water Transport

Materials:

1 white flower (or stalk of celery)
sharp knife
2 glasses of water
2 colors of food dye

Directions:

1) Put a teaspoon of one color of food dye into 1 glass of water. Then put 1 teaspoon of the other color of food dye into the other glass.
2) Cut about 5 inches of the flower's stalk from the bottom.
3) Stand glasses close together and put one of the stalk halves into each glass, making sure not to break or bend the stems too much.
4) Leave the flower in the water overnight. What do you see in the morning?

Explanation: **Like roads, the tubes (phloem) that carry water to the petals of the flower don't all go the same way to the same place. If you used celery, you should be able to see the phloem tubes easily with the naked eye.**

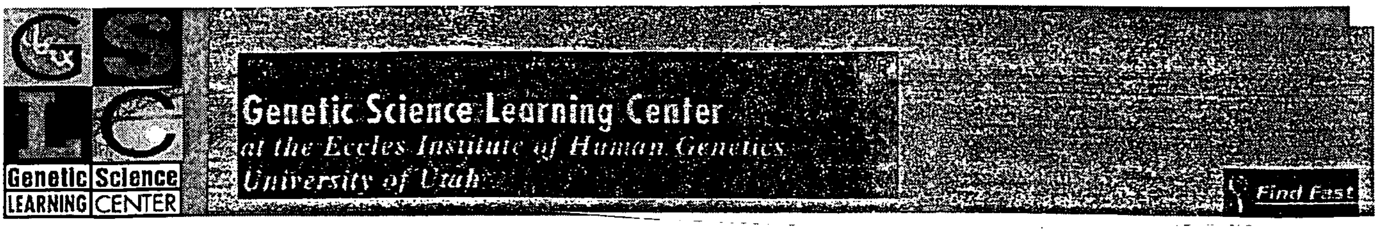
For more biology-related activities, don't forget to check out my Ecological Games, Night Activities, Nature Hikes and Activities, Water For Tomorrow Games, and of course my various Links pages.

Questions? Comments? Do you have another neat experiment you'd like me to add? Please, e-mail me at nice_dragon@geocities.com and I'll be happy to post your material here!

[Next: Chemistry Experiments] [Cool Science Experiments]
[Nature and Environmental Links] [Main Links Page] [Guiding Resource Centre]

Appendix D: The Natural History of Genes

44



people


TEACHERS


STUDENTS & TEENS

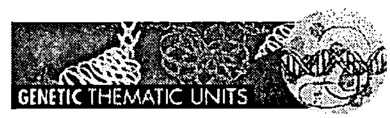

PARENTS & FAMILIES

feature

Scientist Profile: Mario Capecchi

He may be a geneticist who uses probability theory to calculate the outcomes of experiments, but he also is an individual whose personal life proves that, while some events are not probable, anything is possible.

topics



most requested

1. How to extract DNA from anything living
2. What can our chromosomes tell us?
3. Current events in genetics

A joint project of the University of Utah Eccles Institute of Human Genetics, Museum of Natural History, and School of Medicine

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This site is best viewed with at least IE 3.x or Netscape 4.x and 800x600 screen resolution.

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Genetic Science LEARNING CENTER

BASIC GENETICS

DNA Extraction: intermediate level

Would you like to extract LOTS of DNA?
This protocol yields large quantities of DNA that can easily be spooled and collected.

Acknowledgements
This protocol was developed by Louisa A Stark, Ph.D., while she was Senior Scientist with the University of Colorado Hughes Undergraduate Biological Sciences Education Initiative, a program funded by the Howard Hughes Medical Institute. Dr. Stark is currently the Director for Science Education with the University of Utah Genetic Science Learning Center.

Genetic Science LEARNING CENTER

BASIC GENETICS

DNA EXTRACTION: Equipment and Materials Needed

You will need the following materials and equipment for each DNA extraction:

- Raw wheat germ - 1 gram or 1 teaspoon
- Liquid detergent - 1 ml or a scant ¼ teaspoon
- Alcohol - 14 ml or 1 tablespoon
- 50-60o C tap water - 20 ml or 1½ tablespoons
- 50 ml test tube, capped test tube, beaker, or spice jar
- Graduated cylinder, measuring spoons, or other measuring devices
- Glass stirring rod, wooden applicator stick, or shish kebob skewer for stirring the mixture (not needed with capped test tube)
- Pasteur pipette and bulb, eyedropper, or pieces of paper towel - may be needed to remove foam
- Glass or paper clip hook, or wooden applicator stick or shish kebob skewer for collecting DNA
- Sealable container (tube, vial, jar, etc.) to store DNA (optional)
- 50% alcohol - for storing DNA (optional)
- Filter paper - for drying DNA (optional)

Additional information on these materials and equipment items can be found in Notes on the Materials and Protocol.

Genetic Science LEARNING CENTER

BASIC GENETICS

DNA EXTRACTION: Notes on the Materials and Protocol

Quantities
Exact quantities of wheat germ, water, detergent and alcohol are not crucial to the success of this DNA extraction; approximate quantities will work.

Wheat Germ
This protocol will only work with raw wheat germ, which can be purchased at a health food store or some large supermarkets; toasted wheat germ does not work.

Water Temperature
Do not use water hotter than 50-60oC. The water will become cooler during the extraction procedure, but this does not matter. Test your tap water - it may be hot enough right from the tap.

Detergent
The following liquid soap products have been tested and found to work well for this DNA extraction protocol: Lemon Fresh Joy, Woolite, Ivory, Shaper, Arm & Hammer, Herbal Essence shower gel by Clairol, Tide, Dish Drops, Kool Wash, Cheer, Sunlight Dish Soap, Dawn, Delicate, All, and Ultra Dawn.

The following liquid products do not work well: Life Tree, Shout, Shaklee, Sunlight Dishwasher, and LOC. Powdered detergents also do not produce good results with this protocol.

Alcohol
70% isopropyl alcohol ("Rubbing alcohol")
This alcohol is the least expensive since it can be purchased at a grocery store or pharmacy. However, it contains a higher percentage of water, making it slightly more difficult to precipitate out the DNA. The DNA may also be somewhat more difficult to collect when using this alcohol. It is helpful to keep drawing the DNA up into the alcohol from the alcohol-water interface using a glass hook, etc.

95% ethyl alcohol and EverclearÒ grain alcohol
(which is 95% alcohol)
Both of these alcohols work equally well. The DNA is easy to collect.

99% isopropyl alcohol
This alcohol gives a slightly higher DNA yield than 95% ethyl alcohol.

All alcohols can be used at room temperature.

Measuring Devices

Plastic film cans hold approximately 33 ml or 2 tablespoons. Clear film cans can be marked with the volumes needed and used for measuring.

An easy way to measure and dispense the detergent is to fill 1.5 ml microcentrifuge tubes with detergent. When adding the detergent to the water/wheat germ mixture, pour the detergent out of the tube, but do not rinse the tube; the amount that pours out will be approximately 1 ml.

Making a Hook for Collecting DNA

Using one of these hooks makes it much easier to collect the DNA you extract.

To make a glass hook

- Hold the tip of a 5-inch glass Pasteur pipette in a flame (alcohol lamp or Bunsen burner) to seal it.
- Check the seal by trying to blow through the wide end of the pipette.
- Hold the pipette so that the flame hits it about 1 cm back from the tip.
- When the glass droops into a hook, remove the pipette from the flame and let it cool.
- Check to make sure the hook fits into your DNA extraction container (test tube, beaker or spice jar). If you plan to keep the DNA in a container of alcohol, make sure the hook also fits into that container.

To make a paper clip hook

- Unbend a paper clip to form a hook with one end.
- Check to make sure the hook fits into your DNA extraction container (test tube, beaker or spice jar). If you plan to keep the DNA in a container of alcohol, make sure the hook also fits into that container.

50% Alcohol for Storing DNA

You can use either isopropyl alcohol (rubbing alcohol) or ethyl alcohol for storing the DNA you extract. To make 100 ml of 50% alcohol:

Isopropyl Alcohol
71 ml of 70% isopropyl alcohol (rubbing alcohol)
29 ml of distilled water

Ethyl Alcohol or EverclearÒ grain alcohol
53 ml of 95% ethyl alcohol (ethanol)
47 ml of distilled water

DNA Precipitation

DNA precipitates out at the water-alcohol interface; i.e. the boundary between the water and the alcohol. Therefore, it is crucial to pour the alcohol very slowly so that it forms a layer on top of the water solution. If the alcohol mixes with the water, it will become too dilute and the DNA will not precipitate out.

If there is foam on top of the water/detergent/wheat germ solution, remove it before pouring in the alcohol; the foam rises above the alcohol and makes it difficult to remove the DNA.

You will usually see DNA precipitating out of solution at the water-alcohol interface as soon as you pour in the alcohol. If you let the preparation sit for 15 minutes or so, the DNA will float to the top of the alcohol.

You can usually get more DNA to precipitate out of solution by using one of the DNA-collecting tools to gently lift the water solution up into the alcohol. This allows more DNA to come in contact with the alcohol and precipitate out.

You may find it helpful to pour the water/detergent solution into a clean test tube, leaving behind the wheat germ, before adding the alcohol.

Genetic Science LEARNING CENTER

BASIC GENETICS

DNA EXTRACTION: Protocol

1. Place 1 gram or 1 teaspoon of raw wheat germ in a 50 ml test tube, beaker or jar.

2. Add 20 ml or 1½ tablespoons of hot (50-60 °C) tap water and mix constantly for 3 minutes.

3. Add 1 ml or a scant ¼ teaspoon of detergent and mix gently every ½ minute for 5 minutes. Try not to create foam.

4. Use an eyedropper, pipette, or piece of paper towel to remove any foam from the top of the solution.

5. Tilt the test tube, beaker, or jar at an angle. SLOWLY pour 14 ml or 1 tablespoon of alcohol down the side so that it forms a layer on top of the water/wheat germ/detergent solution. Do not mix the two layers together.

6. Let the test tube, beaker, or jar sit for a few minutes. White, stringy, filmy DNA will begin to appear where the water and alcohol meet.

7. Use a glass or paper clip hook or a wooden stick to collect the DNA. You may collect more DNA by using the hook or stick to lift the top of the lower, water layer up into the bottom of the upper, alcohol layer.

8. If you want to keep the DNA, store it in 50 - 70% alcohol in a sealed tube or air dry it on filter paper.

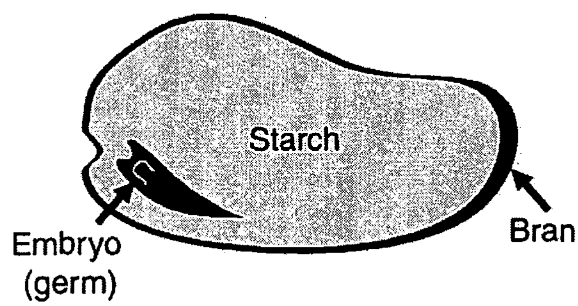
Genetic Science LEARNING CENTER

BASIC GENETICS

DNA Extraction: background information

Wheat germ
This is the DNA source in this protocol. Wheat germ comes from wheat seeds. The "germ" is the embryo, which is the part of the seed that can grow into a new wheat plant. When wheat seeds are milled into white flour, the wheat germ and wheat bran are removed, leaving only starch. Wheat germ contains many nutrients while wheat bran consists of fiber. Whole wheat flour contains all parts of the wheat seed and is therefore more nutritious than white flour while also provideing important fiber for digestion.

Cross Section of a Wheat Seed



Water temperature
The heat softens the phospholipids (fats) in the membranes that surround the cell and the nucleus. It also inactivates (denatures) the deoxyribonuclease enzymes (DNase) which, if present, would cut the DNA into such small fragments that it would not be visible. Denatured enzymes and DNA unravel, loose their shape, and thus become inactive. Enzymes denature at 60oC and DNA denatures at 80oC.

Detergent
Detergent contains sodium laurel sulfate, which cleans dishes by removing fats and proteins. It acts the same way in the DNA extraction protocol, pulling apart the fats (lipids) and proteins that make up the membranes surrounding the cell and nucleus. Once these membranes are broken apart, the DNA is released from the cell

Click here to see diagrams of how detergents work.

Alcohol
The DNA released from the cell nucleus is dissolved in the water/detergent/wheat germ solution and cannot be

the water/detergent/wheat germ solution and cannot be seen. DNA precipitates out of solution in alcohol, where it can be seen. Besides allowing us to see the DNA, the alcohol separates the DNA from the other cell components, which are left behind in the water solution

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Genetic Science LEARNING CENTER

BASIC GENETICS

DNA EXTRACTION: Suggestions for Further Exploration

What is the best protocol you can develop for DNA extraction?

Scientists often use a protocol, such as the one given here for extracting DNA from wheat germ, as a starting point for developing new protocols or improving old ones. Below are some ideas for things you might explore as you work to develop your own protocol.

DNA Sources

Try using this protocol to extract DNA from other foods, such as oatmeal, seeds, yeast, etc.; the procedure may need to be modified (longer initial soak in hot water, etc.).

Detergents

Try using different detergents and soap products to extract DNA. Compare the amount of DNA extracted with these products. To quantify the amount of DNA you extract:

- Weigh pieces of filter paper.
- Use a hook to place the DNA you extract on these pre-weighed filter paper pieces. Spread the DNA out as much as possible; it will dry more slowly if it is clumped.
- Let the DNA sit for several days until you are sure it is absolutely dry.
- Weigh the filter paper again with the DNA.
- Calculate the DNA weight:
  (Weight of filter paper + DNA) - (Weight of filter paper before DNA) = DNA weight.

Alcohols

Compare the amount of DNA obtained by using different alcohols. Use the procedure above (under Detergents) to quantify the amount of DNA you extract.

Water Temperature

Explore the effect of water temperature on DNA extraction by using different water temperatures with the protocol. Use the procedure above (under Detergents) to quantify the amount of DNA you extract.

Genetic Science LEARNING CENTER

BASIC GENETICS

DNA EXTRACTION: Resources

Books
From Cold Spring Harbor Laboratory Press, Plainview, NY, Phone: 1-800-843-4388:
DNA Is Here to Stay, by Dr. Fran Balkwill. 1992. (Ages 9-15)
Amazing Schemes within Your Genes, by Dr. Fran Balkwill. 1992. (Ages 9-15)
Double Talking Helix Blues, by Joel Herskowitz. 1993. (Book and Tape, Ages 8 and up)

From Barron's Educational Series, Inc., Hauppauge, NY:
Ingenious Genes, by Patrick A. Baeuerle and Norbert Landa (Ages 8-12)
How the Y Makes the Guy, by Norbert Landa and Patrick A. Baeuerle (Ages 8-12)

Biotechnology: The Technology of Life, A Sourcebook for Teachers Grades K-12, ed. by Douglas Dawson, Stacey Hill and Jill Rulfs. 1995. Kendall/Hunt Pub. Co., Dubuque, IA.

Internet
Access Excellence (search for "DNA Extraction")

The Instruction Manual for All Life. Includes "Zoom into DNA" - zoom in on a human hand from skin to DNA.

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