

CURRICULUM OF THE COURSE “TRENDS AND ISSUES IN SCIENCE”

El curso “Tendencias y asuntos de ciencias”

Michael J. Demchik and Virginia Carol Demchik

Jefferson High School, Shenandoah Junction, WV 25442, USA

e-mail : mdemchik@adelphia.net

ABSTRACT

This course called “Trends and issues” consists of a collection of topics that have been used in the classroom in other courses. The intent is to provide a linkage, as well as, a hands-on approach where possible in a single course. Many, if not, most of the topics have a global significance, for example, acid rain, deforestation, hazardous substances, nuclear understanding, energy and energy shortages , etc. All elements of the programs presented here have been evaluated in single element settings. With an assessment that covers all elements of the program, the effectiveness in combination of these topics can be determined.

Key words: Science teaching , curriculum design

Resumen

El curso “Tendencias y asuntos de ciencias” contiene una colección de los temas de significado global (por ejemplo, lluvias ácidas, deforestación, sustancias peligrosas, energía y otros) los cuales pueden ser utilizados en otros cursos de ciencias. Todos los temas están enfocados a los posibles enlaces y también actividades prácticas con otros cursos. Los elementos del programa del curso presentado se evaluaron y comprobaron la efectividad educativa del diseño del curso presentado.

Palabras clave: diseño curricular, educación en ciencias

Introduction

This course has been developed with the intent of presenting it to the principal and the curriculum

committee to be considered as a potentially new course for the science department. While program development has been essentially local, segments of it has national and international involvement. This program is an outgrowth of projects and topics that have been utilized in a number of our courses over the years. Evaluation of the individual programs and activities taught over the years reduced the content to central but inter-related issues. The identified elements point out the emergence of trends and issues in science that face us as a population daily. The extracted topics include:

Acid rain, land use, air, land, and water pollution, water and water resources, wildlife and wildlife resources, hazardous substances, energy and energy related resources, nuclear controversies, genetic engineering, populations, food and food related resources, medicine and health, discovery, invention, and the marketplace and its relationship to science, technology and society.

Of the topics listed, some of those mentioned previously that are not listed directly are incorporated into the body of others. For example, when the three streams study comes about, water resources are incorporated. The others are incorporated into a similar situation.

Further analysis of the current programs suggested that the instructional method be multi-dimensional or an eclectic approach. The modes should include independent study, large-group instruction and small-group instruction, laboratory activities, role-playing and simulations, computer and library research, limited lecture, films and other audio-visuals and visitations of resource people. Central to the program will be a vertical development, a program that treats the issues from local, regional, state, national and international point of view wherever possible.

Another essential element will be the development of a personnel and resource network through which our course and others in the science department could be served. While a small network already exists, one part of the personnel network that will be developed that will include support personnel. These are individuals whose job is that of a support person to scientists such as watch engineers at power plants, photographers, electroplaters and the like. These individuals will provide examples of the day-to-day workplace and their support to the individual at the next level of the career step. They may be able to provide guidance for the individuals who might be interested in positions such as these.

The content selected for use includes acid rain, deforestation, hazardous substances, nuclear understanding, energy and energy shortages, chemical resources, and stream studies and locally developed forensic activities. All of these activities have been successfully taught in other classes or are currently being revised. Other topics that could be utilized here are currently under development and/or are ready to be trial tested.

Acid Rain

Acid rain is defined as rainfall with a pH lower than 5.6. It is generated by coal-fired sources and is generated by automobiles and industrial sources. It includes oxides of sulfur (SO_x) and oxides of

nitrogen (NO_x). The acid rain sequence has taken various forms over the last twenty-five years or so. This sequence is the most recent and involves presenting preliminaries of acid rain in a short discussion period. The discussion is followed up with the use of the classroom library of about four hundred personal books and the in-class use of the Internet. Following a short discussion and on-going library research, several projects were set up. These include “The Effects of Acid Rain on Great Northern Beans”, “The Effects of Acid Spray on Geranium Plants” and “The Effects of Acid Rain on Potato Plants”. Observations and measurements as available were made daily. There was an acid rain simulation called “The Acid Rain Controversy In Calorimetric County. One of the projects and the simulation appeared in a journal. (Demchik 2001, Demchik 2000).

During the course of discussion and researching information discussion on project design selected by the students from students developed designs. They were presented to the class and the best two in their opinions were selected as options for study and exploration. One project lead to the development of a lengthy study was called “A Longitudinal Study of Pisum Savitum” and it lasted at least eighty days. (Demchik 1999). This project provides a good deal of information that can be derived and be related to Mendel’s seven basic identifiable characteristics of pea plants.

During October and again in February students volunteered to collect acid rain and acid snow at the appropriate time and place according to a designated protocol. (Demchik 1994, Borys 1994). The numbers of students that volunteered over the years varied between 20 when we first started and 107 as the largest number of volunteers.. The average number over the last fifteen years was about 70 volunteers. One project involved schools in England for several years in the past and schools in the United States for the last seven years. The number of schools in the United States varied from 19 to 46 participating schools during the operating years. The results were shared and published. (Demchik 1997, Demchik 1996). The following set of sample data taken from one of the acid rain/acid snow projects and is reproduced as follows from a month study of acid rain with nineteen participants from other states.

Results for the Second Week of February 2000

School	Feb. 8	Feb.9	Feb. 10	Feb. 11	Feb. 12	Feb. 13	Feb. 14
Langhorn, PA	4.8	0	0	0	0	0	5.2
Hickory, NC	4.8	0	4.4	4.6	0	0	0
Des Lacs, ND	0	0	0	4.5	4.5	0	4.5
Oakland, CA	0	0	0	0	0	0	0
Mansfield, TX	0	0	0	NA	NA	0	0
Norwalk, IA	0	0	0	0	0	0	0
Shen. Jct., WV	0	4.2	4.2	0	0	0	4
Covington, KY	4.1	0	0	0	0	4.5	0

Nichlosville, KY	5.5	0	0	0	5.5	0	0
Fargo, ND	0	0	0	0	0	0	0
Santa Fe, NM	0	0	0	0	0	0	0
Burlington, VT	0	0	0	0	0	NA	4.3
Paulding, OH	0	5	5	0	0	0	0
Basalt, CO	0	0	0	0	5.7	0	0
Pittsburg, PA	5.2	0	0	0	5.0	5.0	0
Beaumont, TX	0	0	5.6	0	0	5.6	0
Asheville, NC	4.4	0	4.2	0	0	4.1	0
Colorado Springs, Co	0	0	0	0	0	0	0
N. Canton, OH	NA	NA	NA	NA	NA	NA	NA

(NA = Data unavailable for this day/week. O = Did not collect during this time period.)

The data provides an opportunity to compare the data collected at various sites throughout the country. A large map of the United States and a placement of average data on this map would provide a view on the average of acid precipitation at the sites involved in the study. However, nineteen locations provide a rather wide range of the data. When the number of schools involved was greater a better picture emerged. However, regardless of the data collected the data provided an opportunity for the paired schools to communicate about their own data compared to the total picture and also have an opportunity to have a mode for getting communication between schools going. Once accomplished then other factors such as hypotheses and the like can be used and shared with others. Graphing this data can provide an opportunity to follow the progress in one whole picture and provide a base to make comparisons in future collections. The data provide multiple opportunities for students and teachers to communicate about the data but potentially other things as well.

Deforestation

The intent of this section is to explore the problem by using a starting article by Peter Raven called “Deforestation: a global tragedy”. (Raven 1988) The Raven article will be used as a starting point for examination of Internet sources to determine if there are other points of view. Should these exist then an Internet research will be pursued. The students will prepare a newscast in which all members of the class participate in some manner. The number and method of participation would be dependent on the nature and members of the class.

Hazardous Substances

This section of work starts by students reading a fictitious Department of Natural Resources report, which could likely be true. (Nyden 1984) It is modified from a newspaper article which listed over 200 hundred sites in a southern state which could contains some hazardous material. The process is intended to lead toward bill writing and lobbying the legislature. The intent here is to give the students experience with the conditions under which bills are passed. Students are presented with an article "How A Bill Becomes A Law". (Demchik 1992) This article was a newspaper article written by this author in order to provide newspaper readers and students with this knowledge in the event they were unfamiliar with the process. The sites in the state that are hazardous are examined and discussion ensues regarding how these materials can be cleaned up and who is responsible for clean up. Discussion about the type of laws required will occur and an environmental lawyer will be invited to a discussion section.

Nuclear Understandings

This topic will be explored through Internet access. A survey set of questions will be developed that are representative of the types of information to which everyone should be exposed. Both teachers and other students will be asked to participate in a short ten question true and false test. The idea is to give students an opportunity to collect, examine, tally, analyze, and draw conclusions from the data analysis. It sort of simulates the Gallup pole idea.

Energy and Energy Related Resources

This topic involves the preparation and closure on debating appropriate questions related to energy and energy resources. These questions will be determined by the teacher and honed to the nature of the class. The class will be divided into six small groups for preparation and subsequent debate. Research followed by agreement on the information involved. Finally, competition with other groups determined who the winner was. The intent here is simply to have the students experience these processes.

Chemical Resources

A cooperative venture with the newswriting class will focus on selected topics that would be of interest to the readership and explore chemical resources, as well. Each student will have a role and cooperatively become involved with the news-writing class. Past topics completed are: Chemistry Is Continuously In The State Of Change, and Chemical Resources Review. Both topics were generally well received in an arbitrary survey of students coming down the hall one day. Again the nature of the class will determine the question and how it will be dealt with.

Stream Studies

Three streams were selected for study purposes and have been tested for the last eight years both chemically and biologically. A limnological study of the streams provided a rather interesting study. The students were in awe of the number and kinds of organism found in these streams. Evaluation of on-site and in-lab studies have been rather extensive in the past. (Demchik 2001, Schnably,2000, Demchik, 1996, Demchik, 1994) Data collected on surface waters appears in print and on the Internet and related to one watershed our students have examined and evaluated. (Schnably,2000) Typical data appears in the sample form given as follows. The questions raised in this section relate to a historical comparison of drought years that could eventually be compared to non-drought years. A variety of hypotheses can be generated in order to compare existing to new data. It can be also used as a teaching tool to illustrate what hypotheses could have been generated and have immediate results available to determine significance. Certainly other options are open such as data display through bulletin board presentations or similar procedures to those described for the acid rain data.

Average Measurements-Rocky Marsh

Dates	5/21/94	9/4/99	5/29/00
pH	7.5	7.0	7.5
Dissolved oxygen	13.0 ppm	9.0 ppm	7.0 ppm
Dissolved carbon dioxide	18.0 ppm	40.0 ppm	47.0 ppm
Nitrates	0.0 ppm	2.0 ppm	0.0 ppm
Phosphates	0.0 ppm	0.1 ppm	<0.1 ppm
Silica	7.0 ppm	7.5 ppm	8.0 ppm
Total hardness	342 ppm	514 ppm	313 ppm
Calcium hardness	291 ppm	300 ppm	265 ppm
Magnesium hardness	51 ppm	214 ppm	48 ppm
E. coli	negative	positive	negative

Forensic Science

A fictitious scenario and is prefaced by the study(ies) of hair, animal and man, cloth, soil, artificial blood, chromatography, and electrophoresis. The students who pursued this section in the past had fun and were excited about learning. The scenario was develop around a crime scene break-in to a house and subsequent clues left behind by the culprit(s) were to be examined according to the information gleaned from the preliminary studies.

Antarctica Project

This project involves connecting by Internet with one of the editors of the Antarctic Sun and posing questions both about the science involved and living conditions on the ice. The questions posed and the responses to those questions provided an interesting involvement. In the past, we have had some Internet connections with teachers who are researching with a mentor on the ice. We have had connections with one who studied the Adelie penguins and another who studied the dry valleys. These individuals were teachers working with mentors. Their study was characterized by the standard set of objectives, hypotheses and procedures so that students could see what was studied and the outcome of that study as it progressed.

New Studies

Each year a new topic is selected and tried for use in one of the classes. This course is based on each of the sections that had been added over the years to courses taught.

Coursework Connections

Some selected content topics will be included. In some cases, expansion of the ideas generated in other classes will be incorporated. Transition element chemistry, electrochemistry, nuclear chemistry and elements of organic chemistry will be incorporated, as well. The reason that these are considered is that with the exception of AP Chemistry, these topics are not taught in-depth in other classes.

Evaluation

Pre and post assessment on The Global Issues Survey (Demchik 1991, Bybee, Terry 1984) will evaluate the impact of the course on these science, technology and society topics. Copies of the survey can be found in both references. Statistical treatment has been significant in the past and will be applied here. While there are no plans at the present to incorporate a standardized test, those that have been applied in the past have shown a high degree of success.

Priority Ratings of Global Issues Of Two Classes Ten Years Apart

Global Issue/ Year	2000-2001	1999-2000	1990-1991	1989-1990
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Human health and disease	1	1	2	1
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Mineral Resources	6	6	10	5
The atmosphere	2	2	1	4
Energy shortages	7	7	6	11
World hunger	4	4	7	2
Land use	8	8	11	8
Plant extinction	9	9	8	10
Population growth	5	5	3	9
Nuclear reactors	12	12	9	12
Hazardous substances	10	10	4	7
Water resources	3	3	5	6
War technology	11	11	12	3
N	76	75	17	17

When the surveys were given a significant amount of time passed.

The number of students better than quadrupled as more students were exposed to these topics as time progressed. It also is an indicator that more interest in these topics and the coursework that housed them.

The items involved in the study do not completely deal directly with all topics on this survey. While this is the case, it does provide us with other information from which we can glean a potential topic for study based on whether there are changes or not. Other items while they are not set out as a separate topic they are treated to some degree in the content. One such example is the deforestation article deals to some extent with plant and animal species extinction. It also relates to why the removal of the forest affects foods and the lack of potential for growth after a few utilizations. With the exception of war technology, all of these items affect one another in some manner. Other combinations exist throughout the body of the material and affect each other in a similar way.

Conclusions

This program provides the opportunity for studying science in a wide variety of modes. It was felt that this course may provide opportunities to explore many topics rather than the one or two that can be utilized within a single course. Basically since the time to complete all the objectives within a given course allows only limited expansion into other areas. This option certainly can provide students with updated sections of material currently in vogue and aid in rounding out their science education. This course will be submitted for potential use in the not too distant future. In a new situation like this there is much yet to discuss. However, a framework has been established and those items bearing further exploration can be handled through contact by email at mdemchik@adelphia.net or by "snail" mail at: Drs. Michael and Virginia Demchik,

Box 1420, Shepherdstown, WV 25443.

Bibliography

Borys R. *Protocol for Acid Snow*, Desert Institute, Reno, Nevada, 1994.

Bybee R., Terry M. Global Issues, *The Teacher's Clearinghouse For Science and Society Education*, Fall, 1984

Demchik M. Experiencing Experimentation and Project Design, *Science Activities*, Volume 38, number 1, Spring 2001.

Demchik M. Acid Rain Classroom Projects, *Science Activities*, Volume 37, Number 3, Fall 2000.

Demchik M. The Longitudinal Study As A Central Teaching Focus, *American Biology Teacher*, Volume 66, number six, 1999.

Demchik M. Chemistry II, Sixteenth Biennial Conference on Chemical Education, University of Michigan, August 2, 2001.

Demchik M. Students Examine Winter Snow, *The Teachers Clearinghouse For Science and Society Education*, Winter 1997.

Demchik M. , Demchik V. Project JAR, Access Excellence, San Francisco, 1996.

Demchik M. Project SWOOSH, *The Clearinghouse For Science and Society Education*, Fall 1996.

Demchik M., Demchik V. Project Swoosh, Access Excellence, San Francisco, 1994.

Demchik M. Protocol for Acid Rain, Access Excellence, San Francisco, 1994.

Demchik M. How A Bill Becomes A Law in the Parameter, *Coal Valley News*, November 1982.

Demchik M. Using Statistical Methods To Determine Science Activities, West Virginia Academy of Science, Montgomery, WV, April, 1991.

Demchik M., Lind K. *Water, Stones, and Fossil Bones*, Council of Elementary Science International. Columbia, MO, 1991. in Eisenhower Materials Clearinghouse.

Nyden P. Hazardous Wastes, Outlook, *Charleston Gazette-Mail*, June 24, 1984.

Raven P. Deforestation: a global tragedy, *The Science Teacher*, September 1988.

Schnably R. Resource Assessment For The Elks Run Watershed Natural Resources Conservation Service, Charles Town, January 2000.

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