INTERNATIONAL GEOSCIENCE EDUCATION ORGANIZATION

NEWSLETTER 99-2

FROM THE EDITORS:

Are you making plans for the Third International Conference on GeoScience Education (GeoSciEd III) in Sydney, Australia? It is not too late to submit an abstract, the deadline has been extended until September 15. See the report from the conference conveners later in the newsletter. We are looking forward to an excellent technical program and, don't forget the opportunity to visit with colleagues from around the world.

Here in North America we are preparing for the start of a new academic year. It sometimes feels like a never-ending battle to get students interested and excited about learning about the earth. Each new year brings new ideas and techniques that we hope will be the ones that open the door for students. Many of those ideas come from being in touch with others in the Geoscience Education community. We all have insights to share and things to learn. The reward is in seeing those students who do respond, learn, and show their excitement.

Once again, thanks to all of you who took the time to respond to our requests for submission to the newsletter. It is exciting to learn more about the efforts being made globally to support education in the Geosciences. The newsletter provides a link to others who are dedicated to teaching and promoting the cause of educating people about the earth whether in a formal classroom setting or in an informal settings. We continue to encourage you to submit notes and articles. If you have a request for information, new and interesting results of a study or activity, an exciting conference, or a short country report, send us a letter or email. You do not have to wait for a deadline to send in a submission. We will take good care of all submissions until we are ready to assemble the next newsletter. Don't put it off, do it now.

We hope that the distribution problems have been resolved, but do let us know if you have problems receiving the information. Please distribute this newsletter to anyone who is interested and by whatever media is necessary. A reminder that the previous issues of the Newsletter are available in English or Spanish at http://www.cosm.sc.edu/~csemgr/igeo.html

Look forward to hearing from you and seeing you in Australia in January of 2000!

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"HONORS"

Dr. R Shankar, Reader in Marine Geology and Research Coordinator, Ocean Science - Technology Cell at Mangalore University, was awarded the "Sir C. V. Raman Award" for 1998, by the Government of Krnataka, in recognition of his contributions in the field of Earth Sciences. The award consists of a citation, a memento, and a cash award of Rs.25,000. It will be presented by the Minister of Education, Government of Karnataka, at a function in Bangalore on August 19, 1999. Dr Shankar intend to donate the cash component of the award to a professional body in memory of his mother.

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"ANNOUNCEMENTS"

GeoSciEd III

Sydney, Australia

January 16 -, 21, 2000

http://www.agso.gov.au.geoscied/

The conference planning is well in hand. We have a good number of registrants at this stage but obviously would like some more. The venue is very well appointed and well located for both the formal conference proceedings and the accompanying social opportunities.

We have finished assembling the offers of papers and posters for the conference and will be developing a tentative program over the next few weeks. At this stage we have received 104 abstracts, mostly for oral presentations with some poster presentations. They come from 23 countries.

We have extended the deadline for papers and registration until mid-September, so if anyone wishes to send an abstract they can do so by sending me a email with the abstract as an attachment.

There is a good cross section of papers ranging across the 5 proposed symposia. There is also a good cross section of authors ranging from school teachers, tertiary academics and researchers, to geoscience agency people, and museum based geoscientists.

This gives four full days with 2-3 concurrent sessions if we allocate 30 minutes for the presentation, questions, discussion and changeover. We are planning field trips for Wednesday to break-up the conference and hope to be able to offer the same quality of experience as Hilo although we don't expect to find an active volcano. An initial program will appear on our conference website in October. We will contact everyone who has offered a paper soon, to confirm inclusion in the program and to request confirmation that the author is still coming to Sydney an is still able to present.

To those readers who have not made up their minds about whether to attend or not, I can assure them that there are some excellent papers. There is a good variety of topics ranging from practical classroom practice to curriculum design. The range is also truly international. We have been impressed by the quality and the common themes that are coming from people

all over the world. I think this confirms that we are part of an International Association which is growing in strength and in breadth.

Ian Clark on behalf of the conveners.

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"AROUND THE WORLD"

BRAZIL

Changes in Brazilian University Geoscience Education

The changing conditions in the geosciences and in the conditions for application of geoscience knowledge have brought on changes in university geoscience education in Brazil. The main changes in science and technology are:

Growing application of quantitative methods:

Mathematical and statistical methods, spatial and non-spatial, have become more elaborate and at the same time more accessible for all geoscientists, because of the spread of powerful and affordable computer hardware and software.

Information explosion:

Geoscience data are produced and processed in huge quantity, supported by automated analysis and data capture equipment, making possible access to all kinds of digital primary data, including remote sensing and map data. Geochemical, petrological, and paleontological databanks, Internet search systems, bibliographical networks, etc, make the collection of secondary data much easier.

Geographical information systems:

GIS enables the geoscientist to organize data and to apply computer analysis to solve geoscientific problems in a much more efficient way than before.

Less demand for traditional resource exploration professionals:

Much smaller numbers of geoscientists are needed for the traditional fields of metals and energy resources than in the boom years from 1950 to 1980.

More demand in the fields of water and non-metallic minerals:

Looking for water and construction materials, and support for their environmentally sound exploitation, employs a growing proportion of resource professionals.

More demand in the environmental field:

Environmental research, environmental impact assessment, projects for environmental control of resource exploitation and land reclamation, land use studies and plans, are only a few of the rapidly expanding activities which need geoscientists.

Multi- and interdisciplinary activities:

Environmental planning and environmental projects need scientists able to work in multi-disciplinary teams, and frequently are interdisciplinary in nature, and are not suited for narrow-minded specialists.

Less stable jobs, more contract and consulting work:

The old government and large company jobs, which provided training and a safe career options have disappeared. Most graduates will work as independent professionals.

Effects on Geoscience Teaching in Brazil

The different sciences within the geosciences and different schools react have reacted to some of the changes expressed above. Some examples of these changes follow:

- Almost all geoscience careers now require more quantitative analysis and schools have responded by developing more quantitative courses which include statistical applications, Geostatistics, and GIS. These applications are popular for both courses and dissertations. They will soon lose their reputation as "new knowledge" and become established tools for all geoscientists.

- Large investments are made in hardware and software to enable universities to handle the information explosion and to link faculty and students to global computer networks.

- Curricular changes happen, less rapidly than needed, due to the legalistic regulation of some professions in geoscience. The exercise of Geology, and Geography are regulated by law, and all courses have minimum curriculum requirements. Changes in law are needed to make changes in the number of courses and class hours. The older universities were founded by the union of independent professional schools, which keep their identity and make difficult, change in enrollment between courses. Tradition also plays a role in making change difficult. In some cases, like in the Geology course of the University of São Paulo, ambitious curriculum modernization was watered down in the voting process, resulting in keeping a large load of traditional subjects as mandatory courses, in a too large five-year course, with a minimum of 3,600 class hours, including an undergraduate dissertation comparable to a MS thesis from elsewhere. Modern subjects are kept as optional courses that only make up the professional training for specialized lines of study, for example, special diplomas, in Mineral Resources, Hydrogeology or Environmental Geology.

- A more ambitious initiative was undertaken by the Institute of Geosciences of the University of Campinas, which now has a new Geoscience course, which is comparable in the beginning years to the Geology and Geography courses. This is different from all other Geography courses in Brazil, which emphasize Human Geography, almost completely abandoning Physical Geography. A similar common beginning is proposed for Geology, Geophysics and Meteorology courses of the University of São Paulo.

- Some proposals are being done to change the official Curricular Directives for Geoscience courses, to reduce the minimum hours of Geology courses to 3,000 and to give a more professional and less academic character to the curricula.

- In some professional options, subjects dealing with Economy and Management are introduced, enabling graduates to work as independent consultants, and not only as employees.

- Keeping up with the public interest reflected in jobs, all Geoscience institutions now offer Environmental subjects, options and specialized courses. In some cases, as in the University of São Paulo, new Environmental Science graduate courses are offered, which try to bridge the gap between the specialized courses and schools, doing multi- and interdisciplinary research.

All these initiatives are undertaken at a time when both budgets and the political environment are hostile. University teaching and research suffer government budget cuts, and companies do not contribute to research even when they are directly benefitting from it. Faculty salaries and benefits are severely cut, making academic life less attractive as an option for graduates.

Arlei Benedito Macedo

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KOREA

Korean Earth Science Education - In the Middle of Reform

The 7th National Curriculum was developed in 1997. New textbooks have been developed according to the new curriculum guides. The 7th curriculum will be administered from the year 2000 and 2001 for elementary and secondary school level respectively.

One of the characteristics of 7th National Curriculum is introducing common core curriculum for grades 1 through 10. All subjects in common core curriculum, such as Korean language, moral education, social studies, mathematics, science, physical education, music, fine arts, practical arts, and foreign language, are compulsory. Earth science is taught as a part of science. The structure of the subject "science" is not layer-cake style but spiral in its nature. The proportion of Earth science in "science" is about one-fourth of every academic year. In the last two years of schooling, 11th and 12th grades, all courses in Earth Science are elective. Two groups of courses, general elective and advanced elective, are offered at this level. "Everyday Life and Science" is a general elective course, and "Earth Science I," and "Earth Science II" are for advanced elective courses.

The major goal of "Earth Science I" is enhancing Earth science literacy for students. "Earth Science II" is more academic in nature and is supposed to be offered to those who are seeking science-related careers. In spite of all this effort, the 7th curriculum seems to have too many themes in Earth science.

The 7th national curriculum also emphasizes enhancing students' self-directed learning, the ability based instruction through the adoption of enriching and remedial opportunities, and incorporating performance assessments into Earth science learning. Modern information technologies have been introduced into classrooms under the classroom modernization project since mid-1990s. A multi-media system is prepared in most classrooms in primary and secondary schools.

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UNITED KINGDOM

The Earth Science Education Unit at Keele University

We have been able to set up the Earth Science Education Unit at Keele, thanks to a generous grant from the UK Offshore Operators Association (UKOOA), the umbrella organisation for the oil industry in the UK. The funding has allowed us to secure from schools two Earth Science trainers (Peter Kennett and Anna Hrycyszyn) who will work with me, the Project Leader, to provide in-service education and training (INSET) at minimal cost to secondary schools in three pilot areas in England. Our offer is that, if schools provide traveling expenses and photocopying costs, we will visit the school to provide Earth science INSET to all the science teaching staff through interactive workshop(s) selected from our menu by the school.

As far as we are aware, this offer of virtually free INSET to individual schools is unique in the world (but please let us know of other examples) - it is certainly unique in Britain. We are very pleased that Earth science is able to blaze the trail in this way. It is certainly necessary, since research continues to show that the quality of Earth science education taught through the National Science Curriculum in schools, is poor. Most of the science teachers who are currently teaching the Earth science are aware of this, and have been asking for more INSET. We are very pleased to be able to offer it to them. We hope that further research will be able to measure the improvements that result from the workshops we provide.

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PHILIPPINES

Quite far from the dismal report I gave in the first issue, there seems to be a very positive turn of events as the next Geological Convention in the Philippines this coming December, for the first time, will contain a special section on geoscience education. Five abstracts have already been submitted for the convention, two of which are mine. Another is the invitation by National Institute of Geological Sciences (University of the Philippines) for me to speak before their faculty about geoscience education (Earth Systems Education). This is scheduled tentatively in September.

Moreover, we are currently in the process of writing a textbook for Grade 7 students which fully embraces the philosophy of Earth Systems Science. With these, I hope to realize a more active geoscience education in the Philippines in the next millennium. But for now, more is yet to be done.

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SOUTH AFRICA

SA Benefits from International Planetary Science Conference Expertise

The 62nd Annual Meeting of the Meteoritical Society was recently held at the University of the Witwatersrand, Johannesburg, from the 11th to the 16th of July - only the second time that this prestigious event has been hosted outside of Europe and North America. In order to mark the occasion, and to utilize the expertise represented by more than 200 of the world's leading planetary and Earth scientists, chemists and isotope geologists, palaeontologists, and physicists, the organizers undertook to ‘take science to the people’. To this end, support for a national lecture tour was sought, and obtained, from a variety of sources, including the Planetary Society, the Mineralogical Association of South Africa, Anglogold, and Rand Afrikaans University. The highlight of this program was undoubtedly the evening public lecture by Dr. Carolyn Shoemaker on the 13th July in Johannesburg, which was attended by more than 1,000 people, and which detailed her and her husband Gene's lifetime work on comets and asteroids, and their potentially catastrophic consequences for our planet. Dr.

Shoemaker also traveled to Cape Town to address the fledgling SAWISE (South African Women in Science and Technology). The remainder of the program, involving Alex Bevan (Australia), Monica Grady (UK), Christian Koeberl (Austria) and Sandro Montenari (Italy), was targeted primarily at outreach into areas beyond the main urban centres and into historically-disadvantaged educational institutions at these venues. Most of the talks drew audiences of 50-80 people and were received with great enthusiasm.

During the mid-conference break on Wednesday the 14th of July, conference delegates visited the Tswaing Meteorite Crater north of Pretoria, one of the world's best-preserved and best-studied recent impact craters, the origin of which was confirmed by Wits University researchers in the early 1990s. Besides the walking tour of the crater, they were also shown the plans for development of the site as an educational and recreational/ecotourism resource by Government, Universities, and Business in partnership with the local communities. The occasion was also used to unveil two new publications on the Tswaing Crater - a monograph on the 'Investigations into the Origin, Age and Palaeoenvironments of the Pretoria Saltpan' (Memoir 85 of the Council for Geoscience) edited by Prof. T.C. Partridge of the Department of Geography and Environmental Science at Wits University, and the first volume in the Council for Geoscience Popular Geology Series, entitled 'The Tswaing Meteorite Crater - An Introduction to the Natural and Cultural History of the Tswaing Region,' written by Uwe Reimold, Dion Brandt, and John Hancox of the Wits Geology Department, together with Robert de Jong of the National Cultural History Museum. Finally, a commemorative plaque was unveiled by Dr. Carolyn Shoemaker dedicated to the memory of her husband, Dr. Eugene M. Shoemaker, who is widely regarded by the planetary scientific community as the father of Planetary Science.

Prior to and after the conference, a series of conference excursions took place to the Gros Brukkaros Volcano and Roter Kamm impact crater in Namibia, the Vredefort Impact Structure southwest of Johannesburg, the Bushveld Igneous Complex, the Barberton Greenstone Belt, and northern Zimbabwe. Conference participants were unanimous in their praise of Southern Africa's rich geological heritage and clearly relished the opportunity to see for themselves some of these world-class features.

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"ARTICLES"

DECLARATION OF THE SECOND WORLD CONFERENCE OF SCIENCE JOURNALISTS, BUDAPEST, 4 JULY, 1999

(Reprinted with Permission)

At the Second World Conference of Science Journalists in Budapest at the beginning of this month the participants passed the following declaration and sent it to UNESCO Director General Frederico Mayor urging him to work on the identified issues and to found a World Federation of Science Journalists. The participants formed an international working group which will coordinate the efforts to establish such an organisation under the auspices of UNESCO.

We, the participants of the Second World Conference of Science Journalists, comprising 146 people from 30 countries, meeting in Budapest, Hungary, from 2-4 July 1999, and drawing upon the recommendations of the First World Conference of Science Journalists held in Tokyo, Japan, in 1992; Recognizing that Article 19 of the United Nations 1948 Universal Declaration of Human Rights states that: "Everyone has the right to freedom of opinion and expression. This right includes the freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers"; Recognizing that the historic Declaration on the Use of Scientific Knowledge and Science Agenda Framework for Action of the World Conference on Science, Budapest, 26 June-1 July 1999, place science firmly within its social and international context, and call on scientists everywhere to work on behalf of humanity; Recognizing the crucial, democratic and international significance of science journalism in linking the world of science and technology with the daily life of the ordinary person; Recognizing that, in concert with the conclusions of the World Conference on Science, the duties of science journalism must now be seen to be broadened and deepened, beyond the crucial clarification of science and technology to the clarification of their process, politics, ethics, and relations with society; Recognizing that these duties must be envisioned on an international scale, to match the globalization of science, technology, economies, politics and cultures; Recognizing that major social changes have taken place in the last decades of the 20th Century which have directly affected many science journalists; and that these changes have both helped and hindered science journalists depending on their national, regional and historical circumstances; Recognizing that the Internet and the World-Wide Web have contributed significantly to communication among scientists and have now become important tools for science journalism, especially by enhancing international communication; Present the following eight recommendations. We:

1. Call on all journalists of science, including the natural and social sciences and humanities, and including our colleagues in the closely related field of health and environment reporting, to recognize our increasing responsibilities to the people of the world to report accurately, clearly, fully, independently and with honesty and integrity;

2. Call on all science journalists to report with awareness not only of science and technology themselves, but of their social and political contexts and of their means of production;

3. Call on all colleagues to recognize the international dimensions and effects of science and technology, to jump the language barriers that divide the world and make increased efforts to report on and from countries and cultures other their own;

4. Call on editors, publishers, broadcasting organizations and other gatekeepers worldwide to recognize not only the wide public interest but also the increasing democratic and social importance inherent in science journalism, and to provide more support, space, program time, staff and training for journalists working in and entering this difficult but fascinating field;

5. Call for efforts to develop the information flow on the Internet in languages other than English;

6. Warn that while the Internet and the World-Wide Web enhance communication, the information so provided must like any source be constantly monitored for its quality, accuracy, objectivity and integrity;

7. Call on UNESCO and other organizations to support: the establishment of a world federation of science journalists associations; the convening by this world federation of biennial international meetings; and the creation by this world federation of a world community of science journalists through a well-designed, easily accessible, edited and quality-controlled world-wide web site;

8. Call on UNESCO and other organizations to do all in their power to support the establishment of facilities for the training of science journalists, which should be accessible to all regions and nations; which should fully reflect the new and wider role of science journalism made evident by the World Conference on Science; and which should be placed especially at the service of journalists from countries which can afford little training of their own.

Submitted by

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GEOLOGY AS A TOOL FOR IMPROVING SCIENTIFIC THINKING SKILLS

Scientific inquiry within the geological sciences has a unique characteristic, which differs from classical scientific inquiry. This characteristic is derived from geology’s involvement with "experiments" that were conducted millions of years ago by Nature. As a result, many geological inquiries are of a retrospective type trying to unravel what has happened in the past, using "fingerprints" left on the Earth. Conclusions derived from geological inquiry

might seem extraordinary or even imaginary in the eyes of a non-geologist (for example the rising of mountains above the sea, or the shifting of continents). Thus, it is very important that students are able to distinguish between direct observations, observations taken from secondary data sources, conclusions, assumptions and hypothesis.

In a learning program that we have developed, we use this retrospective type of inquiry, to enhance Junior-High school students' general scientific inquiry skills. "The Rock Cycle" is a 30-hour learning program focusing on geological processes, which transform the materials within the crust of the Earth. Each of these processes, magmatism, erosion, sedimentation, precipitation, metamorphism, and tectonic movement is learned in an inquiry method. The main sources for this inquiry are concrete items, which are natural materials of the Earth, brought to the lab, or studied in the field. The inquiry is performed as a group task, and guided by a booklet, which includes mainly questions, and only a minimal amount of declarative information. In this learning process the teacher mainly act as a mediator by helping the students to use the inquiry method for the investigation of the Earth and its processes. Her or his main role is to make the connections between the students and the scientific knowledge.

Each chapter in the workbook starts with observations, which create a certain cognitive problem. To solve this problem students follow a route of inquiry that we have designed for them in the workbook. Each chapter concludes with a "reconstruction activity", to make students more aware of the inquiry route they have just passed through. In these activities students examine their investigation with "scientific inquiry spectacles". This examination includes characterizing the different stages of the activity, using terms like "observation", "hypothesis" and "conclusion".

An in-depth study about the impact of the program, "The Rock Cycle" on 7^{th} and 8^{th} Grade Israeli students, showed that students who learned this program improved their scientific thinking skills. A questionnaire specifically developed for this purpose showed that students' ability to identify and distinguish between observations, conclusions and hypothesis had significantly improved. This questionnaire also showed an unexpected gender difference, in which girls were favored over boys, in terms of scientific thinking skills. Another important result of this study deals with the effect of teaching on the scientific thinking skills acquired by the students. Our results show a very large variance among students who were taught by different teachers, indicating that the quality of teaching is a critical factor - only good teaching can improve thinking skills, whereas bad teaching can even cause damage in students' scientific thinking abilities!

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COGNITIVE ASPECTS OF STUDYING THE WATER CYCLE IN AN ENVIRONMENTAL CONTEXT

For the last several years, we have been intensely involved in the development of a new Earth science curriculum for the junior high school level. This curriculum is based on the Earth systems approach and includes a unit about the hydrosphere for the 8th Grade students. We designed this unit within an Earth systems context in order to help students achieve environmental insight. Such insight is largely based on understanding the cyclic mechanisms of our planet. Our main goal is that students should be able to translate environmental problems, such as water pollution into a more coherent understanding of the environment. With such understanding, students might hopefully see the environment as a series of interacting subsystems, with each influencing the other.

In order to fulfill the above general goal in the hydrospheric context, we chose the water cycle as the unifying concept of the curriculum unit. The curriculum materials present the water cycle as a part of a wider set of recycling systems, which include the geosphere, the biosphere and the atmosphere. Environmental problems are presented within the context of this relationship between the hydrosphere and the other components of the Earth systems. Moreover, the relationship between the hydrosphere and the other Earth systems is a result of the transformation of matter (especially water) between the different systems.

The development of the new curriculum unit was preceded by a pre-development study. A formative evaluation followed the completion of the first implementation phase.

The Pre-development Study:

The pre-development study included the following two objectives: a) to identify junior high school students' previous understanding of the water cycle, and b) to explore the students' perceptions of the cyclic and systemic nature of the water cycle.

In order to collect the needed data, a series of specific research tools were developed for this study. These tools including interviews and open and closed questionnaires. The following is a brief description of these research tools:

A Questionnaire for Assessing Students Knowledge (ASK):

This questionnaire includes two parts: Part A includes a Likert-type questionnaire, where students were asked to mark their level of agreement with a list of statements concerning the water cycle. The following are two examples: 1) The composition of a cloud, which has formed above the sea of Galilee is different than a cloud that has formed above the "Dead Sea", and 2) underground water is actually underground lakes that are located within rocks. In Part B, the students were asked to draw the water cycle on a blank paper. For this task, they were provided with a list of the main stages and processes that are included in the water cycle and they were instructed to try to include as many stages and processes as they can from this list.

A Cyclic Thinking Questionnaire (CTQ):

In this Likert-type questionnaire students were asked to mark their level of agreement with a list of statements concerning the cyclic nature of the hydrosphere and the conservation of

matter within the Earth systems. The following are two examples: 1) the amount of water in the ocean is growing from day to day because rivers are continually flowing into the ocean, and 2) the cloud is the starting point of the water cycle and the tap at home is its end point.

Interviews:

Interviews were conducted with 40 students, once they had completed all of the questionnaires. The interview phase had two main objectives: 1) It served as a tool for validating the students answers on the questionnaires, and 2) it gave us an insight into the students perceptions of the water cycle. During the interviews, each student was asked to read his answer, and to say whether he still agreed with his answers and his drawing and to elaborate on his response. After the explanation, the interviewee was asked more questions in relation to his specific explanations.

Approximately 1,000 junior high school students (7th-9th grades) from 30 classes in 6 urban schools participated in the pre-development study.

Analysis of the pre-development questionnaires indicated the following:

- Most of the students demonstrated an incomplete picture of the water cycle and possessed many misconceptions about it.

- Children that drew the water cycle usually represented the upper part (evaporation, condensation and rainfall) and ignored the ground water system.

- More than 50% of the students could not identify components of the ground water system even when they were familiar with the associated terminology. In their mind, underground water is seen as a static, sub-surface lake and water solution chemistry is fixed throughout the entire water cycle. We suggest that those misconceptions reflect students' lack of environmental insight concerning the Earth system.

A significant correlation was found between cyclic thinking and those drawings of the water cycle which included the groundwater component. The following quote is an example from a student who drew the underground water system and his concept concerning the cyclic nature of the water cycle. "There is no starting point and no end point in the water cycle. It is a continuous process."

Analysis of the pre-development study suggests that the students' ability to perceive the hydrosphere as a coherent system depends on both scientific knowledge and cognitive abilities.

Scientific knowledge is composed of two elements: a) factual-based knowledge that includes acquaintance with the components of the water cycle and awareness of its processes, and b) process-based knowledge, namely a deep understanding of the various processes that transform matter within the water cycle.

Cognitive understanding is also composed of two elements: a) cyclic thinking: understanding that the water cycle is a system which has no starting or end points, and moreover, that the same matter is transformed many times within the system, and b) systemic thinking, which is

the ability to perceive the water cycle in the context of its interrelationship with the other Earth systems.

The Development Phase:

The findings of the pre-development study served as a basis for the development of the interdisciplinary program named The Blue Planet. This program focuses on the water cycle as an example of the relationships seen amongst the various Earth systems. It emphasizes a systemic approach by addressing the following aspects:

1. Presenting a coherent depiction of the various processes (chemical, physical, geological and biological) which effect each stage of the water cycle.

2. Relating the water cycle to the different elements of the Earth system.

3. Presenting the water cycle in a Science Technology and Society (STS) format.

4. Using constructivistic methods to alter the students' misconceptions of the water cycle.

5. Using computers to access global data bases so that the students will better understand that the water cycle is a worldwide phenomenon.

The program also focuses on the role of man within the water cycle. To fulfill this goal, the following subjects were included:

- Availability of water resources for human use.

- Understanding various components of the water cycle.

- Surface water and ground water resources.

- Human involvement in preserving water quality.

- Understanding Israel's water needs.

- Sustainable development and water resource management.

- Water as an ecosystem.

Evaluation of the First Implementation Phase:

This study examines the effect of studying the water cycle, and its connection with man, on the development of environmental insight among Junior High School students. More specifically it focused on the following aspects:

- Exploring students’ conceptions and attitudes concerning man's relationships with the Earth system.

- Identifying the types of alternative frameworks students possess concerning the various components of the water cycle.

- Identifying changes in knowledge and cognitive skills developed by students who were exposed to the The Blue Planet program.

The research population of this phase included 700 Junior High School students who studied The Blue Planet program. In this phase, we used research tools of the pre-development study that we have modified following the first trial. In addition we added the following two tools:

1) Concept Maps

The students were asked to create concept maps at the start and finish of the learning process. Comparison of the number and type of items between the concept maps served as a measure of change in the students' knowledge and understanding of processes. The number of connections between the concept maps served as an indication of students' understanding of the relationship between the components of the water cycle.

2) Observations

In order to track the learning event itself, regular observations were conducted in the classes. The observer used a structured observation report that directed her to document the type of activities of both students and the teacher.

Findings:

The following are the findings from the evaluation study of the first implementation phase:

Our observations indicated that for the most part, the teachers concentrated on scientific principles and only little on the cognitive aspects of the connections between the water cycle and the other Earth systems as well as environmental case studies. In addition, most of the teachers tended to ignore the constructivistic activities that were specifically developed to correct students' misconceptions, as well as to develop a broader and more coherent perception of the water cycle within the Earth systems context.

A significant improvement was found in the students' level of knowledge (specifically acquaintance with the components of the water cycle).

The students significantly improved their understanding of the evaporation process. However, in relation to all the other processes only a minor improvement was found.

The analysis of the cyclic and systemic thinking questionnaires (CTQ, STQ) showed some improvements in students' understanding of the different types of interrelationships among the Earth systems. However, even after learning the program, students still have a poor understanding of the systemic nature of the water cycle. Most of the students showed a fragmented perception of the water cycle and make no connections between the atmospheric water cycle and the geospheric underground water cycle.

Conclusion and Implication:

These findings indicate that improvement in knowledge is not enough for the development of environmental insight. For this purpose students should develop their cognitive abilities in cyclic and systemic thinking through learning activities directly developed for this purpose.

In this study, we found that although such activities existed, teachers tended to ignore them. Thus, more effort should be invested in teacher training in order to convince teachers that better knowledge for itself does not contribute to the types of cognitive thinking skills that are necessary for gaining environmental insight.

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"NOTES, COMMENTS, HELP NEEDED"

Suggestions for Web Links:

I was thinking that a good idea could be to organize an international WWW link on the subject "Geological Monuments of the World", with nice photographs, simple explanations and lots of links to related rocks and processes all around the world. Finally let me invite you to visit our web site at http://157.92.20.135/aula-gea?AulaGEA.html/.

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