AC 2007-2650: IMPLEMENTATION OF A PARTNERSHIP TO IMPROVE APPLIED SCIENCE EDUCATION AMONG WOMEN IN UGANDA

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Abstract

The economic, education, and health problems facing Uganda are immense. The average life span is around 42 years of age. Health clinics, potable [drinkable] water and electricity are not readily available for most citizens in rural areas. Many of the public schools and universities lack the facilities to adequately support education in the physical and biological sciences. The literacy rate needs to be improved to promote better understanding of health matters.

In the summer of 2004 three electrical engineering faculty members from Pennsylvania colleges went on a study tour of western Uganda in response to an invitation from community leaders in the Bunyoro-Kitara region.

The goal of the visit was to assess needs and challenges in science education. The team visited 12 secondary schools, three elementary schools and two universities. The team was surprised and encouraged by the number of Ugandan women students at each level committed to a career in science. The team had extensive discussions with parents, community leaders, science teachers, head teachers and female students and collected data to try to quantify the reasons for the intense interest. The team also observed students in the classes and toured science laboratories and school facilities. Follow up visits and dialogues lead to the development of a partnership among parents, community leaders, church leaders, educational leaders and the visiting engineering faculty team. Strategies have been developed and are being implemented that address the challenges of recruiting Ugandan women into the fields of science and technology as well as developing a support system to ensure their success.

At the college level we have characterized the five core areas of molecular biology.

Introduction

Uganda, officially the Republic of Uganda, is a country in East Africa, bordered on the east by Kenya, the north by Sudan, on the west by the Democratic Republic of Congo, on the southwest by Rwanda, and on the south by Tanzania. The southern part of the country includes a substantial portion of Lake Victoria, within which it shares borders with Kenya and Tanzania.

In some sections of Uganda (northern and near Sudan) there was, until recently, fighting going on between the government forces and the Lord's Resistance Army. In general most of the country has political stability.

The capital, Kampala, with a population of 1,208,854 (2002), is located in the south. It is a modern city and a center of business activity. Kampala has the highest rate of HIV/AIDS for Uganda. Makerere University, situated in Kampala, has 30,000 undergraduate students and 3,000 graduate students. It offers courses in many areas: business, law, education, sciences,

engineering, medicine, dentistry, veterinary science, agriculture, forestry and natural conservation, social sciences, psychology, and computing and information technology. Some refer to it as *"The Harvard of Africa."* It was founded in 1922 as a technical school, and in 1963 became The University of East Africa.

However, Makerere University does not adequately serve the educational needs of rural Uganda.

Many of the graduates of Makerere chose not to return or settle in rural Uganda.

Unfortunately, like in many African countries, there is a "brain" drain in Uganda. Many professionals chose not to stay in Uganda. They migrate to other countries having a significantly higher standard of living and a "safer" environment.

More than 85% [1] of Uganda's 28 million [2] people live in rural areas where an estimated 43% [3] (10.2 million people) do not have access to safe water.

However, the economic, education, and health problems facing Uganda are immense and are compounded by:

1) poor infrastructure to sustain life,
2) lack of resources and inadequate education to combat disease [average human life span being around 42 years],
3) lack of veterinary care for farm animals for much of rural Uganda,
4) inadequate supply of potable water,
5) lack of electrical power for villages, schools, hospitals, and clinics [problem with food preservation],
6) lack of waste handling and treatment facilities for most communities, and
7) lack of a manufacturing base to provide employment.

General Needs

There are many problems to deal with in building up the infrastructure of Uganda. Medical authorities and the World Health Organization (WHO) have stressed the need to provide safer water, and promote public awareness of health measures to stem the HIV/AIDS rampage. Education in the schools needs to better address public health issues. The literacy rate in the rural and poorer sections of Uganda needs to be raised to promote more effective communications in health matters.

There are major infrastructural needs that require the services of professionals, technicians, and highly skilled workers. Most importantly, funding sources are needed in order to acquire the services of skilled people and also needed equipment. The agricultural and manufacturing base needs to be expanded to provide goods for export and jobs to feed money back into improving the rural communities and addressing health issues.

Hospitals, schools, clinics, community government centers need support and trained personnel – many coming from the biological and technology sectors. Water supply systems require monitoring and maintenance. Transportation vehicles require maintenance. Electronic

instruments and computers require skilled service people. Electrical generators and battery systems require skilled workers to maintain them.

Rural Community Needs

For some communities assistance is needed in dealing with waste problems. There are human and animal waste issues that require attention. Aluminum is so expensive to extract from minerals that recycling is essential. The rising prices of metals – copper for instance – has encouraged the criminal element to cannibalize equipment essential for community services. Jobs are needed to reduce criminal activities pursued by those just trying to survive.

As rural communities establish water supply systems, people trained in technology will be needed for their construction and maintenance. As populations in villages increase, technologists will be needed to deal with problems in waste handling and treatment.

Community libraries need to be established with Internet connectivity to facilitate informational retrieval.

Rural communities need services of those trained in technology to build up the infrastructure. As electrical distribution systems are extended to rural areas, there will be a need for technologists. There will be a need to have people trained in the technology of building and maintaining small power systems for schools, health clinics and public office buildings. As computer and Internet services are extended to schools and offices of local public officials, persons trained in the applied sciences will be needed.

Farming and Wild Animal Preserve Needs

Farmers need assistance in raising crops and in the care and treatment of their animals. Persons trained in plant pathology and agricultural chemistry are needed. One has to be very concerned about the use and possible misuse of insecticides and pesticides.

There are three problems with wild animal preserves: diseases, poachers, and destruction of habitat by animal and man. Biologists are needed to help overcome some of the major problems.

Clinics and Health Care Needs

Services at health clinics need to be expanded for those living in rural areas. Many communities need electrical power. Some health clinics and schools operate with inadequate or no electrical power. Many communities even lack the low-level power to operate computers and accommodate Internet connectivity. Health clinics stand to benefit from having Internet connectivity and computer printers.

College and School Needs

Many of the public schools and colleges lack facilities to support education in the physical and biological sciences.

There are three key tools for the study of elementary biology: an optical microscope, a camera, and statistics. To facilitate the use of statistics, a pocket calculator with scientific functions, a personal computer, and statistical software are preferred. For data gathering and field studies a digital camera is most useful. The appropriate companion for the digital camera is a PC with image processing software.

For high schools electrical power is needed for illumination of microscope subjects and for the operation of centrifuges. Solar panels and battery systems can provide the power for illumination in microscopy and the operation of computers. To provide the electrical power to operate centrifuges a small combustion generator would be needed. To support the education in biology useful experiments need to be identified that bear on the identification of organisms associated with water.

For many schools, microscopes, ultra-centrifuges, gel-electrophoresis units, histology reference slide kits, and digital cameras for field studies are needed for biology labs. Water analysis instruments for use in the field and in the laboratory are essential for biology. For cell biology chromatographic apparati are essential to support fractionation. The following chromatic apparati are needed: (a) partition (paper), (b) thin-layer, and (c) column.

Instruments are needed for use in chemistry to prepare materials and process samples. To promote laboratory safety, eye wash stations, chemical storage cabinets and exhaust hoods with utilities are needed. Stills are essential to generate laboratory grade water for use in both chemistry and biology.

Models and PC software are needed for geometry courses so students can better grasp three-dimensional geometry for their pre-calculus courses. Software for displaying the composition of sine and cosine waves and studying wave motion is recommended for both trigonometry and physics. Equipment to demonstrate diffraction and interference of water and light waves needs to be acquired. Equipment for use by the physics and chemistry teachers in demonstrating emission and absorption spectroscopy is needed.

Instruments for measuring circuit parameters are needed for physics labs. A meter for measuring intensity of sound waves is needed.

Approach

This paper has two themes: (1) major needs in infrastructure for Uganda have to be addressed and (2) both men and women with the appropriate education are needed to address those needs.

For Uganda, where we have had considerable experience, we argue that we must help build up its infrastructure so that the graduates of their schools and universities can go on to help their society.

Some might ask why one would give such strong emphasis to education in the biological sciences at an engineering education meeting. The answer is simply that the “handwriting was on the wall” back in 2001. Then, the National Institutes of Health (NIH) addressed crucial National needs in the news media. {NIH is an excellent source of funds to sponsor university

research.} Data was published on graduate education. NIH provides information on core research areas that are directed at meeting important National needs. The data published in the newspapers indicated that the number of doctoral degrees granted declined in American universities in all areas but two - computer science and the biological sciences.

Just after 2001 a significant portion of the money to support research was coming from the computer and biological areas. Shortly thereafter, more engineering professors were submitting successful research proposals to private industries, foundations and government agencies to do work in the biological sciences.

At Carnegie Mellon University, a "tissue engineering center" was established. At Cornell University engineers have been working in the biological science areas. The same thing is happening at the Pennsylvania State University. Some of the University of Pittsburgh engineering faculty members are pursuing research relating to "regenerative medicine."

The funding crisis required a change in the mind-set of some engineers in academia. Simply put, they felt that they had to focus more of their reading in the molecular and life sciences.

Addressing Some of the Infrastructure Problems of Uganda

The short-term solution for many health problems of rural Uganda has three components: The first (an engineering solution) is to provide a supply of safe water. The second (an educational solution) is to help the people learn the techniques necessary to 1) obtain and maintain the source of the safe water and 2) assure the safety of the water supply. The third (an educational one) is to strengthen the public health program by promoting better health practices among the public. To help achieve the third one Uganda needs to provide more applied science personnel in the biology area to interact with the general population.

The solution to the problem of building the infrastructure in rural areas in the non-health sector has two components:

- The first is to develop a sound plan (an engineering solution).
- The second is to obtain government approval and find financial funding (grants, community input, and government input).

To obtain the needed technical and labor personnel – engineers, technicians and skilled labor – one would select from the available pool (an educational matter). So the governmental sector must provide support for educating sufficient people with training in the various disciplines.

Many would contend that the "best" investment for the future is in the educational sector. They argue that Uganda must build up its infrastructure so that the graduates of their schools and colleges can go on to help Ugandan society.

To address the "brain" drain in the applied sciences and technology something has to be done and soon. Promoting the education of women to alleviate the "brain" drain has its merits. It is also important to do so for other reasons – fairness, equality, and equal opportunity.

Because of the low expectancy for life, low salaries for professionals, and shortages of jobs in Uganda, there is a desire to locate to a "safer" country where the standard of living is higher and opportunities are better. Some who graduate from colleges and universities in Uganda seek employment outside of Uganda. Some professionals from British Commonwealth Countries in Africa go first to the UK or Canada before moving on to a country having the desired standard of living.

Often professionals marry so that when the family migrates to a country of higher standard of living both become employed. "Brain" drain data is not available to the authors on the fraction of single males and single female professionals that immigrate to countries of higher standard of living. It is conjectured that the fraction is higher among the single males than among the single females.

Numerous colleges in Uganda are not oriented toward providing education in the sciences and technology – choosing instead to emphasis theology, business, and law. This creates problems in addressing issues in strengthening the country's infrastructure and combating disease affecting the life expectancy.

Developing countries must eventually address the interaction of "science, technology, and society." This involves both men and women in each of the three areas. There are important environmental, public health, and ecological issues that require participation of men and women. Children in the secondary schools need to become aware of the interaction of science, technology, and society.

For appropriate education in the sciences and technology, experimental matters need to be pursued so that the graduates acquire the needed practical skills. But laboratories are expensive to provide and require special expertise on the part of teachers. Some though argue that "virtual" labs can be substituted for the "real" thing. In human anatomy courses in some American medical schools the "virtual" approach is being used with justification since the cadavers being old do not give a meaningful or relevant experience. Some physics labs can be conducted with the use of "game physics." But there is much in the chemistry, biology, and medical arts that require interacting with the "real" thing.

Uganda will need a diversity of technicians trained in the applied sciences to address problems in rural areas. They will need two kinds – those oriented to work with scientists and those with engineers. Some of the scientists and engineers who direct the efforts of technicians will be women. With the current migration of Uganda's finest professionals to other countries, an effort is needed both in education and in making it attractive for Ugandan engineers and scientists to remain in Uganda.

Opportunities for public school teachers to upgrade their background in the biological, chemical, mathematical and physics areas are either not adequate or difficult to take advantage of because of the travel distance or lack of supporting funds.

In the high schools of Uganda for the study of classical biology, there is a need to have microscopes and centrifuges. Electrical power is needed for illumination of microscope subjects

and for the operation of centrifuges. Many high schools in Uganda lack electrical power to operate centrifuges. Solar panels and battery systems can provide the power for illumination in microscopy. Useful experiments in biology need to be identified that bear on organisms associated with water.

Rationale for Promoting Education in Molecular Biology

Combating disease and the prevention of its spread relies to a great extent on the understanding of biology. All those in the medical, dental, and veterinary arts need an understanding of biology with a detailed knowledge of clinical microbiology for the study of bacteria and viruses and the basic elements of immunology. A useful source of information on immunology is the text by Benjamini et al [4].

Those in biology understand that many diseases that humans acquire come from drinking "bad" water and from transmission by coming into contact with sick animals that just serve as carriers. In poorer densely populated countries, humans often co-exist with animals in their living quarters, thus influenzas are rapidly spread. Many people understand that some horrible diseases are passed from human to human without being transmitted sexually. As so many of us have learned from experience, certain diseases are easily transmitted though the air when a person is close to a sneezing or coughing sick person. Even hospital staff members take special precautions in dealing with persons who have a difficult infectious disease. Isolation, masks, gloves, etc are needed. With so much emphasis placed on travel by airplanes, infectious diseases [such as SARS] and epidemics become more serious problems. Airborne animals [birds and insects] can propagate infectious diseases.

Specialists from the USA, UK, France, and WHO trained in epidemiology have for decades been focusing attention on diseases in African countries. The epidemiologists are specialists in medicine that study the incidence and prevalence of diseases in large populations. They often focus on the source and causes of epidemics of infectious diseases. When there is an outbreak of a dangerous disease in Africa, teams of epidemiologists rush there.

The rampage of HIV/AIDS and hemorrhagic fevers underscores the need to educate both men and women in many areas, including the applied sciences and technology.

Uganda for the short haul has placed much attention on the letter approach [5] ["A, B, and C"] to combat HIV/AIDS and according to the WHO has been rather successful even in the absence of a vaccine.

However, for the long haul to combat disease, one might argue well that Uganda needs to add another letter, "D", to the letter approach. By the letter, "D", we imply Develop educational programs at the college level with the primary goal being to train more men and women in molecular biology.

The hope for the future of African countries is in applying the knowledge of molecular biology to combat disease. In many advanced countries, conventional medicine is already being augmented with molecular medicine. The promise of molecular medicine is that we will have a

better way to detect disease earlier, treat the patient less invasively, and understand disease and its progress more thoroughly. Promising advances are being made through regenerative medicine, stem cell research, and tissue engineering.

Molecular biologists have the need to understand much from classical biology, microbiology, human anatomy, physiology, immunology, and haematology in order to make progress in treating and controlling disease. An elementary account of haematology has been provided by two scientists [6] [Hughes-Jones and Wickramasinghe] from England. The problems of dealing with hemorrhagic fevers [arbovirus infections] and HIV/AIDS are no more challenging than in Africa. The fatality rate is extremely high among those contracting hemorrhagic fevers. Diseases are decimating the gorilla populations in Africa. HIV/AIDS has almost halved the life expectancy in many African countries.

Classical biology, prior to the 1950's required only a scant knowledge of chemistry, mathematics and physics. With the discovery of the structure of DNA which some claim is the most important molecule of life, research in biology started to undergo a transformation in Australia, Canada, Europe, India, Japan, the USA and in other countries.

With the exceptional foresight and backing of Charles de Gaulle in the late 1950's, the French started to aggressively support research in molecular biology. By 1965 Francois Jacob, Andre Lywoff, and Jacques Monod, received the Nobel Prize for their Operon Model, coming out of the study of E. Coli bacteria. Francois Jakob [7] has provided an account for the laity of the modern revolution in biology. His book, ***Of Flies, Mice, and Men***, was translated into English by Giselle Weiss and published by Harvard Press.

Molecular biology is perhaps best characterized by identifying its five core areas: (1) biochemistry, (2) molecular cell biology, (3) molecular genetics, (4) biophysics, and (5) mathematical biology.

We cite examples of American and European textbooks for those interested in pursuing molecular biology further. For biochemistry we have the text by Mathews and Van Holde [8], for molecular cell biology the text by Alberts et al [9], for molecular genetics the text by Hartwell et al [10] [Nobel laureate], for biophysics the trio of texts – Glaser [11], Cotterill [12], and Sybesma [13], and for mathematical biology the elementary text by Yeargers et al [14].

The revolution in biology in the '50s underscored the importance of chemistry and other allied sciences in understanding biology. Three of the five core areas of molecular biology are steeped in biochemistry. Biophysics involves a significant amount of physical chemistry. Physical chemistry is calculus based.

What all this translates into is an action plan for the educational sector of Uganda.

That plan calls for the strengthening of the teaching of chemistry, mathematics and physics in the secondary schools in order to lay the basis for understanding biology and the subsequent combating of disease.

Findings from Faculty Visits to Uganda

In the summer of 2004, three electrical engineering faculty members from Pennsylvania went on a three-week study tour of rural northwestern Uganda in response to an invitation from community leaders in the Bunyoro-Kitara region[15]. The main objective of the tour was to observe first hand how science education was being accomplished in rural secondary schools. The faculty members were invited by the Church of Uganda Bishop whose Diocese shares part of the responsibility for operating the rural secondary schools in northwestern Uganda. The Diocese Education Director, under the direction of the Bishop, arranged the visits to the individual schools and participated in the study as an equal member of the study group. The team visited the science programs of 12 secondary schools. Prior to the trip the team drafted a series of questions to serve as a springboard for discussion with the headmaster, teachers, students, parents and community leaders.

The schools visited were approximately 50 km apart so about one-half of each day was spent traveling to the sites. On one day a secondary school teacher traveled with us; on another day, a church leader and parent traveled with us. Generally a visit began with a meeting with the school headmaster. The team was then introduced to the science teachers who showed the team the science facilities, lab equipment and text books and then introduced the team to the science students. A visit ended with a luncheon or dinner banquet prepared by school staff and parents.

In order to obtain a complete assessment of the needs and challenges in science education, the team also visited three elementary schools, two universities, several engineering based operations and other civic and church leaders in Uganda. The two universities visited were Makerere University and Uganda Christian University, both in or near Kampala. The team also visited with the committee responsible for developing a new rural university in northwestern Uganda to be named Bunyoro University for Development (BUD).

The study team was able to observe students and teachers in their classroom settings, tour science laboratories and school facilities and collect data that would be helpful in determining reasons for the significant lack of interest and lack of success in studying science among students, both male and female.

Key Findings of the Study Group Relative to Improving Engineering Education Among Ugandan Women

1. **Parental and societal support** are crucial for the success of secondary education. The study group visited one school where the organization of parents raised the needed funds to purchase an electric generator so that the school would have its own electricity. Assisting in the financial aspects is a source of great burden for parents who provide a very significant portion of school finances owing to the government's lack of resources for investment in schools as well as their operation. The study group also visited another school that was connected to the Internet. The connection was made possible through collaboration of a parent's group that purchased the network ready computers and an NGO that provided the Internet service. The study group found that the schools where parental support was significant were the ones that had the greatest success of its graduates going on to advanced education.

2. **Parental and societal encouragement** are also crucial. Education is clearly viewed by some parents as the most probable avenue for empowerment and advancement. One of the students that the study group interviewed at the electrical engineering department at Makerere University was the daughter of an administrator at another university in Uganda. The student told of her aspiration to become the Minister of Science of Uganda. She was following the path trough electrical engineering at the encouragement of her father. The study group had the opportunity to meet her father on another occasion and it was obvious that he placed great emphasis on science education. Several other parents that we interviewed as well the Diocese Education Director told us that when they were secondary students, they wanted to pursue science education but could not because of lack of family encouragement as well as educational science resources.

3. **Universal primary education** adopted in January 1997 has increased access and retention of students at the elementary school level. Estimates are that the ratio is 47 % female to 53 % male. However, we found the representation of female learners in secondary science courses to be less than 20 % female. However, the study group was encouraged by the fact that the female students seemed to be holding their own and were doing well according to their teachers.

4. We met many **female role models**. Some of these women were technically trained and were functioning as managers of computer, farming and engineering operations. One was the manager of a rural solar and alternative energy educational center. One was the manager of a computer school and another was the manager of 50 workers at a newly developed coffee plantation (since 2000). The team had the opportunity to attend a university building dedication ceremony at which the President of Uganda acknowledged the presence and work of a research agriculturalist. The team also had the opportunity to observe a meeting of a regional HIV/AIDS working group which was made up of approximately 75 % women. However, it should be pointed out that all of the secondary science teachers, secondary school headmasters, and faculty in the technology programs at the universities that we visited were all men.

Strategies for Improving Secondary Science Education

Since upgrading the quality of science education is essential for strengthening the abilities of African countries such as Uganda to wage war on disease, we have pursued the identification of educational resources.

The authors of this paper have been constructing a resource kit for use in helping to support biology education at both the secondary school and university levels. We have also devoted a significant portion of this effort to the allied science areas needed to support the study of molecular biology.

We mention only a few of the books of definite benefit to students and teachers in Uganda.

In the biology area we have identified two books for both secondary school and college students. One is a field guide, ***Bacteria***, by Betsey Dexter Dyer [16] [It can be conveniently used with an optical microscope.] Another is an excellent introduction to the microscope and photomicrography, ***Photography through the Microscope***, by John Gustav Delly [17], published by Eastman Kodak.

In chemistry and physics, there is a most helpful book on subatomic particles written by a Nobel laureate, Steven Weinberg. When he was at Harvard, he had occasion to teach an elementary undergraduate course on science for liberal arts students. Out of that course came one of the clearest elementary books ever written on subatomic particles. It is entitled ***The Discovery of Subatomic Particles***, Revised Edition [18].

Those who pursue water supply, treatment, and distribution need an understanding of several disciplines in both the science and technology areas. An excellent introduction to the study of water for human consumption has been provided by Julie Stauffer, a Canadian biologist, in her book for the lay person "***The Water You Drink"*** [19]. A most important step in the treatment of surface water is that of disinfection. One must render inactive or kill all the pathogens in the water – bacteria, amebic cysts, algae, spores, and viruses. A residual disinfectant is also needed to prevent recontamination. As noted by Ms. Stauffer on page 36, "Unfortunately, no single disinfectant meets all these requirements, and choosing the most appropriate one means making trade-offs." She goes on to say, "The most commonly used disinfectants are chlorine, chloramines, chlorine dioxide, ozone and ultraviolet irradiation." Some of these are extremely toxic materials and require special safety procedures and highly trained personnel.

The team is also investigating funding opportunities to provide the necessary lab equipment and text books in order to make the improvement in secondary science education possible. Smaller lab equipment and some textbooks have been acquired but the need for microscopes, other lab equipment and funding for teacher continuing education are still critical things.

Strategy for Promoting Women's Participation in Engineering and Scientific and Technological Education

We plan to work in partnership with the three organizations in Uganda that have recognized the needs and are actively addressing the problems. We hope to develop a coalition to pull the resources of each organization together for the betterment of Uganda in general and for young ladies and women in particular.

First, we plan to work with the Church of Uganda Bunyoro-Kitara Diocese who originally requested our help. The church is extremely influential and offers several programs where we can effectively encourage parental participation and encouragement and encourage women to participate in engineering. One such program is their "water well drilling program". Engineers from the US have developed a technique based on older technology whereby a water well can be drilled for $500 [20]. Ten wells have been drilled by the Ugandans working with the engineers. There were unique problems that occurred during the drillings that required engineering solutions. Men and women will be encouraged to work together to drill the wells and to study the biology necessary to treat the water when necessary and to evaluate the quality of water. Another program is the "coffee plantation program." Fifteen acres were developed in 2000 by a partnership of US business people and the Church of Uganda. The coffee plants are now producing beans and are marketed successfully. The coffee plantation can serve as a laboratory where both men and women can study the agricultural engineering and business skills necessary to develop the land as well as learn the skills necessary to market the crop.

In order to recruit women into engineering, we plan to work with two organizations in Uganda that have experience in this area. The Association of Women Engineers, Technicians and

Scientists in Uganda (WETSU) have as its mission: To promote women's participation in engineering, scientific and technological education and work so as to enhance development and uplift the status of women. A second organization that we plan to work with is the Forum for African women Educationalist-Uganda (FAWE-Uganda). FAWE's mission is to work, together with its partners, to create positive societal attitudes, policies and practices that promote equality for young ladies in terms of access, retention, performance and education quality through influencing the transformation of educational systems in Africa. The Church of Uganda offers programs where large numbers of children are gathered together on a regular basis. One such program that they sponsor is a Saturday morning meeting of primary and secondary age boys and girls. Several hundred children attend these once a week meetings primarily to watch DVD videos that are projected on a big screen. We hope to provide an opportunity for representatives from WETSU and FAWE to talk to the children and discuss case studies as well as distribute their brochures.

Conclusion

It can be argued that the best investment for the future is in the educational sector. African countries, such as Uganda, must build up their infrastructure so that the graduates of their schools and colleges can go on to help their country's society. Providing trained Ugandans who will strengthen their country's infrastructure and promoting the education of men and women in the sciences, the applied sciences, and technology merit strengthening.

Many efforts had been made in the past to promote education of men in many fields. We need to encourage more women to pursue the study of science, applied sciences, and technology.

We have identified measures that should be taken in Uganda to promote the education of women in the sciences and engineering and organizations that are now helping the education of women.

For the long haul to combat disease, one might argue well that Uganda needs to add another letter, "D", to the letter approach – Develop educational programs at the college level whose goal is to train more men and women in molecular biology.

Out of convenience and taking country stability issues into consideration, we have chosen to first concentrate on Ugandan rural secondary schools. We have already made significant progress in constructing a resource kit to promote the strengthening of biology education.

Some of the graduates of the rural Ugandan secondary schools will continue their education in engineering, the sciences, and the medical arts.

For engineering graduates of colleges, there will be economic opportunities in both the private and government sectors. Students with technology degrees generally find more private employment opportunities than those from the pure sciences.

For those biology graduates of colleges who want to enter the work force, there must be immediate economic opportunities. Some of these science and technology related jobs should come from the government sector in areas of public health and community development. Some will come from private firms that provide consulting and community services.

If meaningful job opportunities for the biology graduates are not created within Uganda, the graduates will seek employment in other countries, contributing further to the "brain" drain.

Thus, the development of the educational program in biology at the college level must be done with the government's participation.

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