

## **WaterRediscover: Promoting Scientific Research among Middle and High School Students across the Globe**

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### **Abstract**

WaterRediscover is a program coordinated by Nanoenvirology Research Group of Civil and Environmental Engineering Department at North Dakota State University to promote science, technology, engineering, and mathematics (STEM) research among middle and high school students from across the world. It is aimed at training the younger generation with the skill set necessary to carry out scientific research. The participating students conduct 3-6 month long research related to water. The broad objective of the program is to involve the youth in scientific research. WaterRediscover encourages students to use the engineering design process (EDP) to address real world problems. In the last two years the program has attracted participants from Bangladesh, India, Saudi Arabia, Uganda, and the United States including four groups of only female members. WaterRediscover International Teleconference is the culmination function of the program where the teams present their research and interact with each other via live audio and video. The experience from the last two years has helped the author to address certain the needs to improve the program and cover more countries in the future.

### **Introduction**

Promoting science, technology, engineering, and mathematics (STEM) education among the younger (K-12) generation has been recognized by many as one of the needs to create the future manpower, innovators, and world leaders [1,2]. Early introduction to STEM education can create the necessary excitement among the younger generation to remain interested that area and pursue higher education in STEM [2]. While hands-on activities on science and technology can generate the immediate 'high voltage' excitement among young students, they may not necessarily teach them the skill set needed to become independent thinkers and researchers. Research is typically considered to be 'too difficult' for young students. Teaching research methodology to young students has been tried in this program (WaterRediscover) and the program has given the students could the opportunity to realize that scientific research can be exciting and can draw global attention.

WaterRediscover has been organized since 2011 among middle and high school students (grade 7-12) to introduce them to the methodologies involved in scientific research and teach them the skill set needed for presenting their research to a global audience. The main objective of this noncompetitive program is to involve the youths in scientific research.

## **Methodology**

This program uses the vast untapped potential of graduate students from various countries to connect to their homeland. Typically, most graduate students are very well connected with their home countries during the first a few years after they arrive at any US university, and most likely they know some close friends or relatives who are involved or interested in K-12 education. The WaterRediscover program starts with a listserve e-mail by the Program Director (PD) to all graduate students at North Dakota State University (NDSU) requesting their participation in the program. The interested graduate students attend an orientation meeting in the fall semester and start working as the Country Coordinators (CCs) for her/his home country. One of the graduate students also acts as the International Coordinator (IC) and his/her responsibilities include coordination with CCs, preparation of information documents, and dissemination of information via multimedia. The CCs start working with their contacts in their home country immediately, and send out detailed information (in PowerPoint slides) on the program to their contacts. The information on the program includes program objectives, expectations, deadlines, basic steps on how to do research, report writing and research presentation tips, and example projects (Figures 1-3). Once contacts (potential mentors for the research group) are established, individual teleconferences (via telephone or Skype or Google Hangout) are organized. The CC, IC and/or PD discuss with each mentor how to form a project group and go over the details of the program. These meetings are typically led by the CCs and English is not necessarily the language used (the use of the local language is preferred and encouraged). The need to follow the engineering design process (EDP, Figure 4) is emphasized and the mentors are advised not to impose any research ideas on the students. It is also emphasized that the students can use any language they want while working on and presenting their research. If a language other than English is used then help of an interpreter is taken (typically the CC serves as the interpreter).

The teams regularly organize their own group meetings and narrow down on a need based research problem following the EDP. If they run into road blocks then they e-mail/call the respective CC, IC or PD and/or set up teleconferences. The CCs, IC, and PD keep constant touch with the teams to monitor their progress and help them to plan for the next step. In the month of May, an international teleconference is organized where all the teams present their research findings via multimedia tools. NDSU's Information Technology Services (ITS) works with each team to set up the system needed for the teleconference. The preparation for the teleconference typically starts a month prior to the actual event. NDSU's

Interactive Technology Consultant sends out video conference software (PolyCom) to the team and tests for connectivity and clarity. As a backup the teams set up a Skype or Google Hangout account (or both) and test that before the international teleconference. In addition each team dedicates a telephone for use during the teleconference when the Internet is not available. On the day of the teleconference, each team presents a team video (a song or a video about their activities), research findings (via PowerPoint or similar), and take part in post-presentation interactions. The participating students, mentors and their helpers, CCs, and IC are given certificates of participation signed by the President of NDSU, Dean of Engineering, Civil Engineering Department Chair, and the PD. There is no restriction on a team returning back in the following year but the same project is not encouraged unless there are major changes incorporated. It is worth mentioning that WaterRediscover is for projects related to water. However, the projects are open ended and may even be very indirectly related to water.

## **Results and Discussion**

WaterRediscover program started in 2011 with five teams from across the globe which included one team each from Bangladesh, Uganda, and the US, and two teams from India. In 2013, there were seven teams (one team each from Bangladesh, Uganda, and Saudi Arabia, and two teams each from India and the US). The presentations were made in different languages but the presentation slides were in English. The teams worked on various topics ranging from iron, arsenic, and pathogen removal (from drinking water) to phytoremediation of aqueous pollutants (from lakes and reservoirs). In 2013, there were four teams of all female students (India, Uganda, and the USA). While in 2011, three teams had to be supplied with test kits, all the teams in 2013 either had easy access to testing equipment or made their own tools for testing and measurement. Formal surveys on the impact of the program are being conducted and results are not ready yet for inclusion in this paper.

## **Conclusions**

WaterRediscover has, so far, generated a lot of enthusiasm among the participating students. The students have used this program as a forum for global exchange of ideas. While endeavors are being made to expand the program to more countries, there are certain hurdles in the process which include different school year calendars and lack of (or poor) Internet connectivity. In 2013, the international teleconference has to be organized twice as one of the teams could not join during the regular May event because of their on-going long holidays. It is also felt that there is a need to translate the information and project instructions to different languages to encourage larger participation.

## Acknowledgements

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Figure 1: The title page of the information PowerPoint slides sent to the mentors of WaterRediscover teams. The word “water” was written in different languages in the title slide to make the teams feel at home.

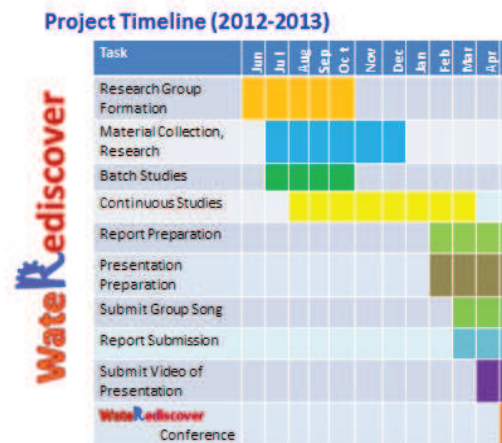


Figure 2: The initial schedule for the program in 2012-13. All deadlines except for the WaterRediscover Teleconference were extended based on the teams' progress and the challenges they face.

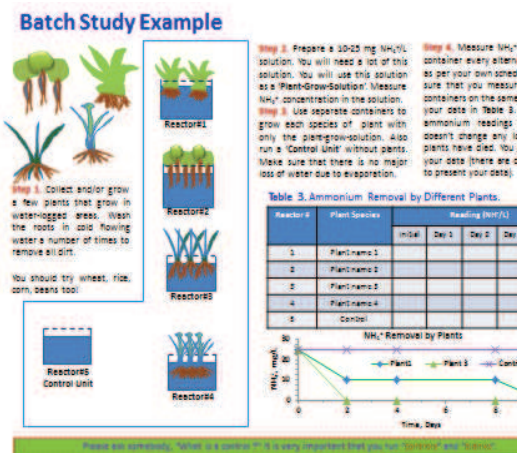


Figure 3: An example of a batch study experiment that could be part of a project related to water. The teams were discouraged from doing the same projects given in the information package but learn how to design an experiment for their individual projects.

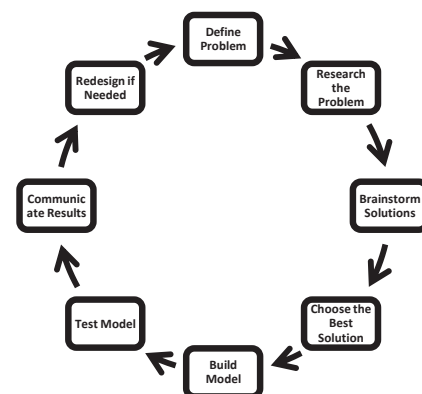


Figure 4: Schematic of the Engineering Design Process (EDP) included in the information package sent to the teams. The teams were expected to use the EDP (or a modified version of it) in each and every step of their project.

## **Bibliography**

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