

# SEPG

.....Innovative ways of bringing science to rural communities.



Girls who had no idea that they needed to take sciences for becoming doctors and engineers.



A playground in front of the school.

## CONTENTS

- 1 Introduction**
  - 2 Background**
    - 2.1 Why Pakistan?*
    - 2.2 The Education System in Pakistan*
    - 2.3 Needs*
    - 2.4 Community to be served*
    - 2.5 Existing Solutions*
  - 3 Innovations**
    - 3.1 Learning*
    - 3.2 Minimizing Costs*
    - 3.3 Interaction amongst students of various backgrounds*
    - 3.4 Minimizing Bureaucracy*
    - 3.5 Leadership and team work skills. Improved written and oral presentations*
  - 4 Implementation**
    - 4.1 Fundraising*
    - 4.2 Work to date*
  - 5 Support Network**
  - 6 Scope**
  - 7 Impact**
    - 7.1 Impact on the Community and on others*
- Appendix – Curriculum**
- A.1 Life Sciences*
  - A.2 Physical Sciences*
  - A.3 Environmental Sciences*
  - A.4 Environmental Concerns*

## SEPG

### 1. INTRODUCTION

SEPG is an acronym for the Science Education in Pakistan Group. The project's aim is to provide access to scientific equipment and enable students in villages in Pakistan to perform experiments using a **mobile science lab**. We believe that in order for students to understand the basics and develop an intuitive understanding of the material experiments and visuals are of vital importance. None of the villages in the province of southern rural Punjab have access to scientific equipment.

Even though the rest of Pakistan has made a substantial effort to introduce experiments, the rural areas are still decades behind due to lack of laboratories. In rural Pakistan we are plagued with poverty, a lack of infrastructure and discrimination between genders. Our innovation to solve this problem is to use a mobile science lab.

Through a mobile science lab we hope to provide students with access to the equipment and **through the physical resources and the classes our current aims involve:**

- Giving children of rural areas motivation and skills to pursue education.
- Equipping students with tools to pursue scientific query.
- Motivating students to participate in school programs again.
- Providing opportunity to rural school children to learn the basics of science through experiments and observations.
- Creating awareness of the relevance of science in their lives by discussing concepts such as cleanliness, hygiene, safe drinking water, the environment and cultivating a scientific attitude in them.
- Teaching girls concepts of female hygiene through discussions.
- Bridging the gap in standards between urban and rural education.
- Visiting other schools periodically to explore the possibility of motivating children to study science.

We will be building a mobile science lab, which will be a standard Suzuki vehicle capable of carrying the equipment. It will be refurbished to include shelves for apparatus, etc.

### 2. BACKGROUND

#### 2.1 Why Pakistan?

The members working on this team are from Pakistan and have seen first hand the disparity that there is in education between the rural and urban areas, which was the motivating factor for SEPG. Most girls do not study science and those who do have never seen the equipment they are studying about. The event that led to the formation of SEPG was:

One of the team members, Mubarik Imam, visited the Kabirwala and Qatalpur high

## SEPG Science Education in Pakistan Group

schools for girls where only three students in grade 10 were studying science. At that time they did not have a good science teacher and she presented her findings to the Educational District Official, who promptly hired qualified teachers to teach instead of the ones present earlier. Since then, the students have become more interested in studying science. She held detailed discussions with students and teachers who expressed the need of doing experiments to get a better understanding of the subject matter that they were studying instead of just memorizing science as a bunch of formulas and facts that come out of textbooks and later regurgitating them. 52% of students when asked for suggestions on improving their school expressed the desire for a science lab. Letters requesting a science lab from selected school principals are also attached at the end of this proposal, in addition to a letter of support from the EDO.

### *2.2 The Education System in Pakistan.*

The education system in Pakistan consists of 5 years of primary education followed by 3 years of middle school and two years of matriculate (grades 9 and 10). We will be targeting the experiments on our science lab for students from grade 6 to grade 10.

### *2.3 Needs*

The female literacy rate in southern Punjab is 14%. In our surveys we learned that most students drop out of class because their parents are unable to pay the fees. Through earlier projects one of our team members worked on we were able to get a grant from Packages Limited, a leading packaging company to fund the education of students for one year for a girl's informal high-school in the village of Qatalpur.

Pakistan's economy is beginning to improve, but 60% of the government's budget is dedicated to Defence and Debt-Servicing (paying back IMF and World Bank loans) while only 3% is allocated to education. The average income of families living in southern Punjab is Rs.1490 and the average family size is 5.5. Most parents have a tough time deciding whether or not to send their children to school. The 2003 Educational Reforms that the government has introduced provides free education for students up to the matric level. With the problem of costs of attending schools now dealt with there is a dire need to improve the level of education in villages.

Due to insufficient funds allocated to education in rural areas, government schools rarely get money for science labs. In our case none of the selected schools have labs, and there is no science lab in any school within a fifty mile radius. Most students have never seen the scientific equipment about which they are studying so it all seems like a mystery to them. There is also a need to teach women about female hygiene. Most of these women don't pursue higher education and get married after graduation. We are hoping to motivate

## SEPG Science Education in Pakistan Group

them to study science and pursue it as a goal in addition to providing all students with a better understanding of scientific concepts.

### *2.4 Community to be served*

Although we aspire to provide mobile science labs to other villages in Pakistan, we are beginning our pilot project in southern Punjab. We will be serving three rural villages within a twenty mile radius. Please see attached documents for details of schools. The students in these schools from grades 6-10 will participate in the experiments. We are designing experiments so that they co-relate to the matriculation syllabus (grades 9 and 10) and enable to help students better understand the material they study in class.

The science lab will visit each school once a week and spend the entire day in the school. This is to enable students to have access to labs on a frequent enough basis so that it can have a substantial impact on their understanding.

### *2.5 Existing Solutions*

Currently there are no organizations that are aiming to provide students with science labs. The government only allocates enough money for teacher salaries and the upkeep of the school building. Starting this year, with the 2003 Educational Reforms education has been made free for students up till the matric level. However, there are no existing solutions to address the lack of science labs and to provide a more involving in rural areas in the whole country. With changing governments, the funds are often diverted from one project to another.

## **3 INNOVATIONS**

Our project involves innovation in lots of different aspects permeating learning, fund-raising, minimizing costs, minimizing bureaucracy etc. We will be building a mobile science lab which will allow for the following:

### *3.1 Learning*

The integration of science experiments into the matric curriculum in rural areas will allow students to learn the material and understand it and see it for them instead of just rote-learning it. By performing experiments like titration students won't need to rote-learn that the color changes when a particular chemical is added to another one. Research shows that children that have hands-on learning experiences have more prolonged experiences and give children an opportunity to have an engaging experience.

We will help integrate the curriculum and the experiments for them, in addition to emphasizing common concepts that can be applied from one science to another, so they can get a more holistic picture of the different disciplines that they are studying. None of these students have seen laboratory equipment before, so we are providing them with new facilities ensuring that they get a hands-on approach.

## SEPG Science Education in Pakistan Group

We are also focusing on girls high-schools where very few girls are motivated to learn science. Science remains a highly male dominated field in Pakistan, like in other third-world countries.

### *3.2 Minimizing Costs*

A mobile science lab also saves duplication costs of building several labs. Instead a mobile lab will provide facilities that can be shared by up to five schools and which will only require the materials for one science lab. It also has the advantage of going to other rural communities for one day every month and doing scientific experiments allowing students to explore science.

We are working on donations for the vehicle within Pakistan to minimize the funding costs and are currently holding talks with Milk Pak for the donation of the vehicle. By selecting experiments that are both inexpensive and have a strong impact on students we are trying to minimize costs. Once this project is set up schools in Lahore have agreed to maintain the labs by supplying them with lab equipment.

### *3.3 Interaction amongst students of various backgrounds*

Students from Lahore and Multan will also be volunteering to help run the lab. We have set up a chapter at LUMS, to get students who are interested in volunteering and teaching children science in rural areas to help out and have currently received responses from over 5 schools and 2 universities. Students at these schools and universities have gone through accelerated high school programs and are thus qualified to teach these subjects. These will also encourage student interaction amongst various income-class groups and motivate them to help serve their community through what they have learned. (Hence, showing them answers to, why do I need to know how a pendulum works, when will I need it again? Well, if you're teaching it to someone you'll need to know it first! ).

When Mubarik visited the site and taught students trigonometry she said: "I was amazed at the speed at which they picked up the material. They were so interested because they saw that someone actually wanted to teach them, and wanted it to continue on a permanent basis. I wish I could have just stayed there and taught them."

### *3.4 Minimizing Bureaucracy*

If we were to go through government channels and ask the government to set up science labs, then labs would need to be set up in each and every school. With changing local governments, the officials usually divert the money to their own constituency. As a result we decided that this would be the best way to get past that problem of insufficient funds and set up a mobile lab. There is also no debate over which constituency should get funding since we will be helping five high schools in the areas of Qatalpur, Berbegi and Kabirwala.

## SEPG Science Education in Pakistan Group

### *3.5 Leadership and team work skills. Improved written and oral presentations*

Students will be required to work in teams for the experiment, but each student will be required to submit their own report. This will ensure that students re-enforce the material that they have learned during the experiments.

Students will have to give a presentation on their findings to the class. This will allow students to develop their presentation skills. Writing a summary after each experiment will also enable students to improve their written skills.

## **4 IMPLEMENTATION**

The mobile science lab will serve to travel around rural areas of Pakistan, which have been traditionally overlooked in terms of improvement in education and general human rights welfare, and expose secondary schoolchildren to science experiments and aid them in their understanding of the government science syllabus. In the beginning, we will focus only on a small area of 3 villages, but hope to expand to other areas based on the initial success of the lab.

SEPG plans to implement the mobile science lab in Pakistan by gaining support from the government in order to assist logistically with the lab. STEP is a local NGO that will be helping me to set up the project. They will be helping operate the lab. The instructor and driver will be hired through the government while the SEPG will provide the equipment and provide the syllabi for the experiments. As the organization will be based mainly in America, the government's help will be critical. We have already convinced the EDO (whose letter of support is attached that their support is crucial to the project). They have agreed to maintain it for us after the initial set up.

After the initial setup, the organization will work out a rotating calendar so that the mobile science lab can travel from one school to another, spend an entire day there allowing students from grades 6-12 to perform experiments. It will return to the same school after one week and provide students the materials to conduct experiments and practicals with.

The organization believes the Pakistani Government's Board of Education as well as the National Human Development Foundation is interested in maintaining the project once we have initiated it.

### *4.1 Fund-Raising*

SEPG intends to raise funds through various government and charity organizations inside Pakistan, as well as representing Pakistani interests in the United States of America. We will also run various fund-raisers of our own on campus to raise awareness of Pakistani culture as well as educational problems and issues in the country. We also welcome help from organizations other than the ones listed here.

## SEPG Science Education in Pakistan Group

### ***IDEAS Competition***

The IDEAS Competition at MIT funds Innovative ideas which have an impact on the community. We have submitted a proposal to the IDEAS Competition and hope to get funding as much funding from them for the materials and the supplies.

### ***Public Service Center Fellowship***

We have submitted a proposal to the PSC for a grant for a summer fellowship. This is to cover the costs of the students who will go to the villages of Qatalpur, Berbegi and Kabirwala to set up the mobile science lab.

### ***Human Development Foundation of Pakistan***

The Human Development Foundation is a recently created directorate of the Government of Pakistan, working to better the human rights situation in Pakistan, as well as improving educational aspects of the country. We wish to approach the Foundation and ask for logistical backing and funding for the program, as we believe the government will be receptive to ideas to improve the educational welfare of Pakistani children in rural areas, whose educational needs are often overlooked.

### ***Association of Pakistani Physicians of North America***

APPNA is a private organization of Pakistani doctors based in North America that has funded various projects in Pakistan and is influential in human rights developments and charity programs.

### ***Shifa Trust***

Shifa is a health organization in Pakistan. As we expand the program to include health education, along with the mobile science lab, Shifa would support us logistically and monetarily in preparing a health curriculum to coincide with the science lab.

### ***Private Donations***

We wish to contact Pakistanis in the US as well as in Pakistan to convince them our cause is viable and pledge their support for the running of our program.

### ***Corporate Donations***

We are currently in the process of looking for corporate donors in Pakistan. We are in the process of contacting Nestle and Milk Pak. We hope to get vans similar to those that Nestle used for distributing Maggi Noodles, and refurbish them to hold the apparatus for the science lab.

### ***PakFund***

An organization set up by MIT-alumn's from Pakistan to support projects for educational development in Pakistan.



## SEPG Science Education in Pakistan Group

### 4.2 Work to date

In addition to surveying the sites we have also put together a sample curriculum. The details of which are specified below. We have also started holding talks with other funding agencies in the US including PakFund and corporate sponsors in Pakistan.

### BUDGET

Item	Purpose	Requested amount (US \$)
Driver's salary (per annum)	To drive vehicle around.	400
Lab Equipment	Scientific Experiment	1000
Intern Stipend	This will cover the travel costs and stipend for an intern who will go and set up the project from MIT over the summer.	2000
Teacher's Salary	Teacher who will maintain the science lab and coordinate curriculum and experiments with each of the schools.	400
Vehicle	Mobile Science Van	10,000

Total funds requested: \$13,800

As of now we have received \$3,000 from the IDEAS competition.

### 5 SUPPORT NETWORK

The government has expressed support to help maintain the lab once it is set up as expressed by the EDO. The schools are also very eager that we start the project as soon as possible, as expressed by the principals of the schools in their attached letters of support. Corporate sponsors in addition to others discussed earlier in the funding section are willing to help support the project.

Students from Lahore and Multan will also be volunteering to help run the lab. We have set up a chapter at Lahore University of Management Sciences (LUMS), to get students who are interested in volunteering and teaching children science in rural areas to help out and have currently received responses from over 5 schools and 2 universities. These schools include: LGS (Defence), LGS (Main Gulberg), LGS (Johar Town), Aitchison, and BHS. The two universities in Lahore that have agreed to send students are LUMS and LSE. Students at these schools and universities have gone through accelerated high

## SEPG Science Education in Pakistan Group

school programs and are thus qualified to teach these subjects. These will also encourage student interaction amongst various income-class groups and motivate them to help serve their community through what they have learned.

**Just imagine... once the project is set up after the initial cost of \$10,000 it will be sustainable and will have immense impact.**

### 6 SCOPE

The scope of the pilot-project currently involves setting up a mobile-science lab for use in the three poverty-stricken areas of Qatalpur, Berbegi and Kabirwala. For the first year we are planning to stay within this community until SEPG gains experience in running the project.

We hope that after the pilot phase that SEPG would have acquired NGO status and donations to the program will be tax-deductible. We are hoping to get companies both in the US and abroad to sign up as corporate sponsors. Once they see a working model in effect they'd be more than happy to fund it. Currently we are looking at McDonalds (Pakistan) which has supported several community service projects in addition to WWF (Pakistan), Nestle and other companies. We are in touch with them, but they need to see a working model and then will be more than willing to support our cause. We also hope to include more students at MIT to work on this project and to facilitate growth and expansion of the program to other regions in Pakistan, and later support the project in other developing countries.

An ideal location might be refugee camps, where children don't have schools and mobile labs could be their connection with learning.

#### **Project Timeline:**

We will be starting the project in May and continuing it till late August.

Week 1: Procure vehicle.

Week 2: Arrange for science teacher and driver through Government Ministry

Week 2 – 4: Teacher undergoes training.

Week 4-6: Develop curriculum and schedule for visiting school areas.

Week 1-6: Procure equipment from donations, funds.

Week 6-10: Run Pilot Program of Mobile Science Lab

Week 11: Run survey to test Pilot Program

Week 12-16: Run Mobile Science Lab with Improvements Implemented.

### 7 IMPACT

#### *7.1 Impact on the Community and on others*

These communities have low literacy rates and many times that has been co-related with high infant mortality rate, low life-expectancy rates, high-crime and terrorism. Motivating children to study science in schools, inculcates logical thinking and inquisitiveness, which are tools that can equip them through life.

## SEPG Science Education in Pakistan Group

More specifically, students will have a better understanding of the physical, chemical and biological processes around them. They can apply their learning to environmental issues and understand the effects of pollution and ways that they can combat it. Teaching women about health-care and hygiene issues will ensure that these issues are spread to their families. So it is a small investment, for a long-term return.

The problem-based learning and hands-on learning coupled with reports and presentations will allow students to re-enforce the scientific concepts that they have learned and improve their communication and presentation skills which is vital to their education. Group dynamics and team building skills will also equip them with life-long skills, which can help them in their career.

The ultimate goal is also to pursue these students to study science at the next level. Currently, most students due to lack of opportunities, in rural areas do not pursue higher education. This is a more acute problem among girls. By focusing on girls as well we hope to encourage students and not ignore the 56% of population in rural areas that is currently not a part of the effective work force.

Through volunteering opportunities we hope to motivate more privileged students to interact with other students in rural areas and share their experiences with them.

People who have been involved in the project as students might want to return later to serve their community and help out children in future generations, also encouraging sustainability.

This work can have additional impacts in other similar communities. It could be expanded to Lebanon and other developing countries with low –literacy raters. Curriculum can be adapted according to the region and it would be an ideal form of teaching science in refugee camps or in areas where there is little infrastructure. Afghanistan and Iraq in the future could be places that the government could look into.

### Core Team

Mubarik Imam	<a href="mailto:mubarik@mit.edu">mubarik@mit.edu</a>
Sameer Riaz	<a href="mailto:sriaz@mit.edu">sriaz@mit.edu</a>
Samina Shaikh	<a href="mailto:samina@mit.edu">samina@mit.edu</a>

### Volunteers:

Ebad Ahmad	<a href="mailto:ebad@mit.edu">ebad@mit.edu</a>
Omair Malik	<a href="mailto:omair@mit.edu">omair@mit.edu</a>
Masood Qazi	<a href="mailto:mqazi@mit.edu">mqazi@mit.edu</a>
Jehanzeb Noor	<a href="mailto:jg_noor@mit.edu">jg_noor@mit.edu</a>

APPENDIX

**CURRICULUM**

Below is a sample curriculum that we have worked out. The details are close to the matriculate syllabus. We are trying to introduce problem-based learning. This material shows a brief sample of what we are planning to do. The exact details are worked out, but for the sake of brevity have been suppressed. This is part of the sample material we feel that 10<sup>th</sup> graders **MUST** know.

We have written up sample experiment procedures in both English and Urdu for students. We are currently also evaluating curriculum developed by the Edgerton Center and are working on incorporating some of their suggestions into the curriculum we are currently developing.

*A.1 Life sciences*

Start with basic structure of science, The Atom

1) What is the atom? Explaining physical structure of atom, then onto periodic table where students will find patterns in periodic table. (E.g. atomic radius...)

2) Cellular structure

What is the cell? Students will learn basic structures and processes of cells and then use microscope to observe structures and behaviors

3) Systems of the body

What is the body made up of? Students will learn body composition i.e. cell – tissue-muscles-organ-system make up of body students will then learn dissection techniques and more microscopic use.

4) Hygiene

For students in more mature stages, they will learn about personal hygiene and pre-natal health (the reproductive system)

5) Nutrition

What is nutrition?

Students will learn about vitamins and minerals essential to health and their functions

*A.2 Physical sciences*

1) What is gravity?

Experimentation with gravity calculate 9.81 learn about forces

2) What is energy?

Discussions between kinetic, potential energy, and thermal energy learning to calculate energies using experiments.

3) Electrical and magnetic

What is electricity? What is magnetism?

Student will learn columbic forces using experiments (ping-pong experiments) and magnetism through demonstrations.

*A.3 Environmental sciences*

## SEPG Science Education in Pakistan Group

1) What are life cycles? Learn about life cycles in nature.

2) Food chain

What is the food chain? Learn about predator and prey relationships, primary, secondary tertiary food source.

3) Climate

How are storms formed? Floods? Earthquakes? Tornados? Look at each briefly

4) Environmental problems

What is the green house effect?

In addition to the above mentioned curriculum we have also worked out science in their lives by discussing concepts such as cleanliness, hygiene, safe drinking water, the environment and cultivating a scientific attitude in them. We will begin by discussing nutritional concerns with students, as a lot of them are from poverty-stricken families and often don't get enough to eat. Their average family size is 5-6 people.

### *A.4 Environmental concerns*

Burning plastic bags is a big problem in Pakistan, and in order to make people aware, we feel that this is the best age to inculcate in them a social conscious and encourage them not to pollute their environment.

Students can be taught basic safe drinking alternatives, including ways to purify water using filtration, chlorination and boiling. Currently several thousand people are affected by cholera and typhoid in Pakistan. Clean drinking water will reduce incidents of these diseases.