One Sky: Eight Years of Astronomy Outreach In the Developing World

Henry Throop Senior Scientist, Planetary Science Institute Mumbai, India

> Brigham Young University October 17, 2017

Carl Sagan Medal Award Talk

Number of Researchers per Capita



Why Do Countries Say they Want to Develop Science?

A basic competence in science and technology is a stated desire for nearly every country in the world.

- The world is no longer agricultural + industrial.
- People want to explore and explain the world around them.
- Countries without scientific literacy lose people, lose ties with other countries, and ultimately lose ability to take care of their own population.

In the last 8 years, I've given hundreds of talks to schools and public groups across the developing world.



South Africa

South Africa remains very segregated despite the official end of apartheid in 1994.

- Personal income
- Unemployment
- Townships
- Education
- School quality
- Teacher quality
- Educated black middle class remains very small

Three Years in South Africa

- 50+ school visits, public talks, museum lectures, science festivals
 - Many visits to rural schools and township schools.
- Started astronomy program at formerly all-white university
 - Taught first university course in Astrobiology in Africa



A chance meeting with some great teachers...



... led to a trip to visit their school in rural Limpopo, South Africa



Madikweng Senior Secondary, Limpopo Province, South Africa

Carl Street, St



Largest building in the village

33

ERIAN

Southern Africa













Talking about New Horizons





Talking about educational opportunities in South Africa and abroad







Making dry ice comets







Preparing lunch for students



Astrobiology talk in the school's new science lab.





No toilets*, no phone, no computers, one water tap...



A bit of soccer while waiting for sunset.



Students stay at school until 10 PM

200+ students, parents, and villagers line up for Saturn and the Moon.





Principal Joseph, with awards from 100% graduation rate. Many students go on to college, and some to the top universities in the country.

Governmental support is not enough. Some teachers are paid directly by the parents, and corporate donations to the school have helped.



Teacher Charles Wasswa has inspired hundreds of South African students with science and math.

He stays late, he works hard, he demands a lot, and he loves his students.

Dendron Secondary School

1200 students, rural village, Limpopo, SA. Public boarding school, science-focused


Astronomy Club presidents welcome me.







Talking about Pluto and New Horizons



Q&A runs for longer than the talk!



Presenting a new telescope



Astronomy Club at Dendron

Astronomy Club learning to observe sunspots, so they can host their own star parties for other local schools.





As of 2015, students don't have access to smartphones, YouTube, DSL. Most students have never used a computer. Without online educational resources, printed material has a lot of value.

Feedback from teachers...

and students.



Nimrod Manyclo September 21 via BlackBerry Smamphones App @

As Madikweng we a proud of being visited by one of the greatest scientists on dis planet earth "HENRY THROOP" - with Henry Throop.





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Trudy Kgodu Dikgale eh ke ho pisala na September 21 at 10:15am - Like



Emrod Manyelo Ja ke bona mmata eptember 21 at 10:17am - Like - K1



Moloko Engineering, U. Pretoria

Tshegofatso Leadership Training program in US





Ananias

Economics, U. Johannesburg

Nimrod

Science Education, U. Witwatersrand, Johannesburg



India

- 1.3 billion people: 20x the population of South Africa, in 2x the area.
 - Population density: lack of sanitation, food, clean water, housing, medical care, education...
 - GDP ~ \$10/day/person
- Many good schools and universities, but not enough for the population! Admission rates can be < 1%.
 But...

India is only the fourth country to successfully send a spacecraft to Mars!

RESERVE BANK OF INDIA TWO THOUSAND RUPEES 22000

₹2000

₹2000

रम साण्डता की ओर

भारतीय रिज़र्व बैंक

2018

दो हजार सपरे

Mars Orbiter Mission, arrived September 2014

Three years in India

- Gave ~50 talks for public groups and schools, at science festivals, observing nights...
- Astronomy research workshop for Indian students
- Taught university-level solar system course

'Pragyan' Engineering Festival

Tiruchirappalli, Tamil Nadu, India









PADMA SHRI DR. SANKAR KUMAR PAL FORMER DIRECTOR

MARCH 3 | 11:00 AM | EEE AUDI

KISHORE JAYARAMAN PRESIDENT OF ROLLS-ROYCE SOUTH ASIA MARCH 3 | 1:30 PM | EEE AUDI

DAVID J PETERSON LINGUIST LANGUAGE CREATOR -GAVE OF THRONES MARCH 3 [6:30 PM [BARN HALL

PADMA BHUSHAN A. SIVATHANU PILLAI FOUNDERCED AND MD - BRAHMOS MARCH 4 | 11:00 AM | EEE AUDI

DR. HENRY THROOP PLANETARY SCIENTIST AND SENIOR ADVISOR-NEW HORIZONS MARCH 4 | 2:00 PM | EEE AUDI

DR. RICHARD A MULLER

MARCH 4 | 8:00 PM | BARN HALL

RAJSHEKHAR MURTHY

MARCH 5 |11:00 AM | EEE AUDI

NANDINI HARINATH

DEPUTY OPERATIONS DIRECTOR, MANGALISAN MARCH 5 | 1:30 PM | EEE AUDI

DR. ADA YONATH

NOBEL PRIZE IN CHEMISTRY, 2009, PROF. WEIZMANN INSTITUTE OF SCIENCE

MARCH 5 | 3:30 PM | EEE AUDI

'Pragyan' Engineering Festival

National Institute of Technology, Trichy, Tamil Nadu





Talking about New Horizons



Student Engineering Competitions





Engineering Speed Tests



'Robot Wars'

Students are equally proud of their heritage, and of moving their country forward

Innovators at any age



The student organizers who have done *everything*:



Planning, Recruiting, Arm-Twisting, Fundraising, Production, Finding Sponsors, Grant Writing, Budgeting, Publicity... logy and Engineering

Similar student-run science and engineering festivals are held at hundreds of colleges across India...

Pragyan
Footprints
TechFest
QuarkNational Institute of Technology, Trichy
MS University, Baroda
Indian Institute of Technology Bombay
MP Birla Institute of Science, GoaParadigmNational Institute of Space Science and
Technology, Thiruvananthapuram
St Xavier's College, Mumbai

These students get more real-world experience than many do in the US!

Khagol Mandal: Observing the Night Sky from an Indian Megacity...

Everyone on Earth sees the same planets, and most of the same stars...

Moon Venus	
Mercury	
	And PERSONAL PROPERTY AND ADDRESS OF TAXABLE PARTY.
	END LINE DURING THE REAL
and the second sec	AND



On the Mumbai local train, heading to observe



On the Mumbai local train, heading to observe





Students checking in to observe



Amateurs setting up telescopes for the night





Star tour for 200 people under the sky
Thali platter while observing!



12:30 AM: Giving a talk about New Horizons and Pluto



4:30 AM: Time for a final chai break before packing up for the night.

200 students and public have braved trains, pollution, dust, and more... in order to connect to the sky. We are lucky to have this world, and so many people who are curious to explore it with us.

Larger International Programs

South Africa and India are major partners in the consortia of countries building the largest telescopes in the world.

But with all the poverty and social issues, why are countries in the developing world spending money on cutting-edge science?

Larger International Programs

- Human Capital Development *i.e.*, because it will develop the country's science and engineering skills, needed in order to grow and evolve.
- Because science is worth doing.

"Scientific endeavour is not purely utilitarian in its objectives and has important cultural and social values. It is also important to maintain a basic competence in "flagship" sciences such as physics and astronomy for cultural reasons. Not to offer them would be to take a negative view of our future - the view that we are a second class nation, chained forever to the treadmill of feeding and clothing ourselves."

> South African White Paper on Science & Technology, Department of Arts, Culture, Science and Technology, 1996

A Few Universal Truths

- People ask the same questions everywhere.
- Direct engagement with people is fun.
- People connect to the sky, anywhere. It's shared, and it's both mysterious and tangible, and it's always there.
- Even in a large country, the influence that one person can have on others can be huge: principals, teachers, etc.

And some advice for anyone interested in giving talks...

- Sit down next to people you don't know.
- Do what's easy! For me, it's talking about astronomy.
- You don't have to be an expert. You already are.
- Consider offering to give a talk with a local US Embassy if you are traveling or living abroad. Or call local schools, universities, science centers, and offer to visit.
- Students everywhere love interest from other parts of the world. You are a huge inspiration to them.

Thanks to...

- All of the teachers and students.
- NASA for enabling us to explore the universe
 - US State Department
 - My family for always encouraging and supporting me
 - The thousands of people who have inspired me with their outreach, teaching, writing, and support.

throop@psi.edu

Photos: Henry Throop; Ephy Manamela; Eddie V; Goats of NITT; Sami Ith

Backup Slides



Principal Matsopola M.K. One amazing founder and leader has made a difference in thousands of students' lives.

State Department

- Fulbright programs international visitors
- US-run Libraries, science centers, reading rooms abroad
 - Free and open access to local students, citizens
- Sponsoring and arranging speaker visits
- Many 'public diplomacy' projects that build ties between countries: economic, scientific, cultural, etc.

Larger International Programs

- South Africa and India are major partners in the consortium of countries building the largest telescopes in the world: the Square Kilometer Array (SKA) and 30 Meter Telescope (TMT).
 - Both South Africa and India are actively developing their research programs. Why, when they have so many social issues?

"Scientific endeavour is not purely utilitarian in its objectives and has important cultural and social values. It is also important to maintain a basic competence in "flagship" sciences such as physics and astronomy for cultural reasons. Not to offer them would be to take a negative view of our future - the view that we are a second class nation, chained forever to the treadmill of feeding and clothing ourselves."

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