

# Overview of MS4SSA Program: Background and Introduction



**WPI**

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# The Historical Context of S&T in Africa

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- With the exception of Africa – it has long been recognized that **world class science and technology are the engines of economic growth (value addition to people & natural resources)**
- This has been achieved in Europe, North America, Australia and most recently in Asia.....
- However, in contrast Sub-Saharan Africa has 83 scientists and engineers per million people compared to 1000 in the developed world
- So why not Africa?

# The Pan-African AIST Flower Model



# Outcome of AUST Training

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- Trained more than 500 very high quality MSc/PhD students in the past 10 years
- About half of them are already working in industry and academia in Africa e.g. Senegal, Liberia, Ghana, Sierra Leone, Togo, Benin, Cameroon, Gabon, DRC, Tanzania
- We are training the trainers for other countries
- Our petroleum engineers often make more in Africa than they can in Europe or North America
- One was hired directly from AUST to work for FMC Technologies in the Netherlands while another has taught at Princeton
- Others are working in industry, universities and government agencies

# The Role of Networks

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- The key is to use networks as catalysts for economic development
- Their potential has already been demonstrated recently by Nigerians in the **movie, spare parts, banking and religion industries**
- Similar networks are possible in the “knowledge” industry by forming networks that link
  - Africa to Africa
  - the international/diaspora to Africa
- However the span of activities must range from ideas to markets...

# Pan African Materials Institute (PAMI)

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- The Pan African Materials Institute (PAMI) was recently funded by ACE at AUST
- PAMI is one of the 43 Regional African Centers of Excellence announced by the World Bank following a competitive selective process
- The West and Central African Center (PAMI) will focus on
  - Training and capacity development across West and Central Africa (short courses and MSc/PhD programs)
  - Interdisciplinary materials research (biomaterials, materials for energy and multifunctional materials)
  - Outreach to girls (WISE), high schools and industry

# Systems-Based Interdisciplinary Approach to PAMI Research

- Advanced Materials (Bio and Nano)
  - Targeting of disease
  - Alternative energy
- Societal Development
  - Affordable infrastructure e.g. recycling of agricultural & industrial waste
  - Value addition to people, minerals and natural products (Africa's silicon)

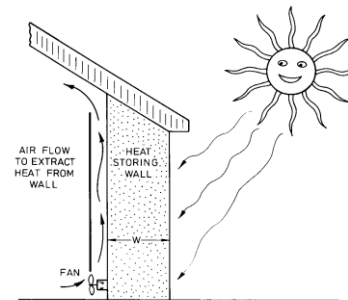
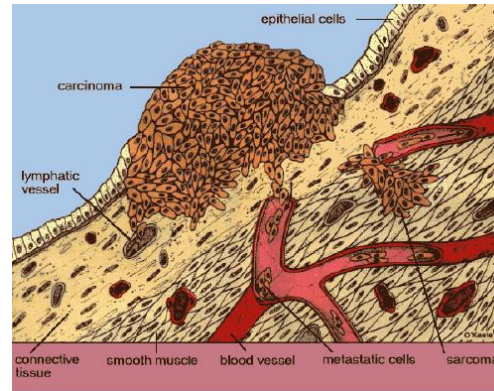


FIG. 6.32 A heat-storing wall. The sun shines on the outside during the day; heat is extracted from the inside at night. The heat diffusion time through the wall must be about 12 hours.

**Organic solar cells:**  
*Harvesting sunlight and generating power with plastic*

A photograph of a small, flexible, red and black striped organic solar cell. The cell is shown in a curved, folded position, demonstrating its flexibility. It is set against a dark blue background.

# Outcome of PAMI Training Efforts

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- Trained more than 20 PhDs in Africa using brain circulation model – all are successful and mostly in Africa – Ghana, Tanzania, Cameroon, Nigeria, Benin
- Another 30 PhDs currently enrolled in PAMI PhD programs – MSE, physics, chemistry, mathematics, petroleum engineering, computer science
- Trained about 100 MSc students in short courses and degree programs – most are working across Africa or engaged in PhD programs across the world e.g. Liberia, Sierra Leone, Burkina Faso, Ghana, Canada, USA, Russia, Italy
- Helping to strengthen African universities, government labs and agencies across Africa – new generation of materials scientists and researchers
- Need to strengthen interactions with industry and other international partners

# The Need to Train The Bottom of the Pyramid

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- There is now a need to address the challenges at the bottom of the pyramid
- The youth bulge in Africa is clear – 70 percent of the population is below 30 years of age
- Most of the youth are not interested in STEM fields
- Test scores and capacity for STEM continue to decline in spite of efforts to promote teacher training
- Hence the STEM capacity of the incoming students into universities continues to decline
- There is, therefore, a need to develop alternative strategies that could stimulate young people to pursue STEM fields that will lead ultimately to African development

# The Origins of the MS4SSA Program

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- The MS4SSA program originated from a conversation between Dr. Jee-Peng Tan and myself in 2015
- We were both concerned about the need to train the next generation of Africans at the primary and secondary school levels....
- We also wanted a new approach that could focus on the training of trainers in ways that could enable the system to produce high quality STEM-focused graduates
- However, we needed partnerships with African governments and teachers with real world experience + professionals that could coordinate the efforts
- This has stimulated the last 2 years of effort to bring the concept of the MS4SSA program from vision to reality.....

# The MS4SSA Partnership

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- The World Bank – Sajitha Bashir, Toby Linden, Hari Andriahrasolonjatovoan, Ryoko Tomita-Wilcox, Tunde Adekola
- WPI – Kim Hollan, Paula Quinn, Alex Pottinger, Kene Mbanisi, Brad Miller, Nick Bertozzi, Nima Rahbar, Rick Vaz, Jessica Rosewitz, Habibeh Chosehali, Sina Askerinajad, Arvand Navabi, Vanessa Uzonwanne, John David Obayemi, Zebaze Kana, Ali Salifu, Ken Stafford
- NJCTL – Bob Goodman, Michelle Lageman, Rosanna satterfield, Josef Kariuki
- Princeton – Jingjie Hu

# Stages in The Development of MS4SSA

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- The World Bank played the role of the convener of countries, potential partners and multiple stakeholders
- The introduction to Bob Goodman and the team from the New Jersey Center for Teaching and Learning (NJCTL)
- The development of Extra-curricular Project-Based Modules to stimulate the interests of young Africans in STEM fields
- Convening of the African countries in November of 2016
- The selection of the African Nodes (Nigeria, Niger, Gambia and Rwanda) in March/April of 2017
- The MS4SSA conference and workshop that was held at WPI from May 15-26 of 2017

# The MS4SSA Conference/Workshop

MS4SSA  
Math and Science for  
Sub-Saharan Africa

- Two week long workshop at WPI was attended by more than 150 people
- Recognized the need strong foundation in math and science – necessary but not sufficient condition
- However we also need a strong culture of problem solving, creativity, tinkering, creativity and team work informed by global best practices
- African Governments
  - Gambia, Ghana, Ethiopia, Zanzibar, Lesotho, Malawi, Mauritius, Mozambique, Nigeria, Rwanda, Burkina Faso, Benin, Guinea, Senegal, Togo, Niger, Mauritania
- Participating Institutions and Collaborators
  - From Africa, Japan, India, China and the United States



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# Overview of the MS4SSA Conference

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- Presentation of the Vision and Mission of MS4SSA – academics, development partners, teachers, professionals
- 15 out of 17 interested Sub-Saharan African countries participated in conference (May 15<sup>th</sup> and 16<sup>th</sup>)
- Discussions of Global Best Practices and African Context/Best Practices and Experience – India, China, Africa, United States + AIMS, UMich, Auburn
- Strategies for the development of pedagogy – Social Constructivism, Active Learning, Project-based Learning
- Implementation strategies for countries and regions
  - Train-the-Trainer Model
  - Regional Nodes
  - National Programs
  - Core Programs
  - Inspirational Programs (Extra-Curricular Programs)

# Overview of MS4SSA Workshop

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- Training workshop was held after the conference from May 17<sup>th</sup> to May 26<sup>th</sup>, 2017 – trained an initial cohort of about 68 trainers
- NJCTL Training Modules in Math, Physics, Chemistry and Biology (May 17<sup>th</sup> to May 19<sup>th</sup>)
- Battle Cry Robotics Competition (May 20<sup>th</sup> and 21<sup>st</sup>)
- WPI Modules on Materials, Robotics and Project-Based Learning (May 22<sup>nd</sup> – May 24<sup>th</sup>)
- Country/Node Implementation and Planning Sessions (May 25<sup>th</sup> and May 26<sup>th</sup>)
  - Individual country implementation plans
  - Interactions between African countries and nodes (Nigeria, Niger, Gambia and Rwanda)

# The NJCTL Approach to STEM....

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- Developed by Bob Goodman and his team at NJCTL
- Bob is an MIT graduate with a strong background in physics and materials science
- Decided to pursue a career in teaching after a very successful career in business
- Selected as the New Jersey teacher of the year after teaching at a Technical High School
- Developed a comprehensive set of teaching modules for K-12 subjects
- Pedagogy – social constructivism and active learning
- Remarkable results in the United States and Gambia and new project in Lesotho

# The WPI Approach to STEM...

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- Ranked number 1 in the United States as the university that best combines teaching and research
- Founded in 1865 based on the principle of combining theory and practice + introduction of the PLAN in 1971
- This unique focus gives WPI students a big advantage in the job market
- Strong focus on STEM education at the primary and secondary school levels – STEM Center
- Strong focus on Project-Based Learning approach to education
- New Center for Project-Based Learning – Rick Vaz and Paula Quinn

# Extra-Curricular Activities to Promote STEM Culture – WPI Approach

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- Develop STEMpathy as part of the culture of young people e.g. extra-curricular activities
- Inspire young people to pursue STEM by engaging them in activities that they find exciting
- They then learn and apply the science in competitions that stimulate their excitement without focusing on abstract concepts
- This has been applied successfully by Dean Kamen (WPI Alumnus) to the development of FIRST Robotics and FIRST Global – use robotics to stimulate the interest of young High School Students in STEM fields
- MS4SSA is now trying to extend this to WPI's modules in robotics, materials science and project-based learning + STEM Cultural Elements

# Inspiring Young People and a New STEM Culture: Battlecry WPI/Africa

MS4SSA  
Math and Science for  
Sub-Saharan Africa



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# Materials and Robotics – Major Drivers of Technology

- Science and technology are the major engines of development
- Materials have always been a major driver in technological change...
  - Alloys
  - Semiconductors
  - Polymers
  - ...

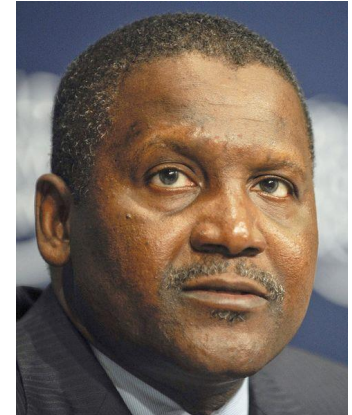
| Hard materials

| Soft materials



# From Artisanal Mining to Wealth

- **Africa has a rich array of minerals and materials resources**
- **Artisanal Mining (Small-Scale)**
  - Difficult conditions
  - Limited profits
- **Industry (Mid- to Large-Scale)**
  - Africa's richest man (Aliko Dangote) manufactures cement from African raw materials
  - Value addition to people, minerals and natural products



# The Materials of Africa

- Africa is a continent that is rich with mineral/material deposits
- These include gold, uranium, chromium, platinum and copper



Africa's Richest Man- Aliko Dangote  
(Biggest Producer of Cement)

[https://en.wikipedia.org/wiki/Aliko\\_Dangote](https://en.wikipedia.org/wiki/Aliko_Dangote)

Worcester Polytechnic Institute

# The Energy Resources of Africa

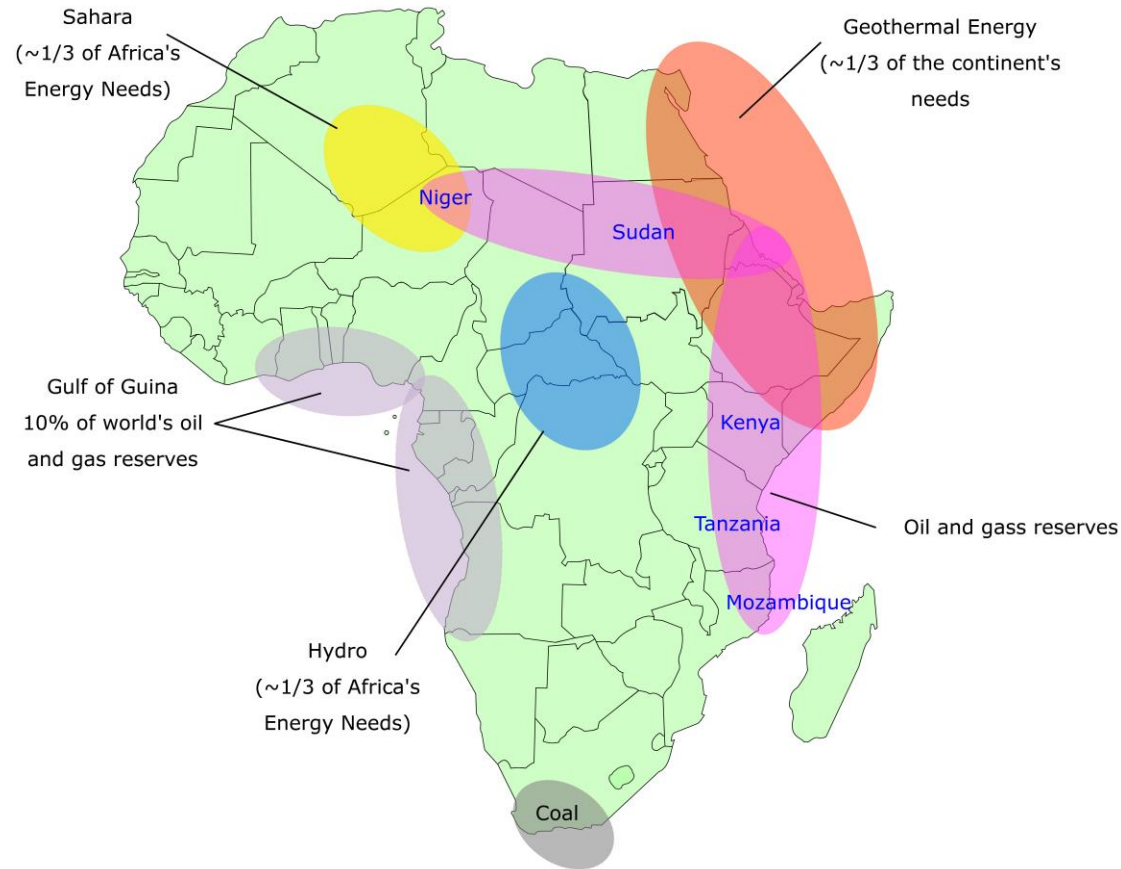
- Africa is rich in energy resources

- The energy resources of Africa include

- Fossil fuels
- Solar energy
- Hydro power
- Wind energy
- Geothermal energy

- These can be harnessed to produce and store energy in rural/urban areas

- Energy generation
- Energy storage



# WPI MS4SSA Modules

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- Materials Science and Engineering Modules
  - Secondary Schools
  - Extra-Curricular Activities
- Robotics Modules
  - Secondary Schools
  - Extra-Curricular Activities
- Project-Based Learning
  - Integration into Teacher Training
  - Primary and Secondary Schools
- Assistments and
  - Assistments
  - Assessments (Formative and Program Effectiveness)

# Initiation of the Nigerian MS4SSA Node at AUST

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- AUST must be congratulated on its selection as an African Node for the MS4SSA Program – team includes Teacher Training College in Ekiti, Ministry of Education, AUST + World Bank-sponsored States
- Selected along with Gambia, Niger and Rwanda through a competitive and transparent process
- The goal is for each node to be a sustainable regional center for the training of trainers in the country and the surrounding region
- Initial Training of Trainers following the Adewoye Symposium and the Initiation of the MS4SSA Nigerian Node on Monday and Tuesday
- NJCTL Math and Science Modules on Wednesday
- WPI Modules on Materials, Robotics and Project-Based Learning on Thursday, Friday and Saturday

# Summary and Concluding Remarks

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- This talk presents an overview of the MS4SSA program and its potential to stimulate the development of the pipeline of Africans that can use STEM to develop Africa
- The origins of the MS4SSA program are presented along with the stages in the development of the program
- The two key components of the MS4SSA program include the NJCTL and the WPI modules
- These two key components can be implemented in country/regional programs that are funded by the Ministries of Education and Development Partners
- Train-the-trainer programs can be used to diffuse the these programs across SSA
- We welcome your involvement in these programs that are designed to develop the next generation of African youth into African Lions.....

