Mathematics and Science in Schools in Sub-Saharan Africa
Scientific Method

1. Ask Question
2. Do Background Research
3. Construct Hypothesis
4. Test with an Experiment
5. Analyze Results, Draw Conclusion
6. Think! Try Again
7. Report Results

- Hypothesis Is True
- Hypothesis Is False or Partially True
Lab: Scientific Method
Lab: Scientific Method

In this experiment, you will first make a “hypothesis”.

Can you accurately calculate the height of an individual if you know their forearm length?
Measure and record the length of each subject’s forearm.

Measure and record the height of each subject.
Lab: Scientific Method

*Data Chart*

<table>
<thead>
<tr>
<th>Forearm Length (m)</th>
<th>Height (m)</th>
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Lab: Scientific Method

Make a graph plotting forearm length vs. height.
Lab: Scientific Method

Measure and record the length of your teacher’s forearm.
Lab: Scientific Method

Using your graph, predict the teacher’s height.

Test your hypothesis by measuring your teacher’s height.
What is the Engineering Process?
Engineering Process

1. State the Problem
2. Generate Ideas
3. Select a Solution
4. Build the Item
5. Evaluate
6. Present Results
In the engineering process, a prototype is designed and constructed.
The prototype is tested, refined and retested until the problem has been solved.
Lab: Engineering Process
In this lab, you will design and construct and test a “roller coaster”.
The only materials you may use is a piece of rubber tubing and a ball bearing.
Lab: Engineering Process

Using just your rubber tubing, construct a roller coaster!

The ball bearing must complete the whole course!

Score: Each vertical loop (360°) = 10 Points!

You may try as often as you like, best score counts!

Failure is just a reason to start over more intelligently!
In real life problem solving situations, scientists often do some “engineering” work while engineers frequently apply the Scientific Method!
Water Crisis in Africa
Global Science Initiative
Cheap Efficient Water Filters
Project Goal

Ratio of Clay to Sawdust
Ceramic “Nano” Pores
Testing Ceramic Filters
Introduction to Material Science
What is Material Science?

The Study of Stuff!
Why learn Material Science?
Africa is the richest continent in terms of mineral deposits in the world!
Course Syllabus 1

Introduction to Engineering

Microscopy

Material Properties

Material Structure

Bonding
Advances in Magnification
SEM
What does a Material Scientist do?
Types of Matter

Pure Substances
- Elements
- Compounds

Mixtures
- Heterogeneous
- Homogeneous
Lab: “Nuts & Bolts” of Classifying
# Lab: “Nuts & Bolts” of Classifying

## Data Chart

<table>
<thead>
<tr>
<th>Sample</th>
<th>Classification</th>
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<tr>
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Lab: “Nuts & Bolts” of Classifying

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What does a Material Scientist do?
Material Structure
Lab: Magnetism-The Inside Story
What does a Material Scientist do?

PERFORMANCE

PROPERTIES

SYNTHESIS/PROCESSING

STRUCTURE/COMPOSITION

😊
Material Properties
Material Failure
Material Failure
Lab: Destructive Testing
## Lab: Destructive Testing

### Data Chart

<table>
<thead>
<tr>
<th>Paper Clip Type</th>
<th># of Turns</th>
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What does a Material Scientist do?
Improving Energy Absorption

Photo Courtesy of Autoliv
Improving Energy Absorption
Improving Energy Absorption
Lab: Energy Absorption
## Lab: Energy Absorption

<table>
<thead>
<tr>
<th>Test Material</th>
<th>Drop Height (cm)</th>
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Course Syllabus 2

Metals

Ceramics

Polymers

Semiconductors

Composites

Sustainable Energy
Metals
Ceramics

SPACE SHUTTLE

elevons
remote-control arm
special launch
living quarters and flight deck
star tracker
engines
forward control thrusters
orbital rendez-vous light
cargo-bay door
maniouvring engine
main engines
body flap
tanks
wing
Polymers
Semiconductors
Composites
Sustainable Energy
Question?