Teaching Inquiry in Nigeria & Canada

Linda Strubbe
Science Teaching & Learning Fellow
University of British Columbia
Carl Wieman Science Education Initiative

linda@phas.ubc.ca
Scientific Thinking
Scientific Thinking

• Asking questions
• Developing and using models
• Planning and carrying out investigations
• Communicating information

(NRC 2012: from U.S. Next Generation Science Standards)
Inquiry-based Teaching

(adapted from the Institute for Scientist & Engineer Educators, Hunter et al. 2014)
Inquiry-based Teaching

Learning practices and concepts is intertwined

(adapted from the Institute for Scientist & Engineer Educators, Hunter et al. 2014)
Inquiry-based Teaching

Learning practices and concepts is intertwined

Mirrors authentic scientific research

(adapted from the Institute for Scientist & Engineer Educators, Hunter et al. 2014)
Inquiry Structure

Engaging the Learner

→ Focused Investigating

→ Making Meaning Together

(adapted from the Institute for Scientist & Engineer Educators, Hunter et al. 2014)
2nd West African International
Summer School for Young Astronomers
July 13 - 17, 2015

FM20.2.04 (Friday 8:45am)
2nd West African International Summer School for Young Astronomers
July 13 - 17, 2015

50 undergraduate science majors and teachers from around Nigeria & Ghana

FM20.2.04 (Friday 8:45am)
2nd West African International Summer School for Young Astronomers
July 13 - 17, 2015

50 undergraduate science majors and teachers from around Nigeria & Ghana

FM20.2.04 (Friday 8:45am)

Inquiry Topic: Distances in the Universe

Learning goals:
• Concept: parallax
• Practice: solve a problem by breaking into smaller questions to investigate
Activity structure
Activity structure

- Hands-on challenge: measure distance to model planet in a field
Activity structure

• Hands-on challenge: measure distance to model planet in a field

• Students ask questions about astronomical images
Activity structure

• Hands-on challenge: measure distance to model planet in a field

• Students ask questions about astronomical images

• Choose own question to study, break down to focus on distance
Activity structure

• Hands-on challenge: measure distance to model planet in a field

• Students ask questions about astronomical images

• Choose own question to study, break down to focus on distance

• Work in teams to plan distance measurement
Activity structure

• Hands-on challenge: measure distance to model planet in a field

• Students ask questions about astronomical images

• Choose own question to study, break down to focus on distance

• Work in teams to plan distance measurement

• Discuss results and process in different groups
Activity structure

• Hands-on challenge: measure distance to model planet in a field

• Students ask questions about astronomical images

• Choose own question to study, break down to focus on distance

• Work in teams to plan distance measurement

• Discuss results and process in different groups

• Reflect on learning
I have learned that when you are a scientist, you are always asking why, why, why, why, why, why
-- Sister Matilda Okoyeowell
I have learned that when you are a scientist, you are always asking why, why, why, why, why, why
-- Sister Matilda Okoyeowell

I have learned that scientists are very curious...They are not so exceptional, just that they ask lots of questions, and they’re really passionate about finding solutions to things. -- Emmanuel Ezenwere
Order-of-Magnitude Problem Solving in Physics & Astronomy

5-week “mini course”
Physics & astronomy Graduate students at CITA / University of Toronto

https://sites.google.com/site/oomtoronto
Order-of-Magnitude Problem Solving in Physics & Astronomy

5-week “mini course”
Physics & astronomy Graduate students at CITA / University of Toronto

https://sites.google.com/site/oomtoronto

Course learning goal:
Order-of-Magnitude Problem Solving in Physics & Astronomy

5-week “mini course”
Physics & astronomy Graduate students at CITA / University of Toronto

https://sites.google.com/site/oomtoronto

Course learning goal:

• How to estimate solutions to complex problems by breaking into smaller pieces, making approximations and assumptions, using knowledge they already have.
How many airplanes are in flight worldwide right now? What is the oblateness of the Earth?
How many airplanes are in flight worldwide right now?
What is the oblateness of the Earth?

In-class problem solving sessions
How many airplanes are in flight worldwide right now? What is the oblateness of the Earth?

In–class problem solving sessions

• Some questions by instructors, some by students
How many airplanes are in flight worldwide right now?
What is the oblateness of the Earth?

In-class problem solving sessions
- Some questions by instructors, some by students
- Work in teams at blackboard
How many airplanes are in flight worldwide right now?
What is the oblateness of the Earth?

In–class problem solving sessions
• Some questions by instructors, some by students
• Work in teams at blackboard
• Instructors observe and facilitate
How many airplanes are in flight worldwide right now? What is the oblateness of the Earth?

In-class problem solving sessions
- Some questions by instructors, some by students
- Work in teams at blackboard
- Instructors observe and facilitate
- Students share results with class
First-Year Inquiry Physics Labs at UBC

• reflect on quality of experimental results
• make comparisons
• understand measurement uncertainty
• improve measurements and iterate

Natasha Holmes, Doug Bonn, Dhaneesh Kumar, James Day, Carl Wieman
Paired teaching:
Method of professional development for teaching

Paired teaching:
Method of professional development for teaching

- Expert and novice teach course together

Paired teaching:
Method of professional development for teaching

- Expert and novice teach course together

- Pilot study and funding at UBC

Paired teaching: Method of professional development for teaching

- Expert and novice teach course together
- Pilot study and funding at UBC
- Jared Stang and I are studying what factors lead to effective professional development

Institutions:

IAU Office of Astronomy for Development
Canadian Institute for Theoretical Astrophysics
Dunlap Institute for Astronomy & Astrophysics (Canada)
University of Toronto
University of British Columbia
Carl Wieman Science Education Initiative (Canada)
Harris Foundation (Canada)
Institute for Scientist & Engineer Educators (USA)
European Southern Observatory (Germany)
University of Nigeria, Nsukka
Centre for Basic Space Science (Nigeria)
National Space Research & Development Agency (Nigeria)
Thank you!

West Africa Team:
Bonaventure Okere
James Chibueze
Sudum Esa
Romanus Eze
Wolfgang Kerzendorf
Valerie Murray
Thai Duy Cuong Nguyen
Finbar Odo
Chukwujekwu Ofodum
Patrice Okouma
Jielai Zhang

CITA:
Chris Matzner
Norm Murray

UBC:
Doug Bonn
Natasha Holmes
Dhaneesh Kumar
Jared Stang

Linda Strubbe
linda@phas.ubc.ca