



*Chaoyang School District Professional Development
Course May 19-30 2015*



Teaching Math & Science With Technology in the 21st Century



朝陽區 朝阳区

Dr. Marina Milner-Bolotin

Day 4 - May, 2015

Day 4 – May 2015

PhET
INTERACTIVE SIMULATIONS

Over 200 million simulations delivered

University of Colorado Boulder

Support PhET's Annual Campaign: [Donate Today](#) [HTML5 Sims](#)

INTERACTIVE SIMULATIONS FOR SCIENCE AND MATH

Play with Simulations

The Tech Awards

Faraday's Law

How to Run Simulations

- On Line
- Full Installation
- One at a Time
- Troubleshooting
- FAQs

For Teachers

- Tips for Using PhET
- Browse Activities
- Share your Activities
- Workshops
- Translate simulations
- Translate the website

About

- What's New?
- About PhET
- Research on PhET
- Contact Us
- Donate

PhET is supported by...

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and our [other sponsors](#), including educators like you.

Computer simulations, games and online learning environments

*You can download the simulations.
You can also use Chinese!*

简体中文 | 正體中文 |

I

Course Tentative Schedule

Day	Technology	
1	Student engagement: Clickers, multimedia	✓
2	Peer Instruction and PeerWise: inquiry via questioning; Exploring GeoGebra	✓
3	Data collection and analysis; mathematics modeling with Desmos	✓
4	Computer simulations, games, and online learning environments	✓
5	Summary and projects' presentations	

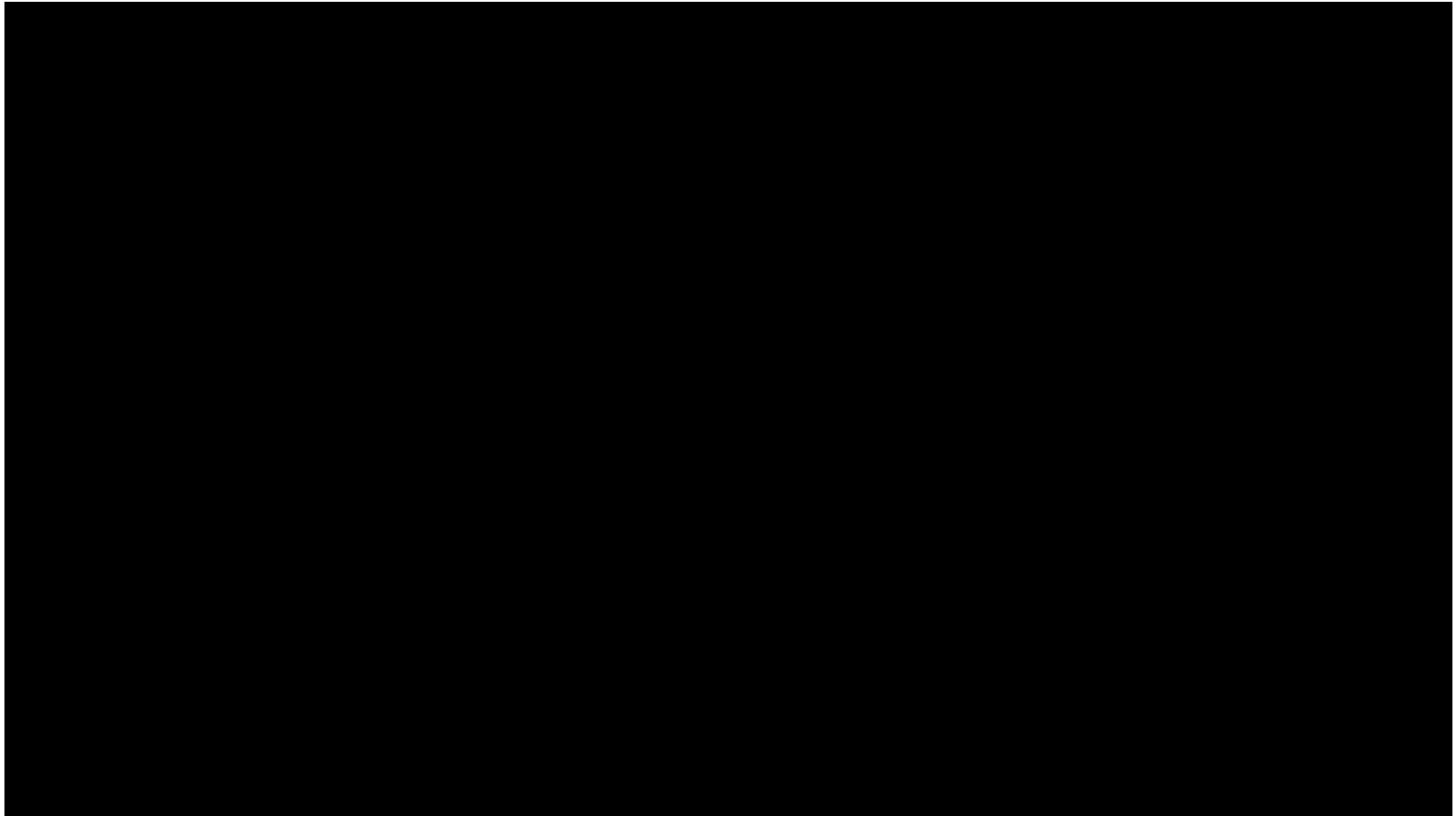
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This will revolutionize education or will it?



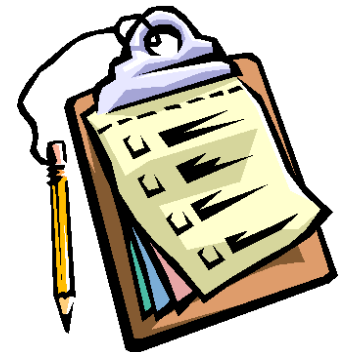
I

**This will revolutionize
education or will it?**



Agenda for the Day

- I. Building students' intuition with technology:
Earthquakes
- II. Exploring virtual labs: PhET
- III. Group activity: Designing lessons with PhET
- IV. Flipped classroom and online teaching
- V. Summary of the day



Agenda for the Day

- I. Building students' intuition with technology: Earthquakes**
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Dot-Decimal Notation:

点阵十进制表示法

- In North America: $10.5 = 10\frac{1}{2}$
- In Europe and in China: $10,5 = 10\frac{1}{2}$

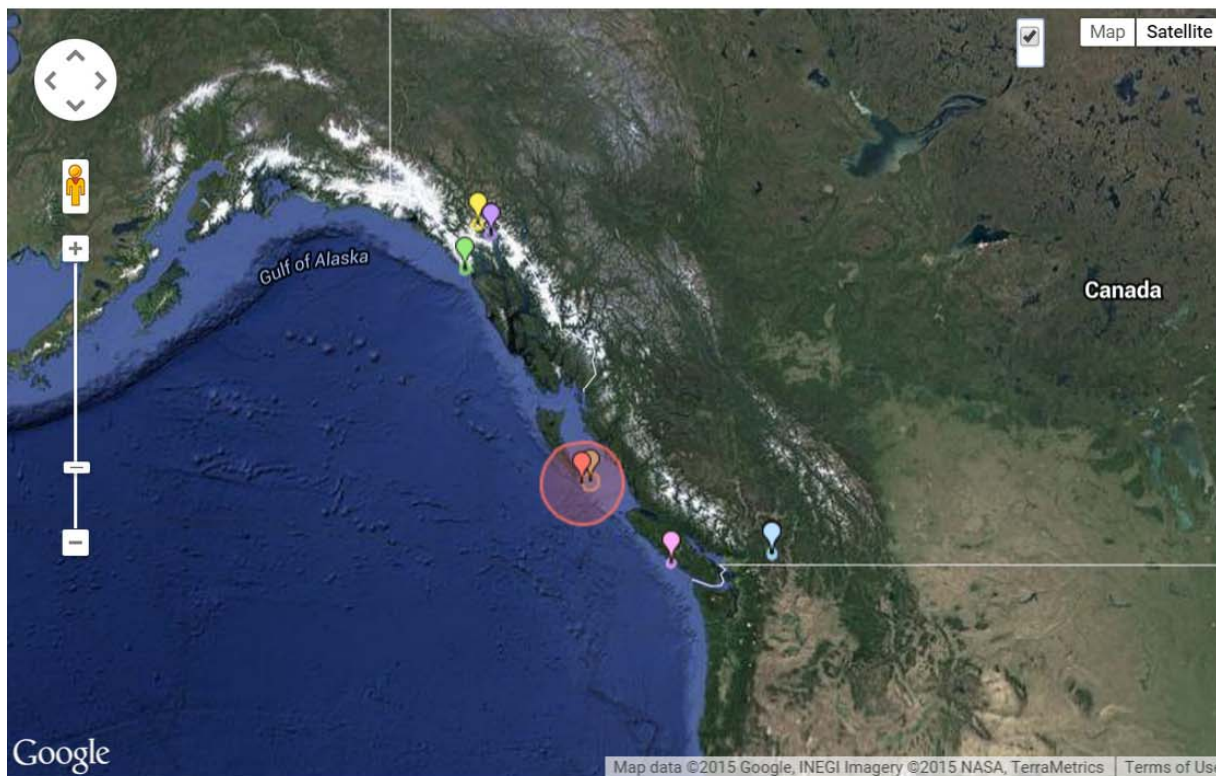
I am using North American notation: **1,234.56** means one thousand two hundred thirty four and 56/100

Understanding Earthquakes' Magnitude



Nepal earthquake on 25th of April, 2015 – 7.8 in magnitude

Understanding Earthquakes' Magnitude



- 6 days ago 2.2 magnitude, 0 km depth
British Columbia, Canada
- 7 days ago 1.9 magnitude, 13 km depth
Southeastern Alaska
- 8 days ago 2.1 magnitude, 7 km depth
Coast Of Southeastern Alaska
- 8 days ago 2.2 magnitude, 0 km depth
British Columbia, Canada
- 9 days ago 2.2 magnitude, 0 km depth
British Columbia, Canada
- 10 days ago 1.7 magnitude, 7 km depth
Southeastern Alaska
- 11 days ago 1.6 magnitude, 34 km depth
Vancouver Island, Canada
- 11 days ago 1.6 magnitude, 0 km depth
British Columbia, Canada
- 11 days ago 4.1 magnitude, 9 km depth
Haida Gwaii
- 11 days ago 6.2 magnitude, 10 km depth
Kitimat, British Columbia, Canada

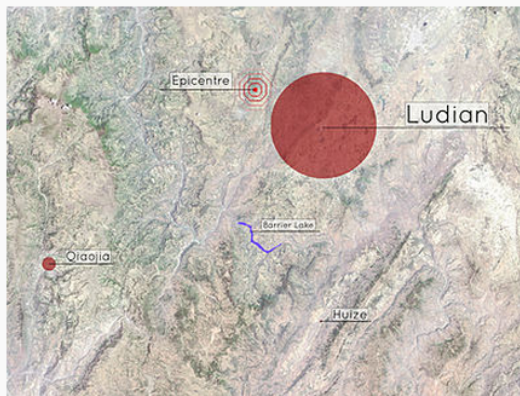
Earthquakes in British Columbia Canada: - Thursday, April 23, 2015 – 6.2 magnitude

Understanding Earthquakes' Magnitude


2014 Ludian earthquake



Location of Yunnan Province in China

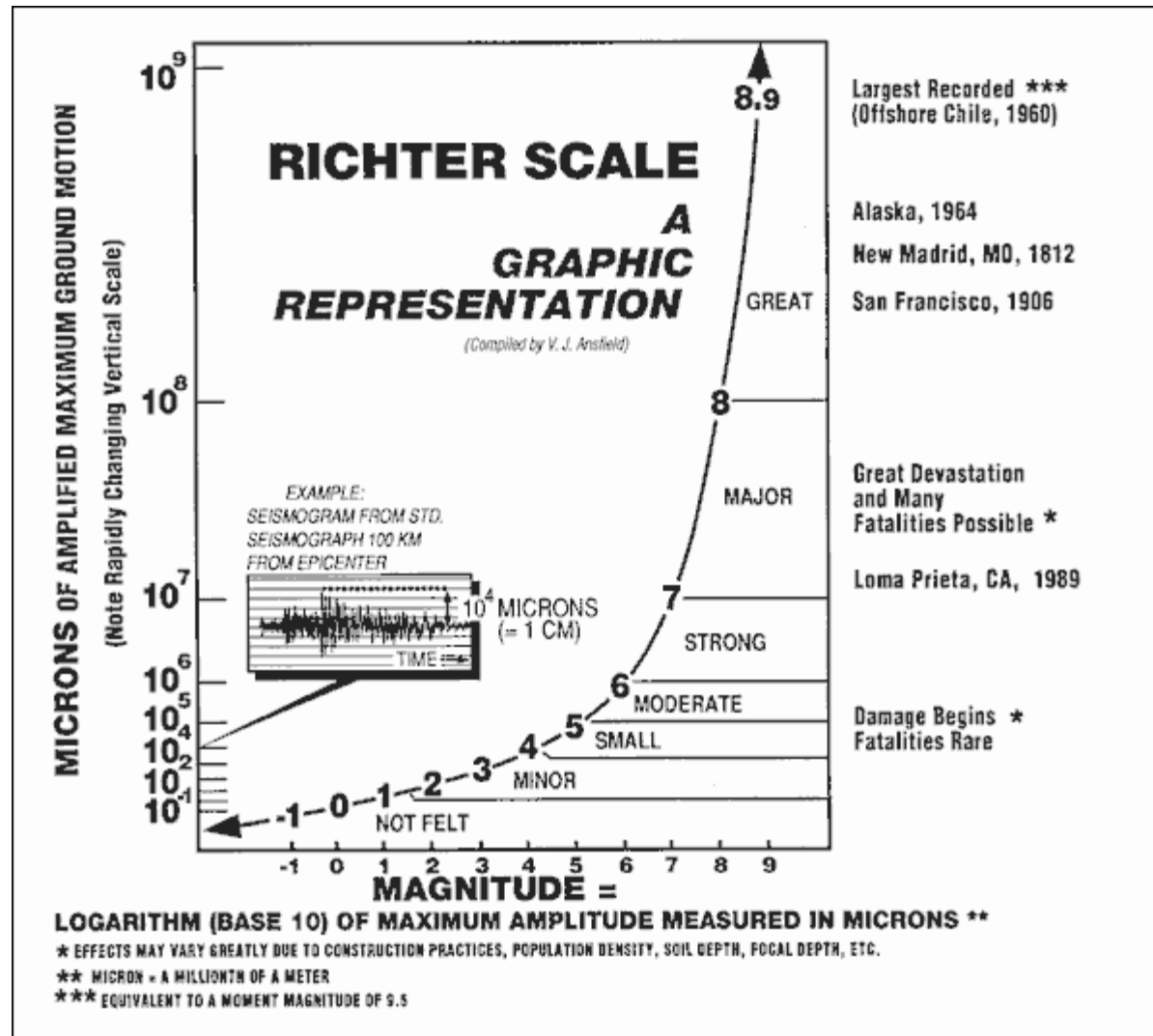


A map of the Ludian Earthquake. Size of red circles represent number of deceased per county.

Date	3 August 2014
Origin time	08:03:13 UTC
Magnitude	6.5 M_L ^{[1][2][3][4][5]} 6.1 M_W ^[6]
Depth	10.0 km (6.2 mi)
Epicenter	 27.245°N 103.427°E
Areas affected	Yunnan, China <ul style="list-style-type: none">• Ludian County• Huize County• Qiaojia County
Total damage	\$6 billion ^[7]
Max. intensity	VII (Very Strong) ^{[8][9]}
Casualties	617 dead (As of 8 August 7:00 UTC) ^[10] ^{[11][12][13][14]} 3,143 injured (As of 8 August 7:00 UTC) ^{[7][10]} 112 missing (As of 8 August 7:00 UTC) ^{[10][15]}

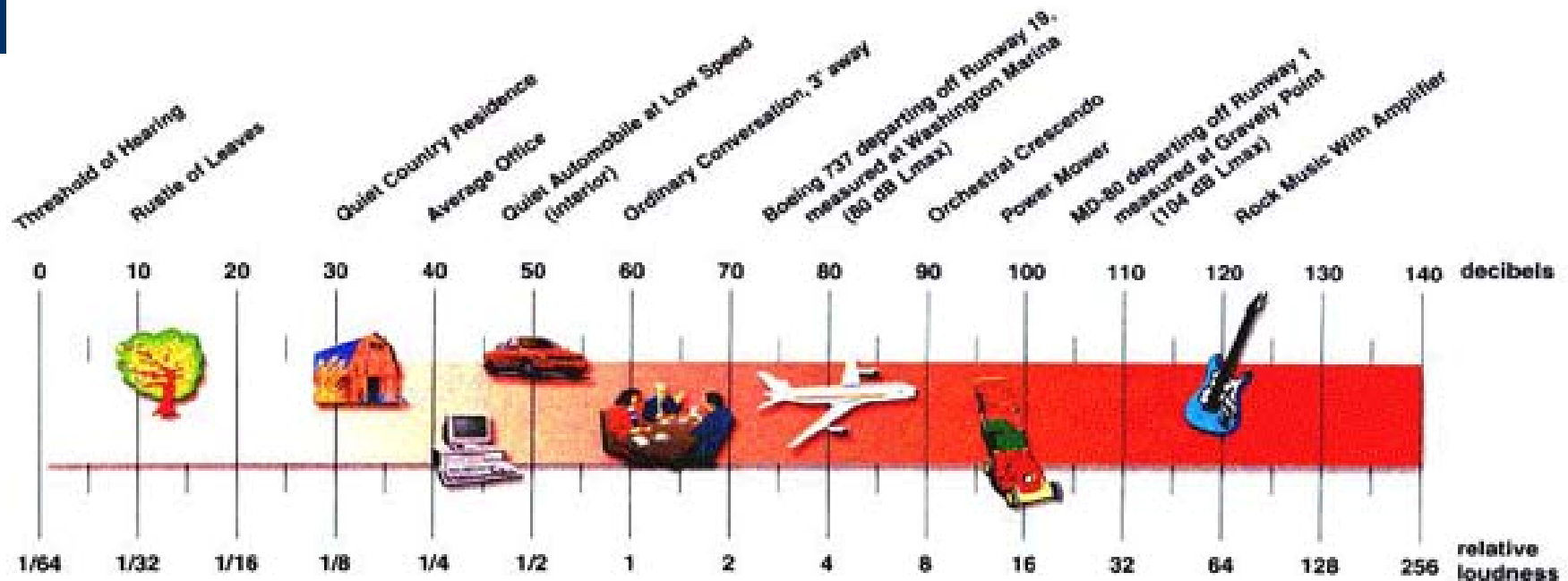
Earthquake in Ludian Province, China: - August 3, 2014 – 6.1 magnitude

Earthquakes' Magnitude: Richter Scale



I

Log Scale in Science: dB



The **decibel (dB)** is a unit for describing sound pressure levels. A-weighted sound measurements (dBA) are filtered to reduce the effect of very low and very high frequencies, better representing human hearing. With A-weighting, sound monitoring equipment approximates the human ear's sensitivities to the different sounds of frequencies.

$$L_2 - L_1 = \left(10 \log \frac{P_2}{P_1} \right) dB \Rightarrow \text{If } P_2 = 2P_1 \Rightarrow L_2 - L_1 = 3dB$$

L – sound pressure level measured in dB; P - power of sound


I

Log Scale in Science: dB



Most Smart phones today will have apps that can help you measure sound levels.

Students' Problems with Logarithmic Scales



Teaching Quantitative Skills in the Geosciences
resources for undergraduate students and faculty

Search the Site

Quantitative Skills > Teaching Methods > Teaching Quantitative Literacy > Logarithms

Quantitative Skills

- Issues and Discussion
- Teaching Methods
- Back of the Envelope Calculations
- Mathematical and Statistical Models
- Measurement and Uncertainty
- Metacognition
- Models
- Teaching Quantitative Literacy
 - Mathematical Concepts
 - Big Numbers and Scientific Notation
 - Exponential Growth and Decay
 - Probability
 - Logarithms**
 - Trigonometry and Angles

Geologic context: earthquakes, [floods and flooding](#), grain sizes/sedimentology, [radioactive decay](#), [population growth](#), changes in atmospheric CO₂, decibel scale, pH scale

Teaching logarithms (logs)

by Dr. Eric M. Baer, Geology Program, Highline Community College

Jump down to: [Teaching strategies](#) | [Materials & Exercises](#) | [Student Resources](#)

Logarithms are the inverse of the [exponential function](#). Originally developed as a way to convert multiplication and division problems to addition and subtraction problems before the invention of calculators, logarithms are now used to solve exponential equations and to deal with numbers that extend from very large to small in a more elegant fashion. For more information on exponential functions, go to the [Exponential Growth and Decay](#) page.

The logarithm function (**log**) is defined by

$$y = \log_b(x) \text{ if and only if } x = b^y$$

and $x > 0$, $b > 0$ and b not equal to 1.
The function is read and is read "y is the log base b of x"

When no base (b) is noted, the assumed base is 10. Thus,

$$y = \log(x) \text{ is the same as } y = \log_{10}(x)$$

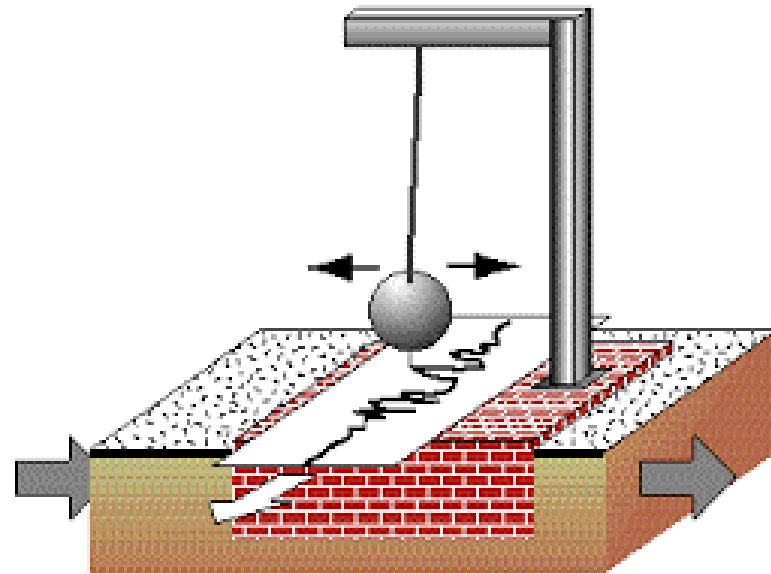
<http://serc.carleton.edu/quantskills/methods/quantlit/logarithms.html>

Comparing Earthquakes' Magnitudes



By how much the **magnitude of the earthquake** in Nepal (7.8) is larger than the magnitude of British Columbia or of Chinese recent earthquakes (6.1)?

- A. 1.7 times
- B. 10 times
- C. 50 times
- D. 100 times
- E. 350 times



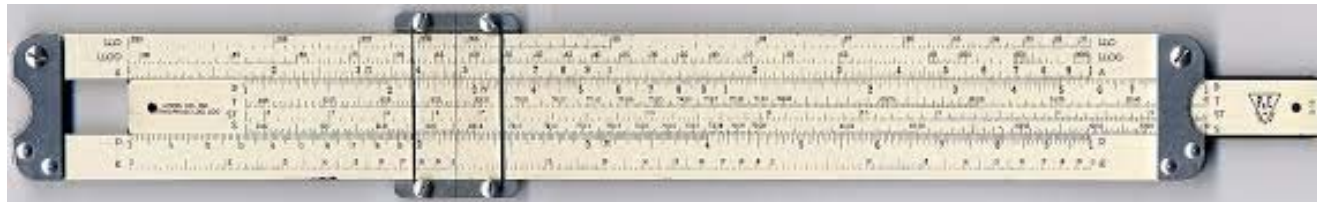
Comparing Earthquakes' Magnitudes



A magnitude (M_s) 7.8 earthquake is 50 times BIGGER on a seismogram than a magnitude 6.1 earthquake. The magnitude scale is logarithmic, so

$$\frac{\text{Magnitude_Nepal}}{\text{Magnitude_China}} = \frac{M_{S_Nepal}}{M_{S_China}} = \frac{10^{7.8}}{10^{6.1}} = 10^{7.8-6.1}$$

$$\frac{M_{S_Nepal}}{M_{S_China}} = 10^{1.7} = 50.118 \approx 50 \text{ times}$$



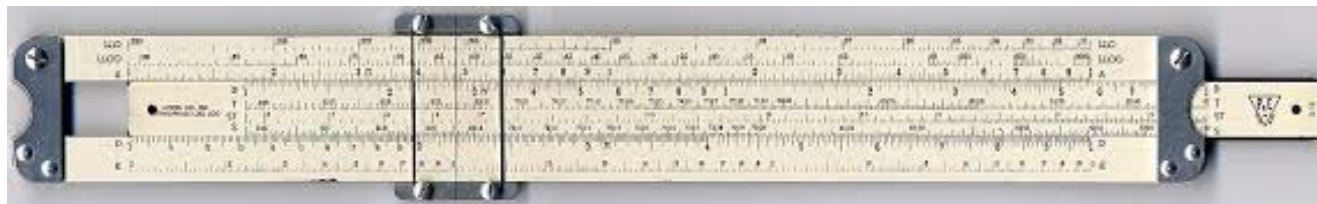
Comparing Earthquakes' Magnitudes



1 unit of magnitude is about 10 times the amplitude on a seismogram; 0.1 unit of magnitude - 1.3 times the energy

$$\frac{\text{Magnitude_Nepal}}{\text{Magnitude_China}} = \frac{10^{7.8}}{10^{6.1}} = 10^{7.8-6.1}$$

$$\frac{\text{Magnitude_Nepal}}{\text{Magnitude_China}} = 10^{1.7} = 50.118 \approx 50 \text{ times}$$



Comparing Earthquakes' Energy Release



By how much the **energy release of the earthquake** in Nepal (7.8) is larger than the magnitude of British Columbia or of Chinese recent earthquakes (6.1)?

- A. 50 times
- B. 150 times
- C. 250 times
- D. 350 times
- E. 450 times



Comparing Earthquakes' Energy Release



By how much the **energy release of the earthquake** in Nepal (7.8) is larger than the magnitude of British Columbia or of Chinese recent earthquakes (6.1)?

- A. 10 times $\log_{10} \text{Energy} = 11.8 + 1.5 M_s$
- B. 150 times $\text{Energy} = 10^{(11.8 + 1.5 M_s)} = 10^{11.8} \times 10^{1.5 M_s}$
- C. 250 times $\frac{\text{Energy_Nepal}}{\text{Energy_China}} = \frac{10^{11.8} \times 10^{1.5 M_{s_Nepal}}}{10^{11.8} \times 10^{1.5 M_{s_China}}}$
- D. 350 times
- E. 450 times $\frac{\text{Energy_Nepal}}{\text{Energy_China}} = 10^{1.5(7.8 - 6.1)} = 354$

I

Understanding Earthquakes

How Much Bigger...? Calculator - Google Chrome

earthquake.usgs.gov/learn/topics/calculator.php

FAQ
Earthquake Glossary
For Kids
Prepare
Google Earth/KML Files
Earthquake Summary
Posters
Photos
Publications

Larger Magnitude:

Range is -3. to 10.

Smaller Magnitude:

Range is -3. to 10.

Magnitude Difference:

A magnitude earthquake
is times **bigger** than
a magnitude earthquake on a seismogram,
but is times **stronger** (energy release).

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EARTHQUAKES **HAZARDS** **DATA & PRODUCTS** **LEARN** **MONITORING**

Latest Earthquakes Hazard Maps & Data Data EQ Topics for Education NEIC

I

Wolfram Alpha

PRO

MOBILE APPS

PRODUCTS

EXAMPLES

BLOG

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WOLFRAM SITES



Making Wolfram|Alpha free to all wouldn't be possible without the support of our Pro
Help us make even more of the world computable in 2015 by going Pro.

Go



$10^{(1.5 \cdot 1.7)}$



Examples Random

Input:

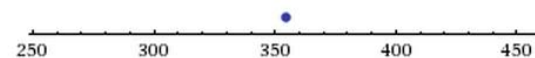
$10^{1.5 \cdot 1.7}$

Result:

354.813...

More digits

Number line:



All 20th roots of 10^{51} :

More roots

More digits

I

Wolfram Alpha

screenrSM

RECORD

January 07 1988 - Y... X

Venus - Wikipedia, the... January 07 1988 - Goog...

time difference from today (Friday, October 9, 2009):

- 21 years 9 months 2 days ago
- 1135 weeks 1 day ago
- 7946 days ago
- 21.75 years ago

Time in 1988:

- 7th day
- 1st week

More

enter any calculation
\$250 + 15%

enter any math formula
 $x^2 \sin(x)$

more »

Examples by Topic »
Visual Gallery of Examples »
Watch Overview Video »

Search the Web

Birth of Nicolas Sarkozy (actor) (1928): 81st anniversary

Birth of Millard Fillmore (politician) (1800): 188th anniversary

Birth of Michael H. Moskow (businessperson) (1938): 50th anniversary

Birth of Lewis Hamilton (auto racer) (1985): 3rd anniversary

Birth of Katie Couric (talk show host) (1957): 31st anniversary

Daylight information for January 7, 1988 in Hanover, New Hampshire:

sunrise	7:23 am EST
sunset	4:28 pm EST

More

Learn about new Lenovo laptops with Intel.
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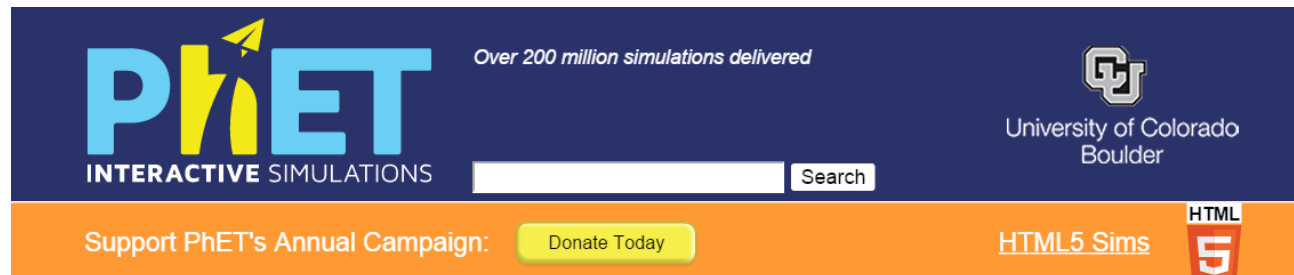
screenrSM

Agenda for the Day

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What is PhET?

FREE
RESOURCES

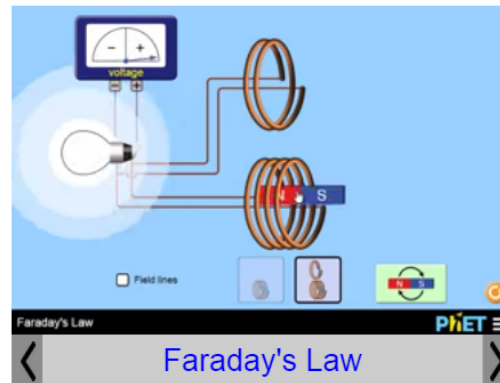



PhET INTERACTIVE SIMULATIONS Over 200 million simulations delivered University of Colorado Boulder

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INTERACTIVE SIMULATIONS
FOR SCIENCE AND MATH

Play with
Simulations



How to Run Simulations	For Teachers	About	PhET is supported by...
<ul style="list-style-type: none">On LineFull InstallationOne at a TimeTroubleshootingFAQs	<ul style="list-style-type: none">Tips for Using PhETBrowse ActivitiesShare your ActivitiesWorkshopsTranslate simulationsTranslate the website	<ul style="list-style-type: none">What's New?About PhETResearch on PhETContact UsDonate	 <p>and our other sponsors, including educators like you.</p>

PhET Computer simulations from the University of Colorado, Boulder

*You can download the simulations.
You can also use Chinese!*

简体中文 | 正體中文 |

Carl Wieman – 2001 Nobel Prize in Physics

Wieman joined [UBC](#) on January 1, 2007 and headed a CWSEI; he retained a 20% appointment at the [University of Colorado Boulder](#) to head the PhET science education project he founded in Colorado.^[3] ... In 2013 he moved to Stanford. He currently serves as Chair of the [Board on Science Education](#) of the [National Academy of Sciences](#). He has used and promotes [Eric Mazur's](#) "peer instruction"... In 2007, Wieman was awarded the AAPT [Oersted Medal](#), which recognizes notable contributions to the teaching of physics.



The Carl Wieman Science Education Initiative at UBC



Carl Wieman Science Education Initiative
at the University of British Columbia



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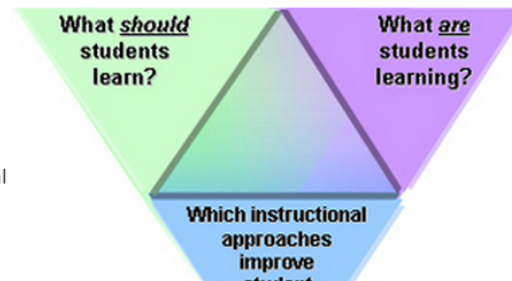
THE CARL WIEMAN SCIENCE EDUCATION INITIATIVE

*Achieving the most effective, evidence-based science education
(effective science education, backed by evidence)*

The Carl Wieman Science Education Initiative (CWSEI) is a multi-year project at The University of British Columbia aimed at dramatically improving undergraduate science education.

The CWSEI helps departments take a four-step, scientific approach to teaching:

- ✔ Establish what students should learn
- ✔ Scientifically measure what students are actually learning
- ✔ Adapt instructional methods and curriculum and incorporate effective use of technology and pedagogical research to achieve desired learning outcomes
- ✔ Disseminate and adopt what works



**SCIENCE EDUCATION
OPEN HOUSE (CWSEI
END-OF-YEAR EVENT)
APRIL 13, 2015**

[click HERE for the schedule
\(talks, posters, workshops\)](#)

NEW VIDEO COLLECTION

[Evidence-based science education in action](#) - This video collection shows clips from university science and math classrooms, along with commentary pointing out key aspects and strategies.

NEW COURSE

<http://www.cwsei.ubc.ca/>

II

Virtual Labs

PHYSICAL REVIEW SPECIAL TOPICS - PHYSICS EDUCATION RESEARCH **1**, 010103 (2005)

When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment

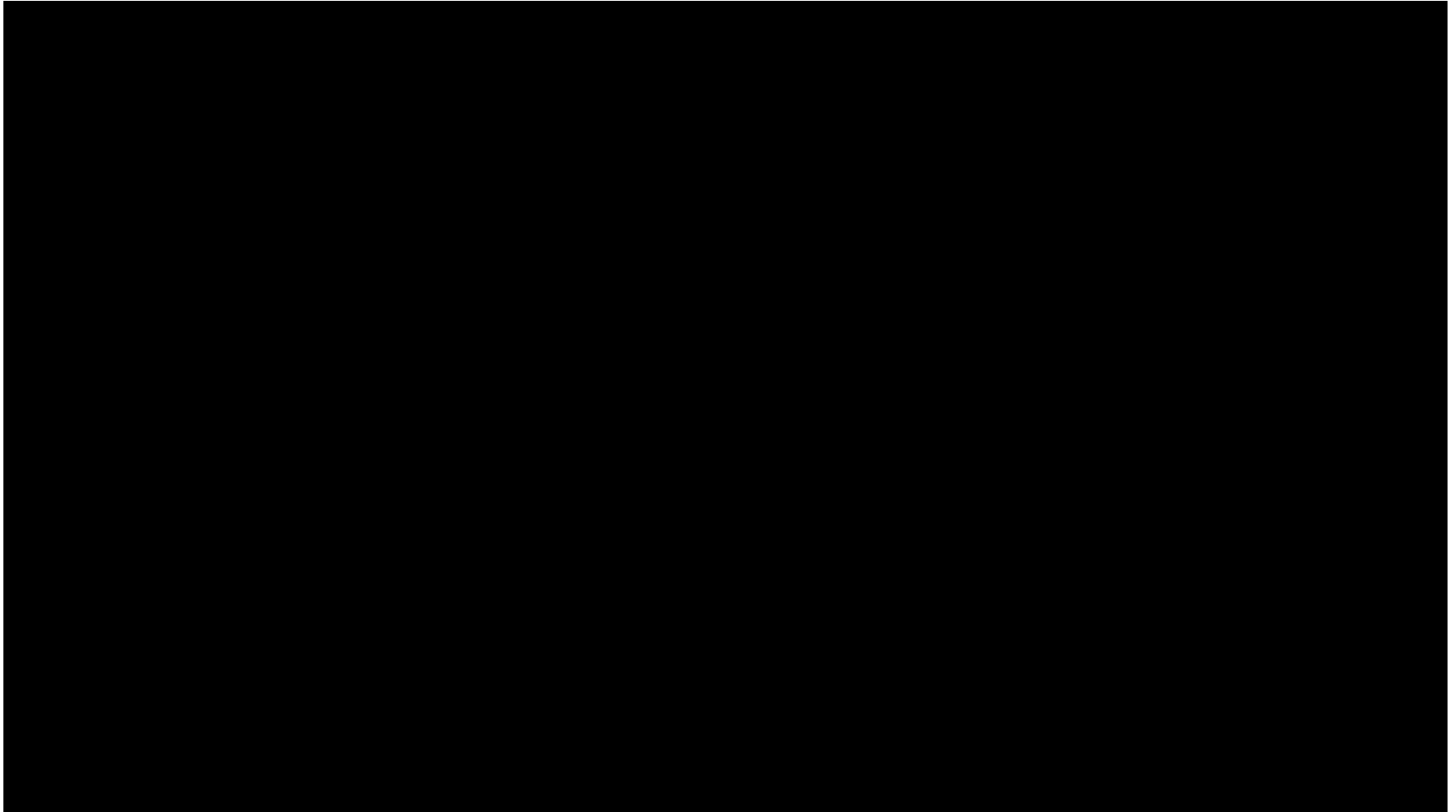
N. D. Finkelstein, W. K. Adams, C. J. Keller, P. B. Kohl, K. K. Perkins, N. S. Podolefsky, and S. Reid
Department of Physics, University of Colorado, Boulder, Colorado 80309, USA

R. LeMaster
Kavli Operating Institute, Santa Barbara, California 93101, USA
(Received 17 May 2005; published 6 October 2005)

This paper examines the effects of substituting a computer simulation for real laboratory equipment in the second semester of a large-scale introductory physics course. The direct current circuit laboratory was modified to compare the effects of using computer simulations with the effects of using real light bulbs, meters, and wires. Two groups of students, those who used real equipment and those who used a computer simulation that explicitly modeled electron flow, were compared in terms of their mastery of physics concepts and their ability to use real equipment. Students who used the simulated equipment outperformed those who used the real equipment in a conceptual survey of the domain and in the coordinated tasks of assembly and troubleshooting. The simulated equipment worked.

[Finkelstein, N. D., Adams, W. K., Keller, C. J., Kohl, P. B., Perkins, K. K., Podolefsky, N. S., . . . LeMaster, R. (2005). When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment. *Physical Review Special Topics - Physics Education Research*, 1(1), 010103.]

What is PhET?



II

Experimenting with DC or AC Circuits

Home

► **Simulations**

New Sims

Physics

Motion

Sound & Waves

Work, Energy & Power

Heat & Thermo

Quantum Phenomena

Light & Radiation

Electricity, Magnets & Circuits

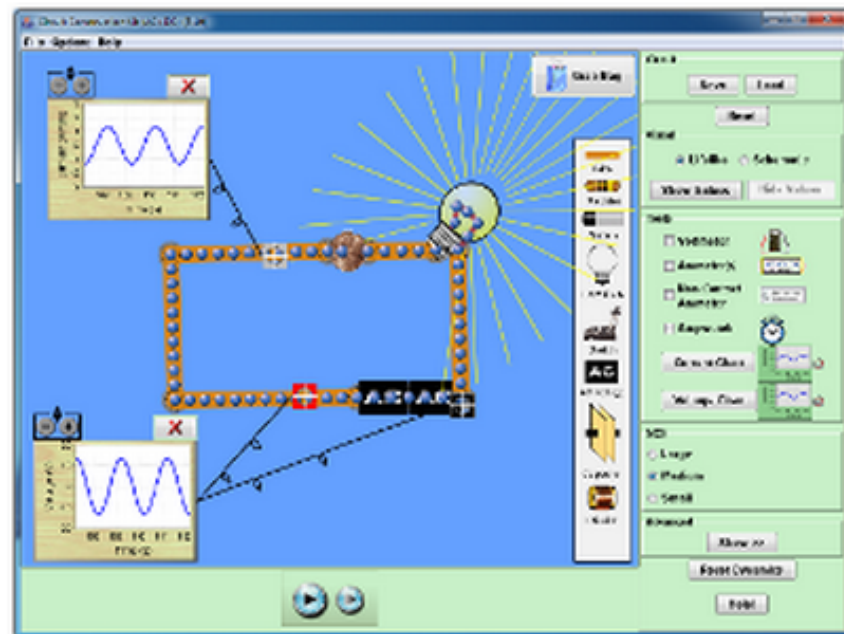
Biology

Chemistry

Earth Science

Math

Circuit Construction Kit (AC+DC)



[Download](#)

[Run Now!](#)

[Embed](#)

Version 3.20

Agenda for the Day

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III

Guiding Questions for PhET

1. Why do I want my student to use PhET?
2. When do I use PhET (home, in class, before instruction, during, or after?)
3. How do I assess student work?
4. Do they work in group or alone?
5. How do I guide them?
6. How do I incorporate it into final assessment?



III

Designing Lessons with PhET

Group activity (45 min)



1. Choose a partner and explore PhET together
2. Design your own PhET activity
3. Share your activity with another group
4. We will share all the ideas with the entire group

III

Break: Mental Exercise



III

Break: Mental Exercise



Suppose 6 monkeys take 6 minutes to eat 6 bananas. How many minutes would it take 4 monkeys to eat 4 bananas?

- a) 1 minute
- b) 4 minutes
- c) 6 minutes
- d) 12 minutes
- e) 24 minutes



III

Break: Mental Exercise



Suppose 6 monkeys take 6 minutes to eat 6 bananas. How many monkeys would it take to eat 42 bananas in 42 minutes?

- a) 6 monkeys
- b) 7 monkeys
- c) 13 monkeys
- d) 42 monkeys
- e) Other

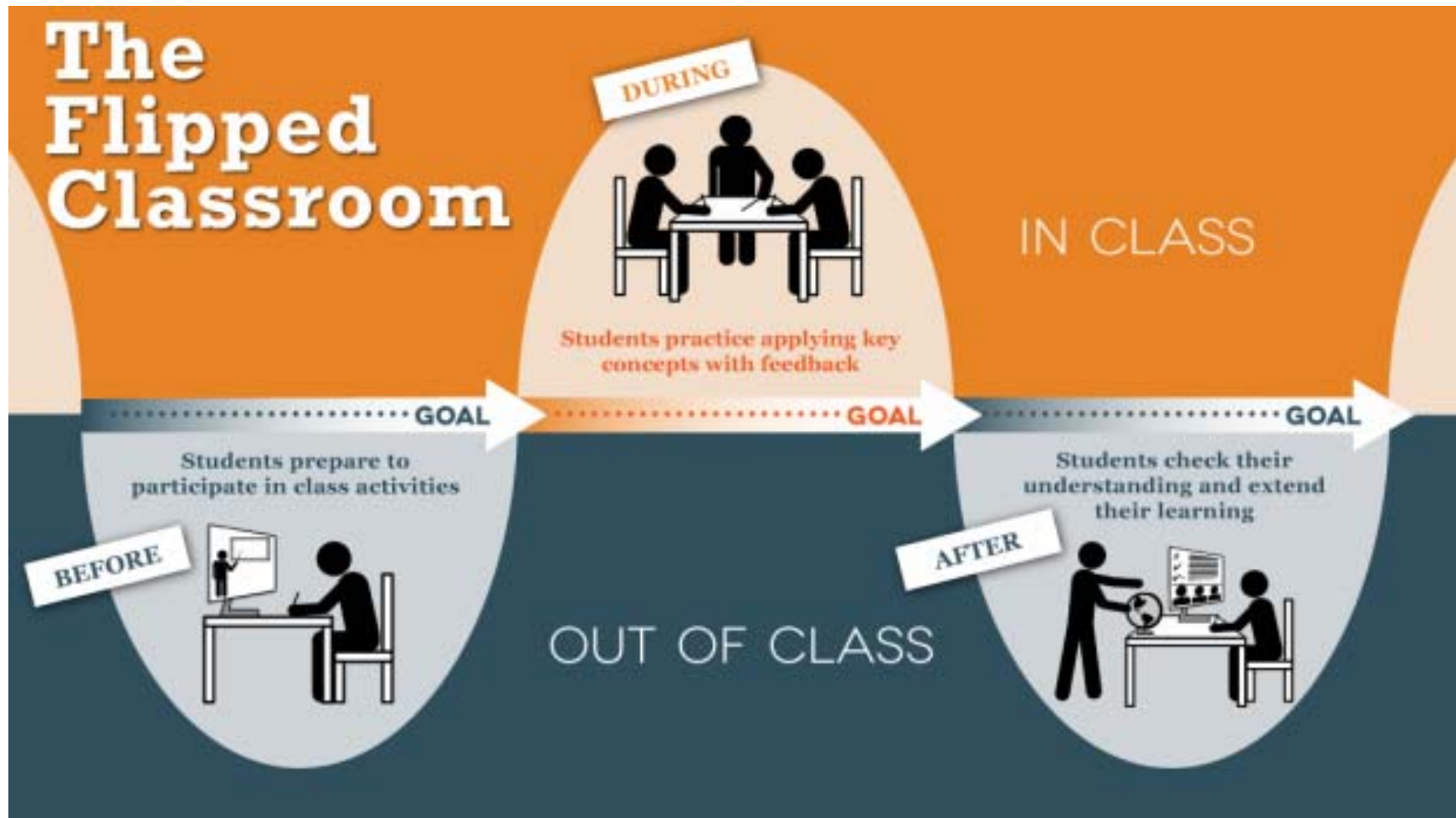


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IV

Flipped Classroom and Online Teaching



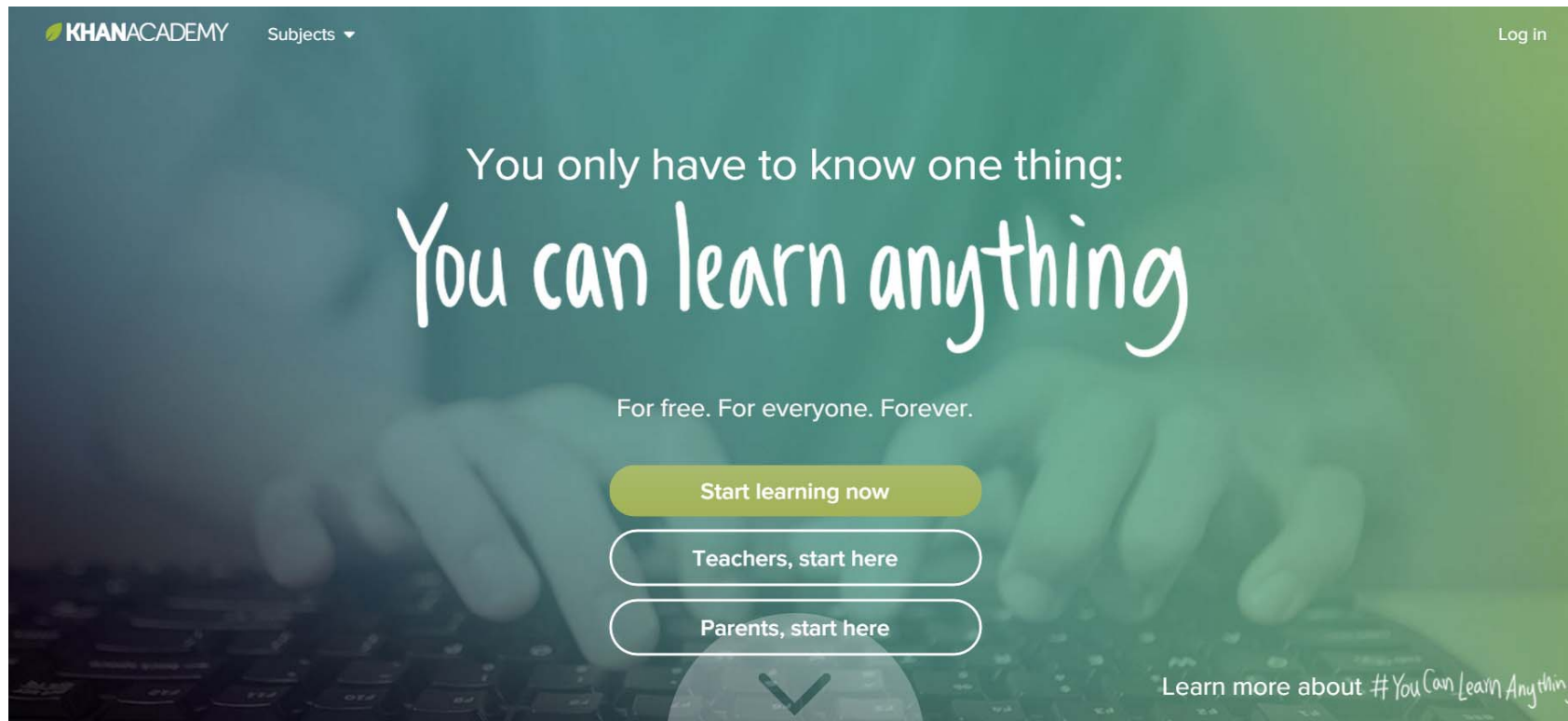
IV

Flipped Classroom and Online Teaching



IV

Tools for Flipped Classroom



Khan Academy and other content providers created a lot of resources you can use in your classrooms : MOOCs, courses delivered by big universities, online resources

IV

Teaching Online Courses



a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

Vancouver Campus



Faculty of Education

Master of Educational Technology

Home

Program Overview



Courses



How to Apply



MET Faculty



For Students



FAQs



MET

MET – International Online Graduate Program

Skilled Educators create rich learning environments where students are introduced to new ideas, develop new skills, and expand their perspectives. The informed use of technology can **engage students** in new experiences and **create a community of learners** across geographical boundaries. The UBC Master of Educational Technology (MET) is a fully online graduate-level program offered by a world-renowned university, that has attracted students from over 35 countries. In addition to the master's degree, there are two specialized graduate certificates both of which ladder into the degree program.

Find Your Program.



Why Online? Where and when do we learn as educators?



Student representation in Jan-April 2015 online ETEC 533 course



ETEC 533: Math & Science Teaching & Learning through Technology

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ETEC533 (66A) Homepage

Build Content Assessments Tools

2014W2-ETEC533-65A-Technology in the Mathematics and Science Classroom-Milner-Bolotin

ETEC533 (66A) Homepage

Announcements

Discussions

Course Schedule

Module A

Module B

Module C

Assignments

Course readings

Groups

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YouTube videos

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Calendar [x](#)

Student Resources

My Grades

Copyright and Connect

Instructor Help [x](#)

Technology in the Mathematics and Science Classroom

ETEC 533

M E T

Course Information

Module A

Enabled: Statistics Tracking



Lessons Learned



**Ryan, T. G., & Young, D. C. (Eds.).
(2014). Teaching Online: Stories
from Within. Champaign, IL, USA:
Common Ground.**

**Chapter 2: Making Online Graduate Teacher Education Courses
Matter—From Theory to Successful Technology-enhanced
Practice..... 10**

Dr. Marina Milner-Bolotin





Thinking about Online Courses

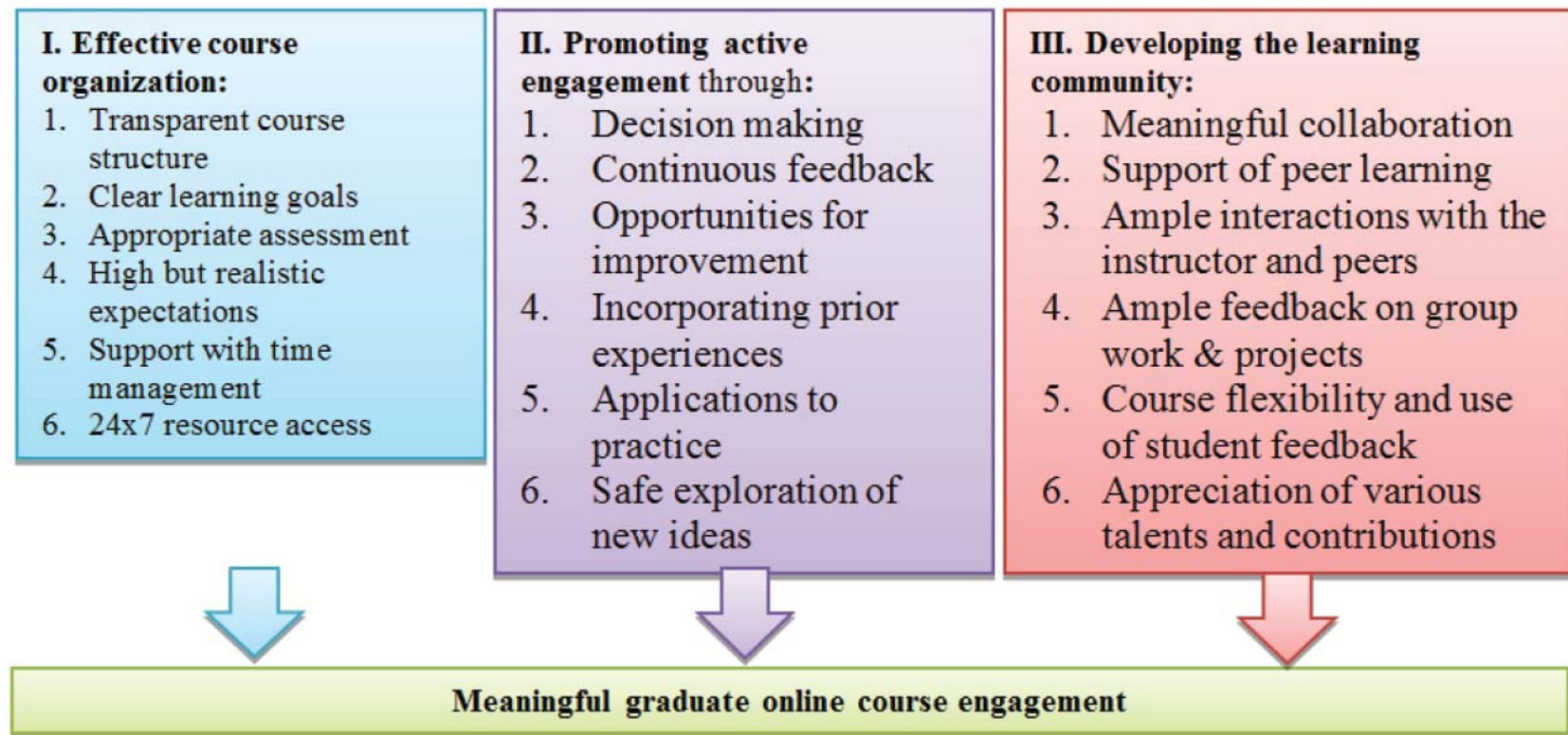


Figure 1: Big ideas for a successful design of graduate courses for educators

IV

Group Activity: Experiencing online education



Group activity

1. If you have participated in an online course, share your experience with your group
2. If you haven't participated in an online course, what would you like to learn if you were to participate in such a course?

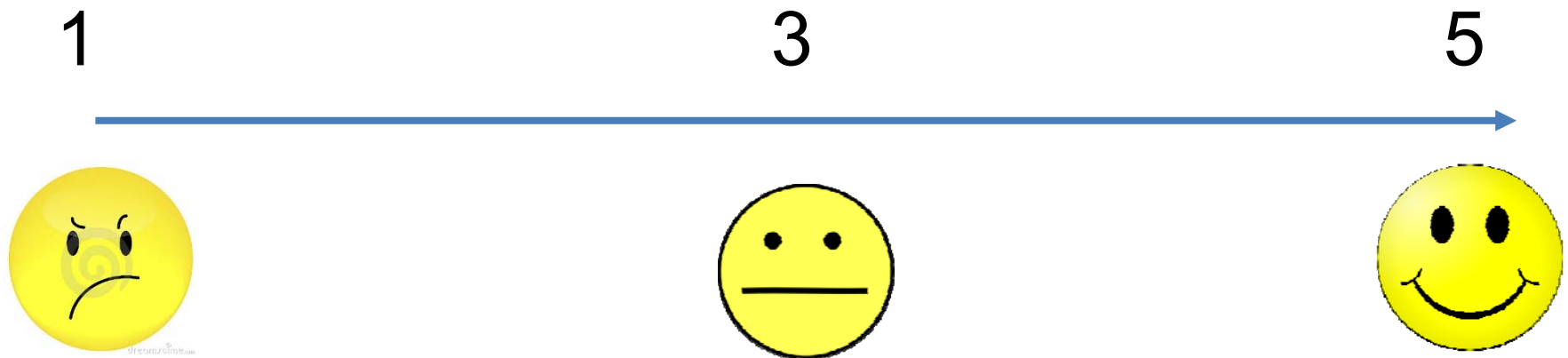
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Day 4: Feedback 1

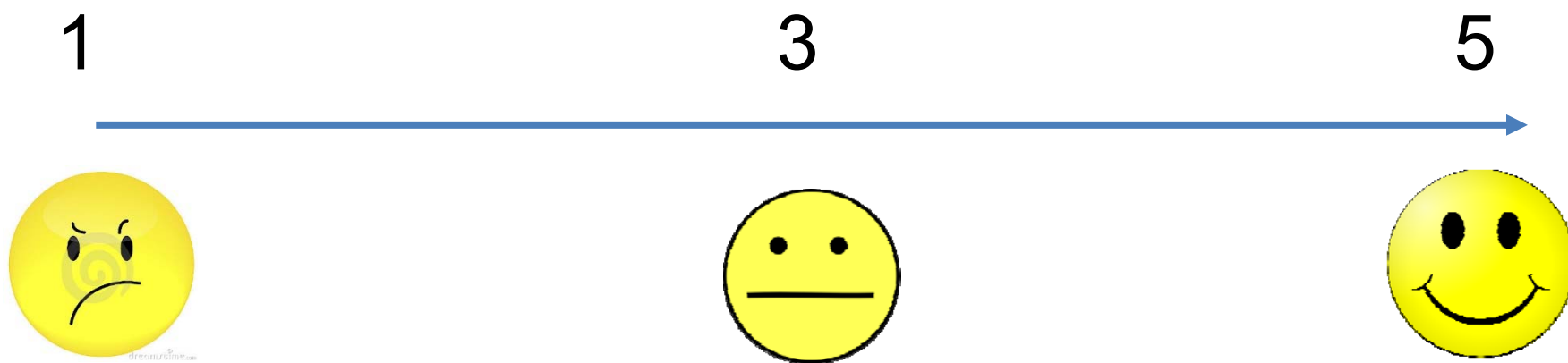
How satisfied are you with the day?





Day 4: Feedback 2

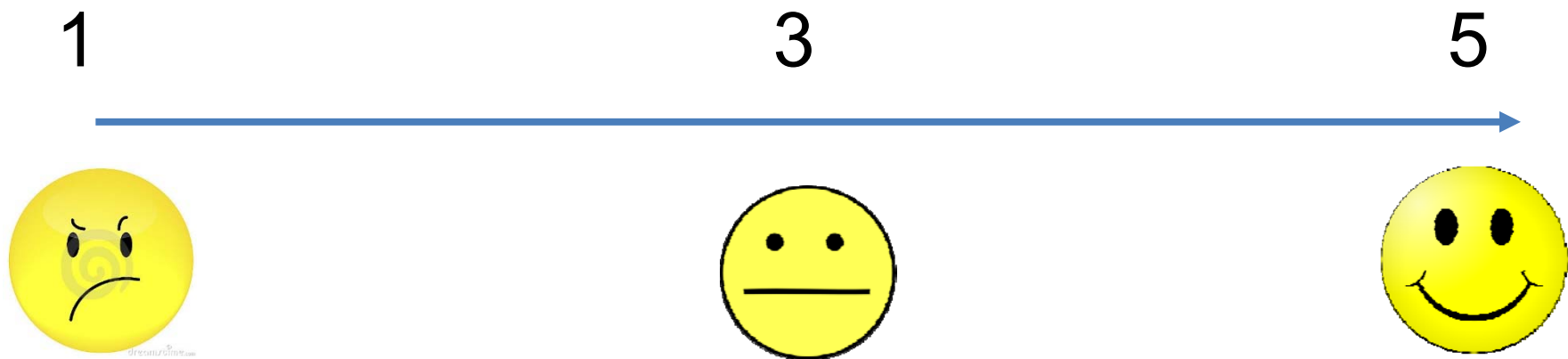
Do you feel you have learned new ideas for math and science teaching?





Day 4: Feedback 3

Are you looking forward to Day 2?





Day 4: Feedback 4

What was the pace of the day?

1

3

5





Day 4: Feedback 5

What was the amount of information for you today?

1

3

5

