

# Teaching data management in a lab environment

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IASSIST 2014 | Toronto, CA | Wednesday, 6/4/14

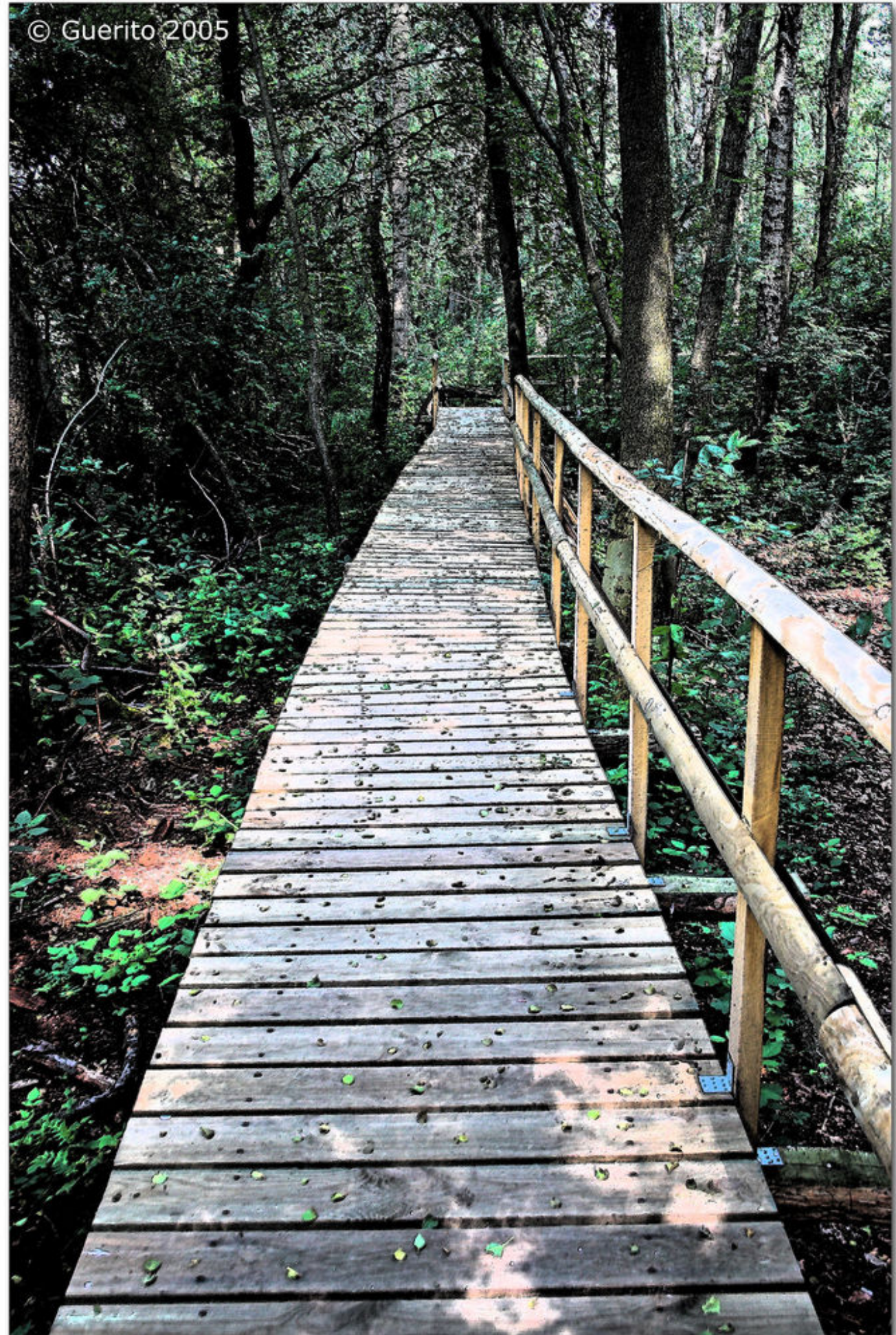
Heather Coates, Digital Scholarship & Data Management Librarian  
IUPUI University Library Center for Digital Scholarship



# What I'm going to talk about

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- Background
- The lab experience
- Evidence-based teaching
- DM Lab - The Early Days
- The Future of the DM Lab

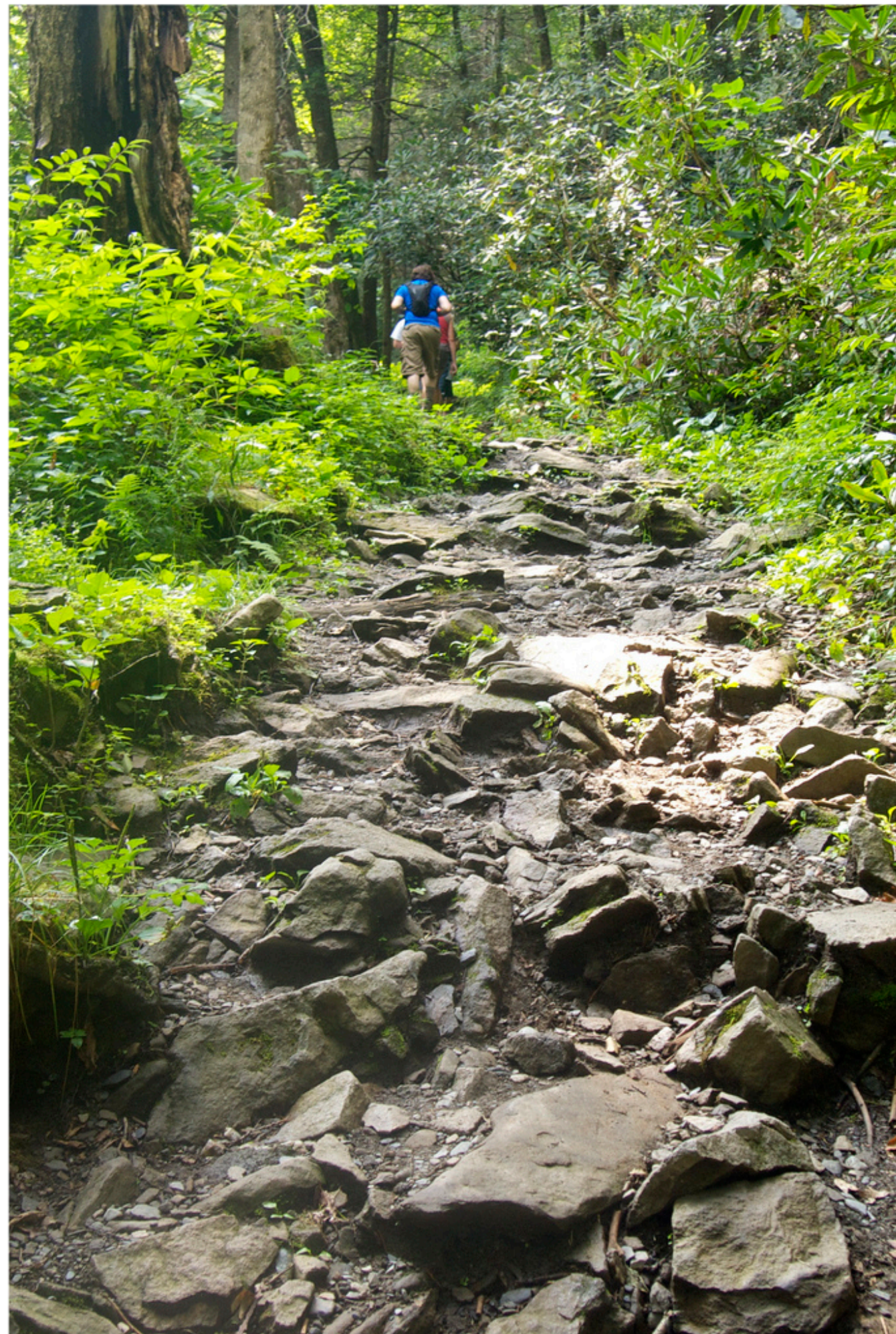




# Background

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- IUPUI 
- Data Services Program 
- Data Management Lab 
- Why IASSIST, why now? 







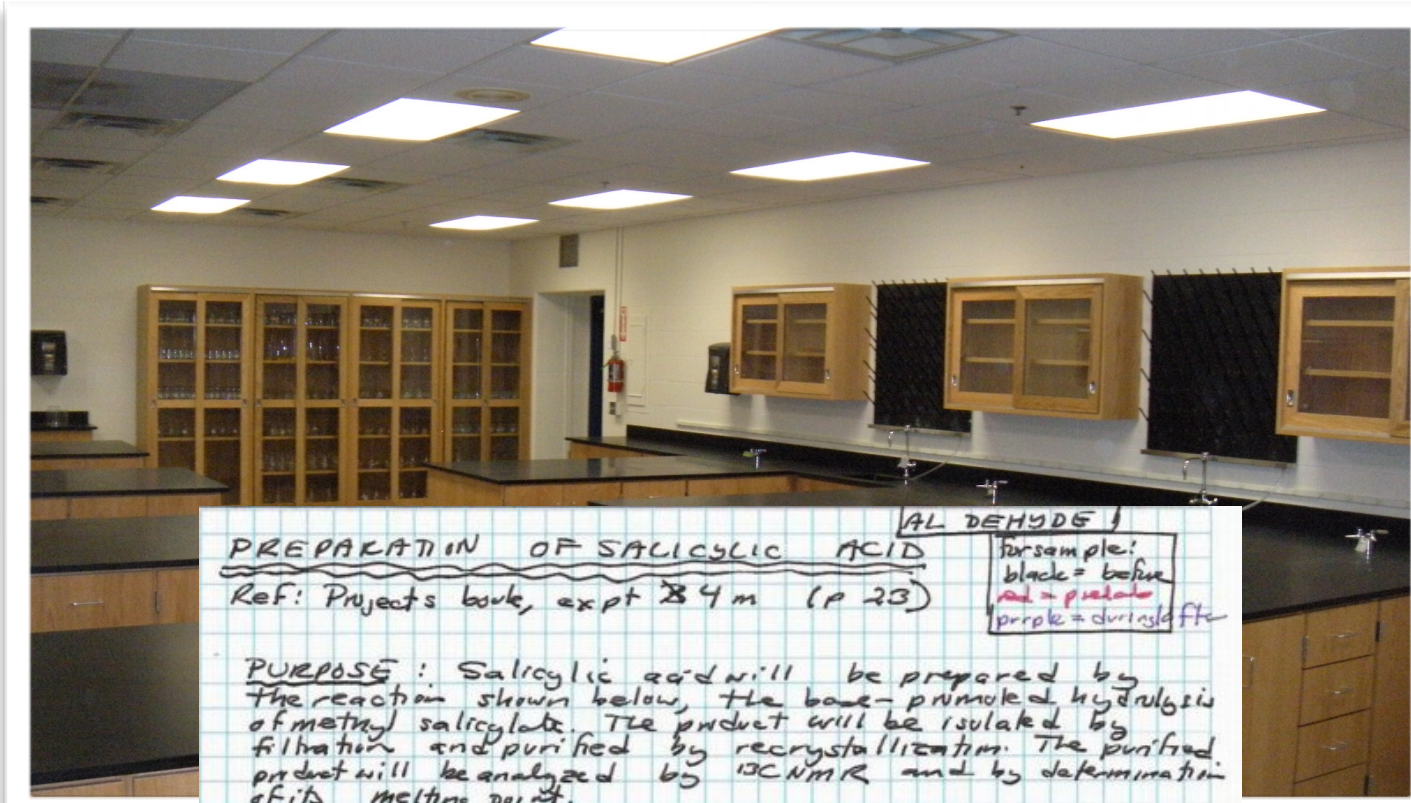
**Data**  
**management**  
**training**

# The Laboratory Experience

Procedural skills

Critical thinking skills

Metacognitive skills



PREPARATION OF SALICYLIC ACID

Ref: Projects book, expt 84m (p 23)

PURPOSE: Salicylic acid will be prepared by the reaction shown below, the base-promoted hydrolysis of methyl salicylate. The product will be isolated by filtration and purified by recrystallization. The purified product will be analyzed by <sup>13</sup>C NMR and by determination of its melting point.

HAZARD DATA

AL DEHYDGE

for sample:  
black = before  
red = pre-oxidation  
purple = during/after

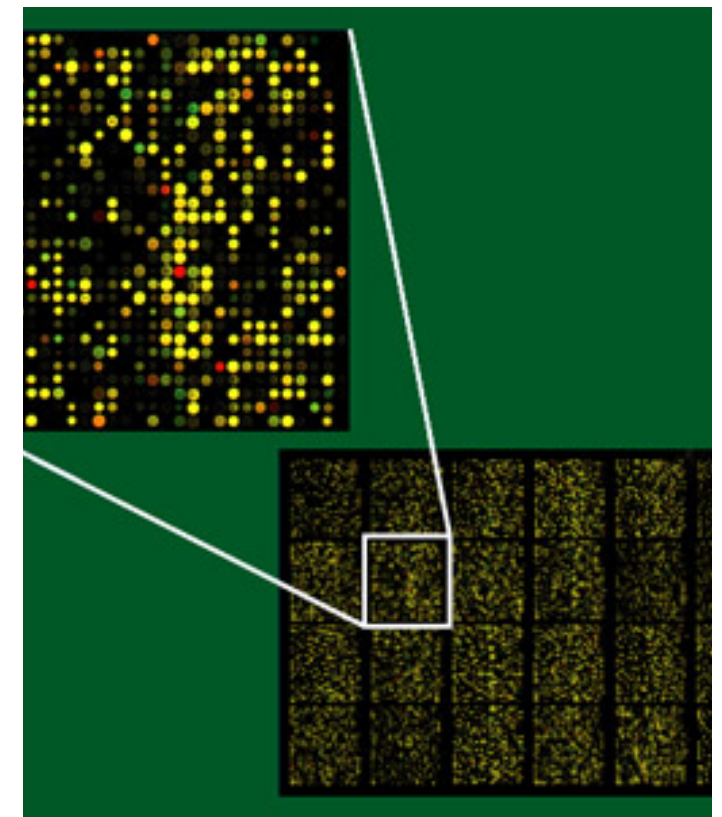
Chemical Reaction:

Methyl salicylate (bp 223°C, MW = 152.07 g/mol, d = 1.179 g/mL) reacts with 2 NaOH(aq) to form Salicylic acid and CH<sub>3</sub>OH. The Salicylic acid is then treated with 5% H<sub>2</sub>SO<sub>4</sub>(aq).

Reflective Journal

Criteria Maximum Mark	Below Average	Average	Above Average
<b>Observations and insights</b>	Simplistic observations, provides little or no insight, comment or analysis, more descriptive than reflective	Adequate degree of observations, some insight and analysis, reflection and outcomes considered but lack depth	Sophisticated and thoughtful observations, high degree of insight and analysis, evidence that outcomes have been processed and reflected upon
15	0-7	8-11	12-15
<b>Language and structure</b>	Not well organized, predominantly descriptive with little interpretation or reflection, poor vocabulary and grammar, numerous errors	Better structure with a logical progression, use of limited interpretation and reflections, competent vocabulary and grammar, occasional errors	Excellent coherence and progression, ideas and observations are well structured, effective and accurate use of vocabulary and grammar, very few errors
5	0-1	2-3	4-5
<b>Comments and discussion</b>	Rarely engages with other group members on the pertinent issues and discussion.	Engages with other group members on the pertinent issues and discussions, questions or supports the group members' arguments with relevant evidence.	Actively engages with other group members on pertinent issues and discussions, convincingly questions or supports the group members' arguments with relevant evidence, introduces new perspectives.
5	0-1	2-3	4-5





What is the lab experience?

“...it is vital to isolate and define goals for which laboratory work could make a unique and significant contribution to the teaching and learning of science.”

–Hofstein & Lunetta, 2004

# Faculty identified goals for the lab experience

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- Critical thinking skills & experimental design
- Lab skills & techniques
- Engaging in science
- Teamwork skills
- Written communication skills
- Connecting lab & lecture



# Goals for the data management lab experience

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- Critical thinking skills & project design
- Data management skills & techniques
- Engaging in data management activities
- Team science skills
- Project documentation skills
- Connecting data management to the research process

**Evidence<sup>💬</sup>  
Based  
Teaching**

**I FACILITATE THINKING.**

**I ENGAGE MINDS.**

**I LISTEN TO QUESTIONS.**

**I ENCOURAGE RISK.**

**I SUPPORT STRUGGLE.**

**I CULTIVATE DREAMS.**

**I LEARN EVERY DAY.**

**I TEACH.**





**Lecture**

**Examples**

**Exercises**

**Discussion**




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- Start with the end in mind
  - Keep it brief (15-20 minutes)
  - Use multiple channels for communicating the message
- Doppler-Effekt**
- Relativistischer Fall, Licht
- $$\vec{E} = \vec{E}_0 e^{-i\varphi}$$
- $$\varphi = \omega t - \vec{k} \vec{r} = k_\mu x^\mu$$
- Der Zuschauer bewegt sich mit Geschwindigkeit  $v$
- $$\varphi = k_\mu x^\mu = k'_\mu x'^\mu$$
- $x^\mu = (ct, \vec{x})$   
 $x'^\mu = (\gamma(ct - v\vec{x}), \gamma(\vec{x} - vt))$
- Lightkegel
- $\vec{A} = \vec{p} = \frac{E}{c} \vec{v}$





~~...~~ *link integral*



A close-up of a person's hand writing on a chalkboard. The chalkboard has some faint, illegible writing on it.











# Effective examples

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- Enable learners to integrate new information into a coherent structure (e.g., mental model)
- Provide worked and partially worked examples to facilitate procedural learning
- Provide feedback appropriate for each learner's level of experience

$$\begin{aligned}\sigma_x^2 &= \frac{\sum_{i=1}^N (X_i - \mu_x)^2}{N} \\ \sigma_x^2 &= \frac{(2 - 6.8)^2 + (15 - 6.8)^2 + \dots + (2 - 6.8)^2}{5} \\ &= \frac{(-4.8)^2 + (8.2)^2 + \dots + (-4.8)^2}{5} \\ &= \frac{23.04 + 67.24 + \dots + 23.04}{5} \\ &= \frac{114.8}{5} \\ &= 22.96\end{aligned}$$

# Relevant exercises

- Meaningful
- Contextualized
- Designed to teach the targeted skill NOT following instructions or getting the right answer
- Provide opportunities to apply the targeted skill or procedure or strategy
- Provide opportunities to practice self-regulation of learning skills

KUMON®  
O 152 a

O 152

## Applications of Integrals 3

Time : to : Date Name

100%	90%	80%	70%	69%~
(mistakes) 0	—	—	—	1—

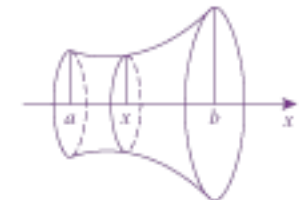
© 2006 Kumon Institute of Education

Rotating  $y = f(x)$  ( $a \leq x \leq b$ ) around the  $x$ -axis once forms a solid shape. Letting  $|f(x)|$  be the radius at  $x$ , a circle forms. Letting  $S(x)$  be the area of the circle,

$$S(x) = \pi |f(x)|^2 = \pi [f(x)]^2$$

Therefore, letting  $V$  be the volume of the solid shape,

$$V(x) = \pi \int_a^b [f(x)]^2 dx$$



Similarly,

Rotating  $x = f(y)$  ( $a \leq y \leq b$ ) around the  $y$ -axis once forms a solid shape. Letting  $|f(y)|$  be the radius at  $y$ , a circle forms. Letting  $S(y)$  be the area of the circle,

$$S(y) = \pi |f(y)|^2 = \pi [f(y)]^2$$

Therefore, letting  $V$  be the volume of the solid shape,

$$V(y) = \pi \int_a^b [f(y)]^2 dy$$



1. Determine the volume of the solid generated when the part of the curve in the 1<sup>st</sup> Quadrant of  $y = 1 - \sqrt{x}$  is rotated around the  $x$ -axis.



# Fostering discussion

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- Activity-based
- Encourage reflection
- An important part of formative assessment
- Provide opportunities to practice self-regulation of learning skills



# Data Management Lab

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Pilot: January 2014

Modular Series: March - April 2014



Data Management Lab v2.0 materials available at:  <http://www.slideshare.net/goldenphizzwizards>



# Modules

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**Intro to  
RDM**

**DM  
Planning**

**Organize  
Data & Files**

**QA/QC**

**Collection**

**Entry &  
Coding**

**Screen &  
Clean**

**Automate**

**Protection  
& Security**

**Rights &  
Access**

**Attribution  
& Citation**

**Ethical &  
Legal  
Obligations**

# Measure ~~Twice~~, ~~Thrice~~, Many Times, Cut Once

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- Define expected outcomes and quality standards for data
- Identify your legal obligations as they affect data management and protection and ethical obligations for ensuring data confidentiality, privacy, and security
- Choose tools, formats, and standards wisely
- Plan & implement a sound storage & backup plan, including use of data locks or master files
- Outline planned project and data documentation to enable effective reporting
- Use best practices for data collection, entry, coding
- point to docs on Slideshare



[www.slideshare.com/goldenphizzwizards](http://www.slideshare.com/goldenphizzwizards)



**Ask for help**



# An actionable data management plan

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- Draft it during the planning phase
- Update it during start-up
- Correct & maintain it during the active phases
- Enhance it during processing, analysis, & write-up

# Defining success<sup>💬</sup>

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- If you can't measure it, you can't manage it
- Anticipate problems to prevent them
- Information needed to communicate the process and explain products to colleagues (e.g., thesis/dissertation, manuscripts)
- Enabling extension, secondary use/reuse, and replication/reproducibility














# Failing upwards

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- Choose  best course format possible
- Teach fewer topics, dive deeper 
- Incorporate meta cognitive skills to promote self-regulation of learning
- Structure  & support activities better
- Formative assessment of data management plans & documentation 
- Evidence of behavior  change, implementation





Thanks for your attention!





# Images

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- Rocky path: <https://www.flickr.com/photos/13448066@N04/3255009670/>
- Hikers on rocky path: <https://www.flickr.com/photos/devonaire/6071209350/>
- Old Lab: <https://www.flickr.com/photos/sludgeulper/3230950117/>
- Enid & Betty in the lab: <https://www.flickr.com/photos/28853433@N02/4679198690/>
- Microarray chip: <https://www.flickr.com/photos/47353092@N00/2034113679/>
- Lecturer: <https://www.flickr.com/photos/39213312@N07/3722413559/>
- I teach: <https://www.flickr.com/photos/28430474@N05/6902965047/>
- Calculate SD example: [http://ci.columbia.edu/ci/premba\\_test/c0331/s7/s7\\_3.html](http://ci.columbia.edu/ci/premba_test/c0331/s7/s7_3.html)
- Discussion group: <https://www.flickr.com/photos/47423741@N08/8733059592/>
- Success baby: <https://www.flickr.com/photos/91633309@N08/8827619102/>
- Lab notebooks: <https://www.flickr.com/photos/89975702@N00/5878993041/>
- Data steward logo: [http://www.trilliumsoftware.com/images/360\\_01.jpg](http://www.trilliumsoftware.com/images/360_01.jpg)
- Data quality graphic: [http://library.ahima.org/xpedio/groups/public/documents/graphic/bok1\\_049652.jpg](http://library.ahima.org/xpedio/groups/public/documents/graphic/bok1_049652.jpg)



# Resources

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- Bruck, L. B., Towns, M. & Bretz, S. L. (2010). Faculty perspectives of undergraduate chemistry laboratory: Goals and obstacles to success, *Journal of Chemical Education*, 87(12), 1416-1424.
- Clark, R. C. (2010). Evidence-based training methods: A guide for training professionals. Alexandria, Va: ASTD Press.
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- Nilson, L. B. (2003). Teaching at its best: A research-based resource for college instructors. Bolton, MA: Anker Publishing Co.