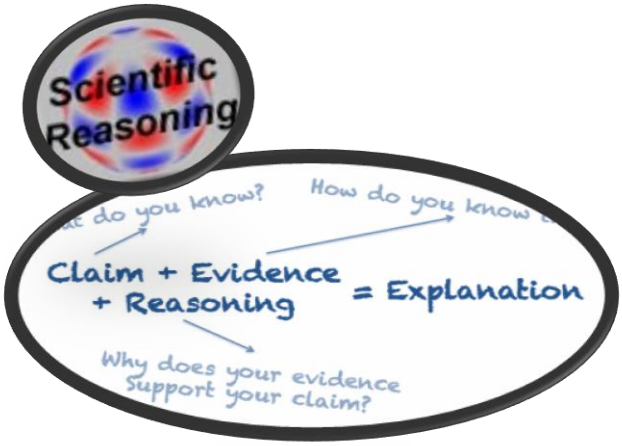
CAMPUS FORUM ON ISLO 2: SCIENTIFIC REASONING & QUANTITATIVE ANALYSIS



The SLO Committee will lead our college's second Institutional Learning Outcomes campus-wide forum and you are invited to join us! What are some of the tools to help students use reasoning to solve problems or analyze data? We'll answer these questions as we meet with colleagues and share ideas on how to strengthen these concepts across all disciplines.

- **Tuesday, March 10th**
- **3:30 to 5:00 PM**
- **Wright Event Center**
- **Refreshments will be served**
- **Faculty presentations**
- **Group activities and discussions**

Please RSVP to Rachel Marchioni at rmarchioni@vcccd.edu

ISLO FORUM ON ISLO #2
SCIENTIFIC REASONING & QUANTITATIVE ANALYSIS
Tuesday, March 10, 2015
3:30 to 5:00 PM
Wright Event Center

AGENDA

A.	Welcome	Andrea Horigan Debbie Newcomb
B.	SLOs at Ventura College	Dr. Greg Gillespie
C.	SLOs and Accreditation	Dr. Patrick Jefferson
D.	Recap of ISLO #1 Forum, Introduction to ISLO #2	Andrea Horigan
E.	Assessment data summary	Debbie Newcomb
F.	Scientific Reasoning across the Curriculum	Chloe Branciforte
G.	Quantitative Analysis across the Curriculum	Dr. Jeffrey Wood
H.	Group activity and discussion	All
I.	Conclusion	Andrea Horigan Debbie Newcomb

Quantitative Reasoning Skills: ISLO-2

ISLO Forum 3/10/2015

Jeff Wood

Department of Physics and Astronomy

Quantitative Reasoning Skills: ISLO-2

Learning Objectives:

At the conclusion of this session, participants should be able to:

1. Describe Quantitative Reasoning (QR) skills.
2. Explain to their students how their QR skills will benefit them and society.
3. Identify and score activities (in a physics experiment) that match rubric components for ISLO-2 QR skills.

Quantitative Reasoning Skills: ISLO-2

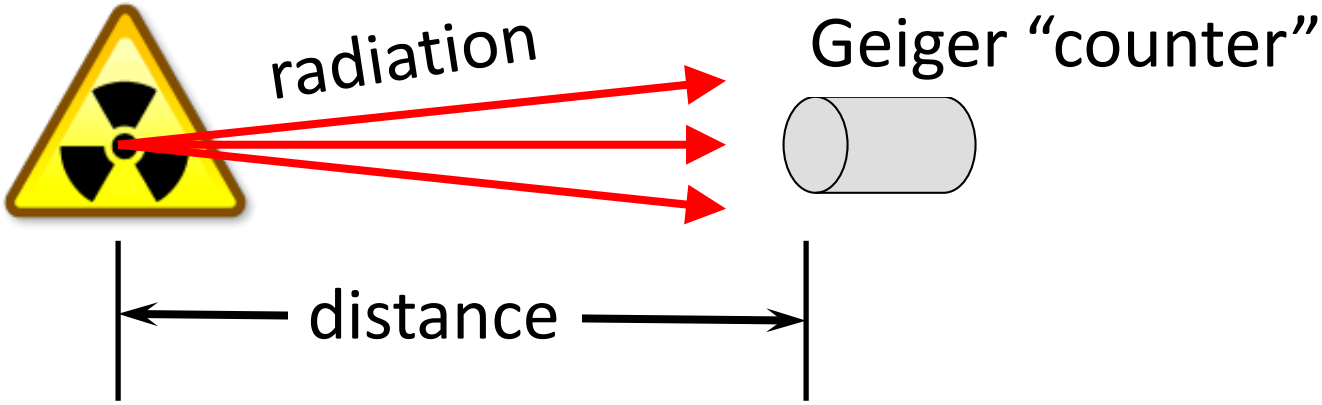
"When you can measure what you are speaking about, and express it in numbers, you know something about it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind..."

William Thomson,

(Lord Kelvin)

Library of Congress

Example: Radioactive Decay



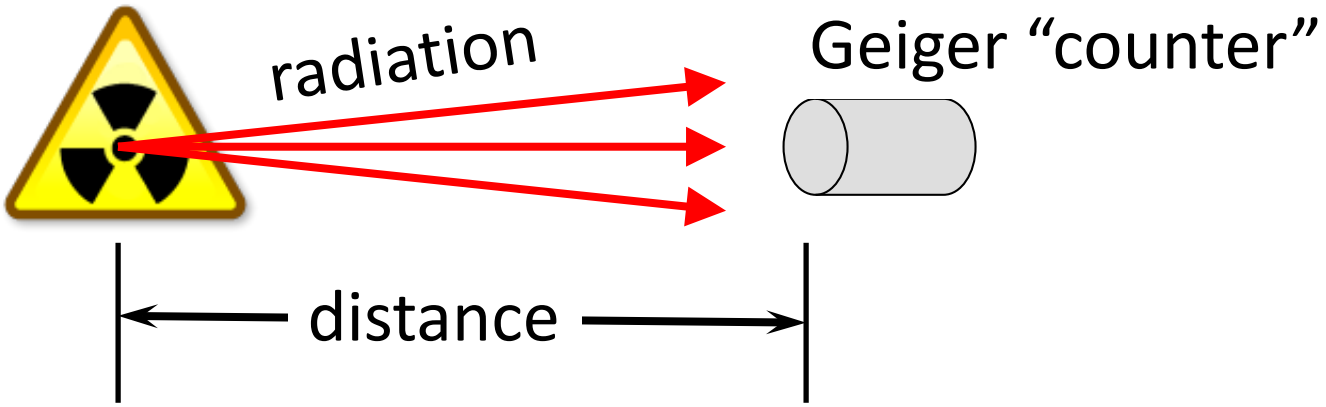
The objectives of the experiment are to:

a) measure radiation intensity (counts/sec) for different distances between a Geiger counter and a radioactive source (Cesium-137)

b) find the relationship between the measured radiation intensity (counts/sec) and the distance to the radioactive source

c) calculate the “Activity” of the radioactive source

Example: Radioactive Decay



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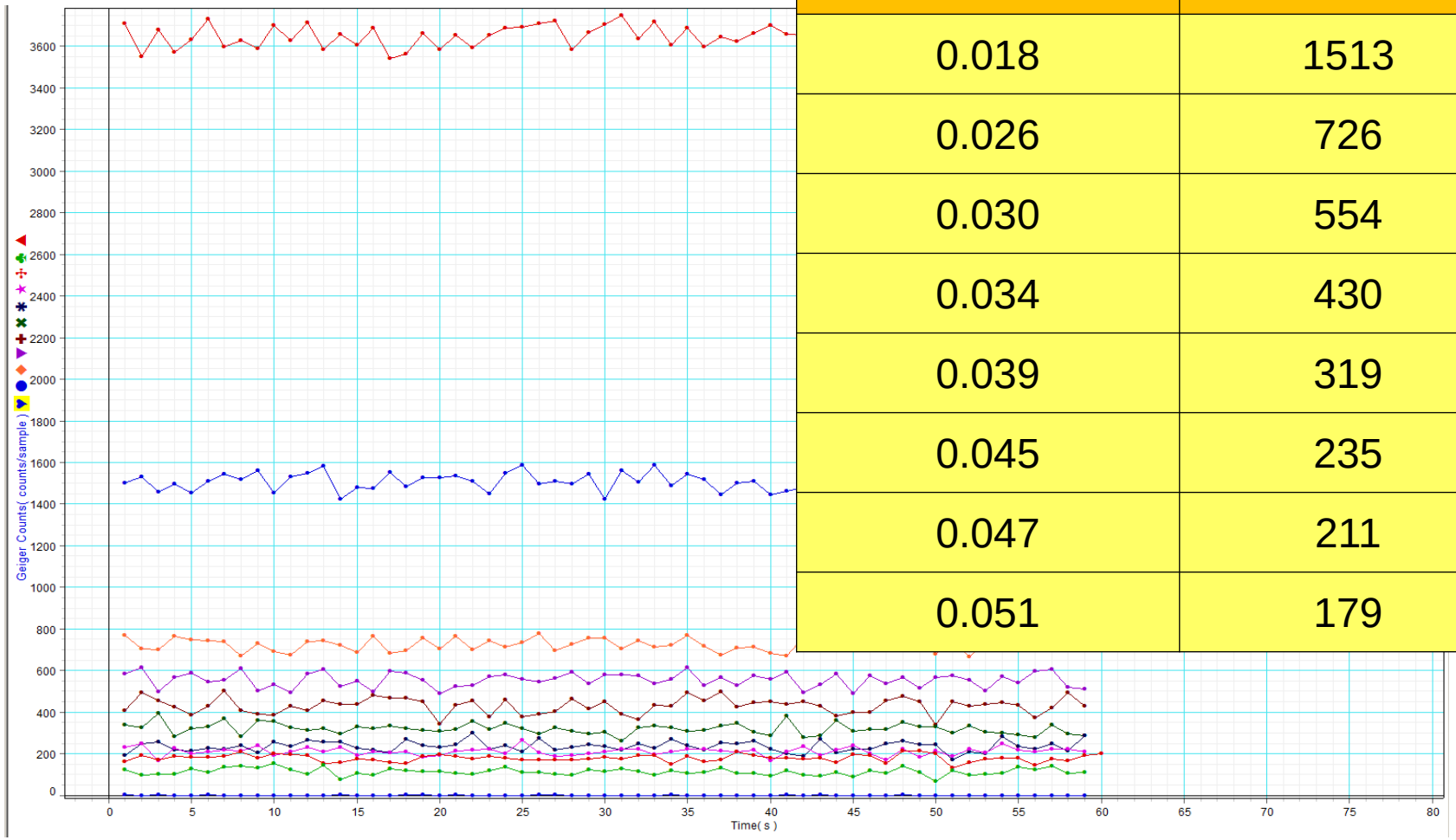

Data Table

Distance (m)	Counts/s
0.018	1513
0.026	726
0.030	554
0.034	430
0.039	319
0.045	235
0.047	211
0.051	179

Quantitative Reasoning Skills: ISLO-2

Component	Meets or Exceeds Expectations	Does Not Meet Expectations
Points	**1**	**0**
Illustrate and/or communicate mathematical and/or statistical information symbolically, visually and/or numerically	Represents mathematical/statistical information generally clearly but: 1)May make minor errors 2)May lack some clarity 3)May lack precision.	Inconsistently or rarely represents mathematical/statistical information and lacks clarity and precision.

Example: Radioactive Decay

Data Table

Distance (m)	data
0.010	1513
0.026	726
0.03000	554
0.034	430
0.04	319
0.045	235
0.047	211
0.051	1790

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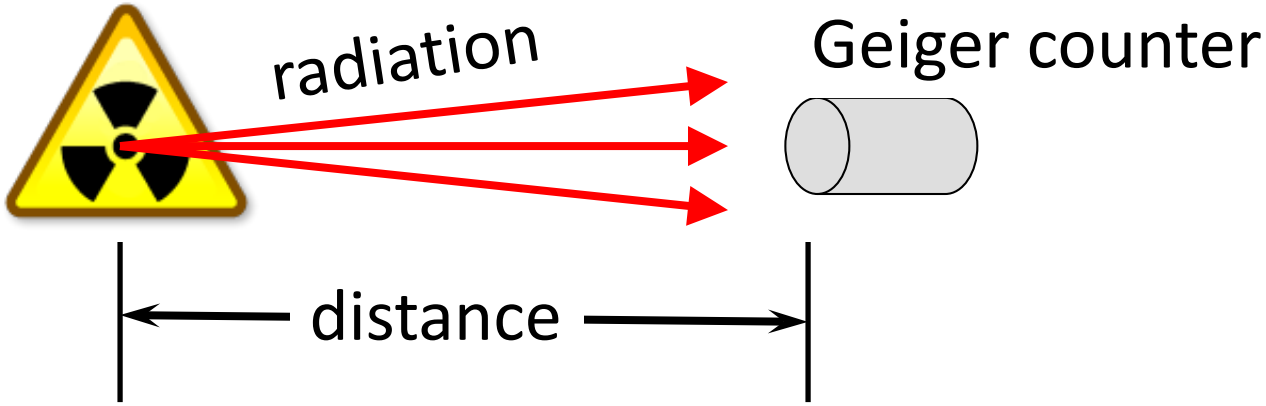

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a) measure radiation intensity (counts/sec) for different distances between a Geiger counter and a radioactive source

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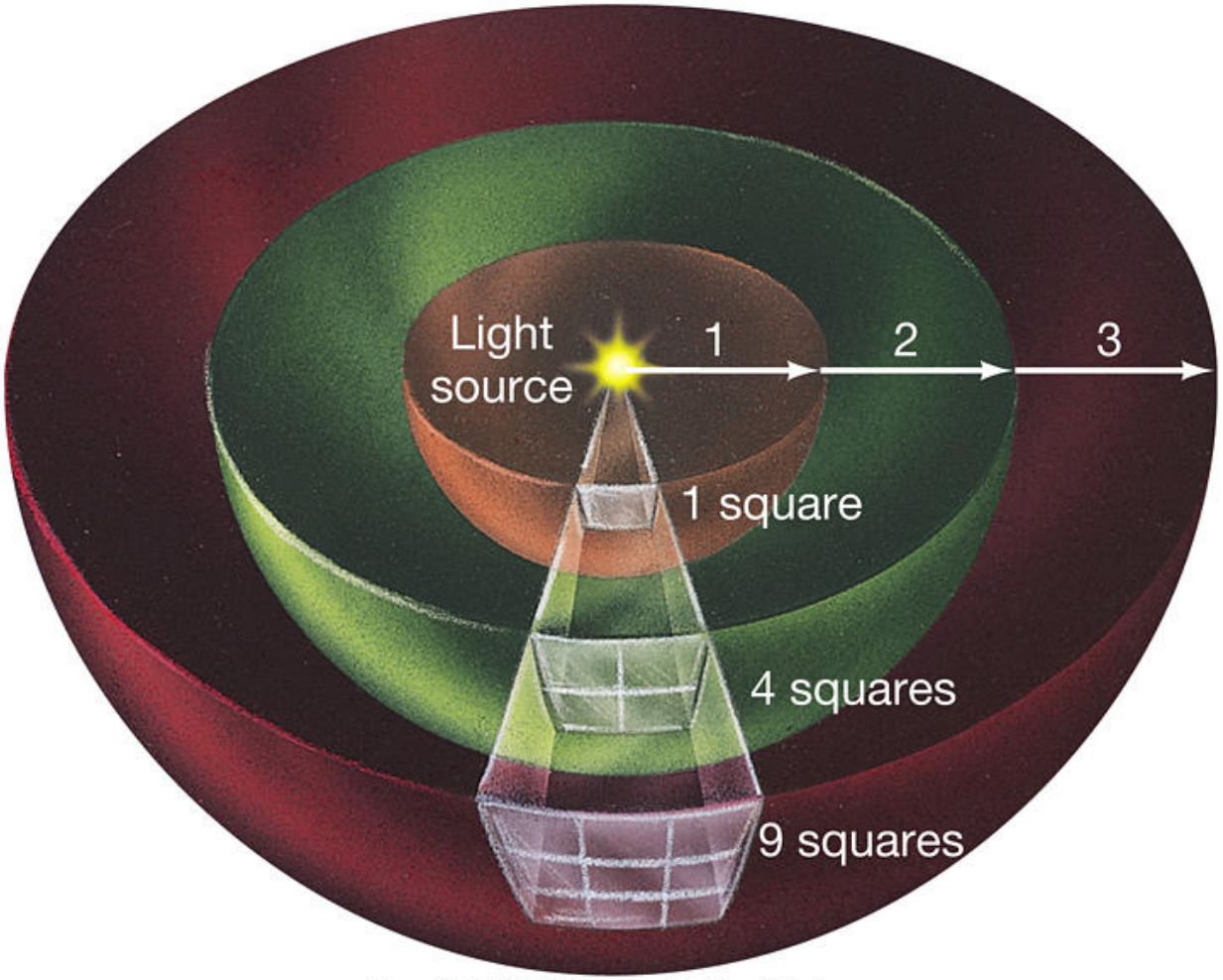
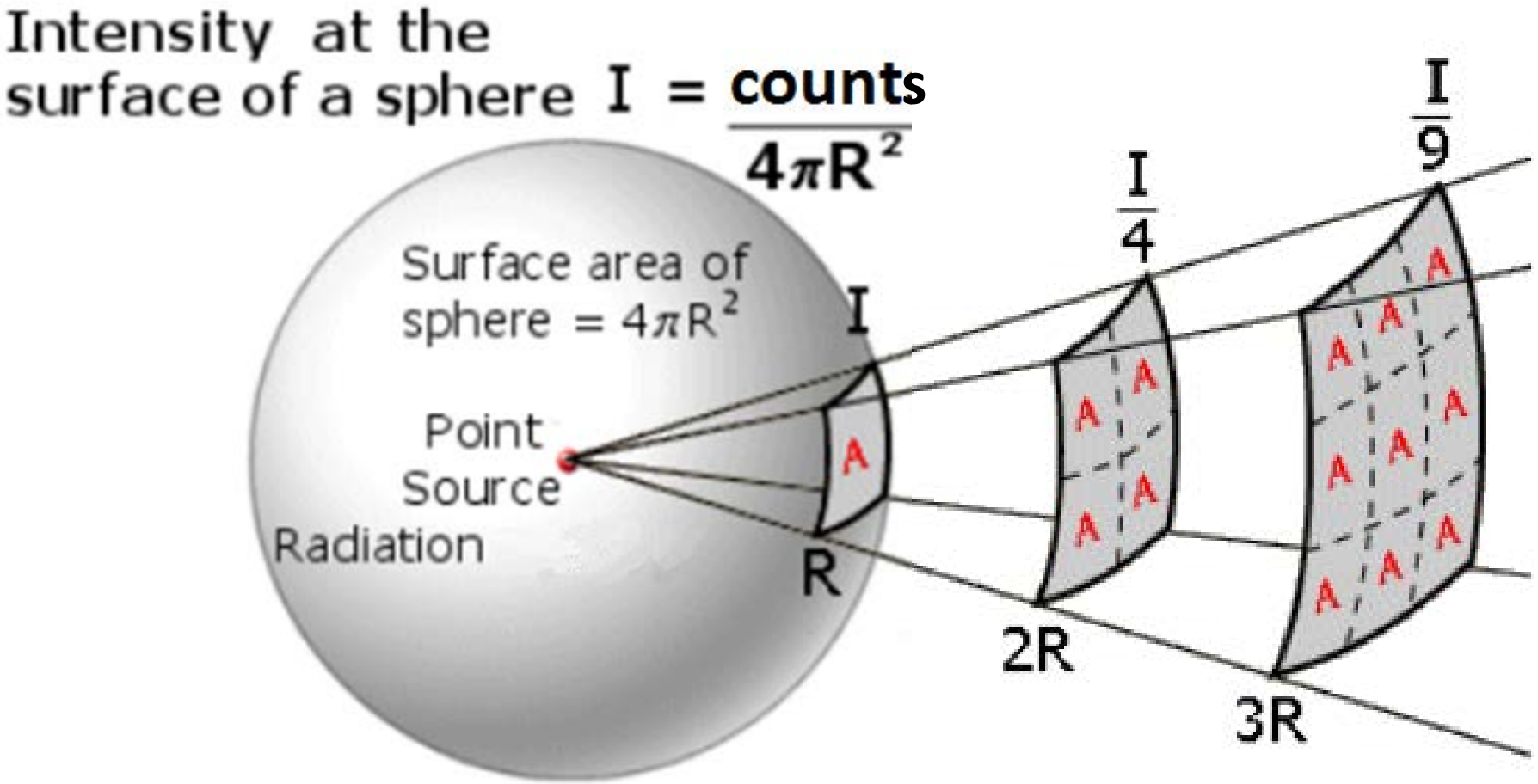
Example: Radioactive Decay

Intensity = counts/area

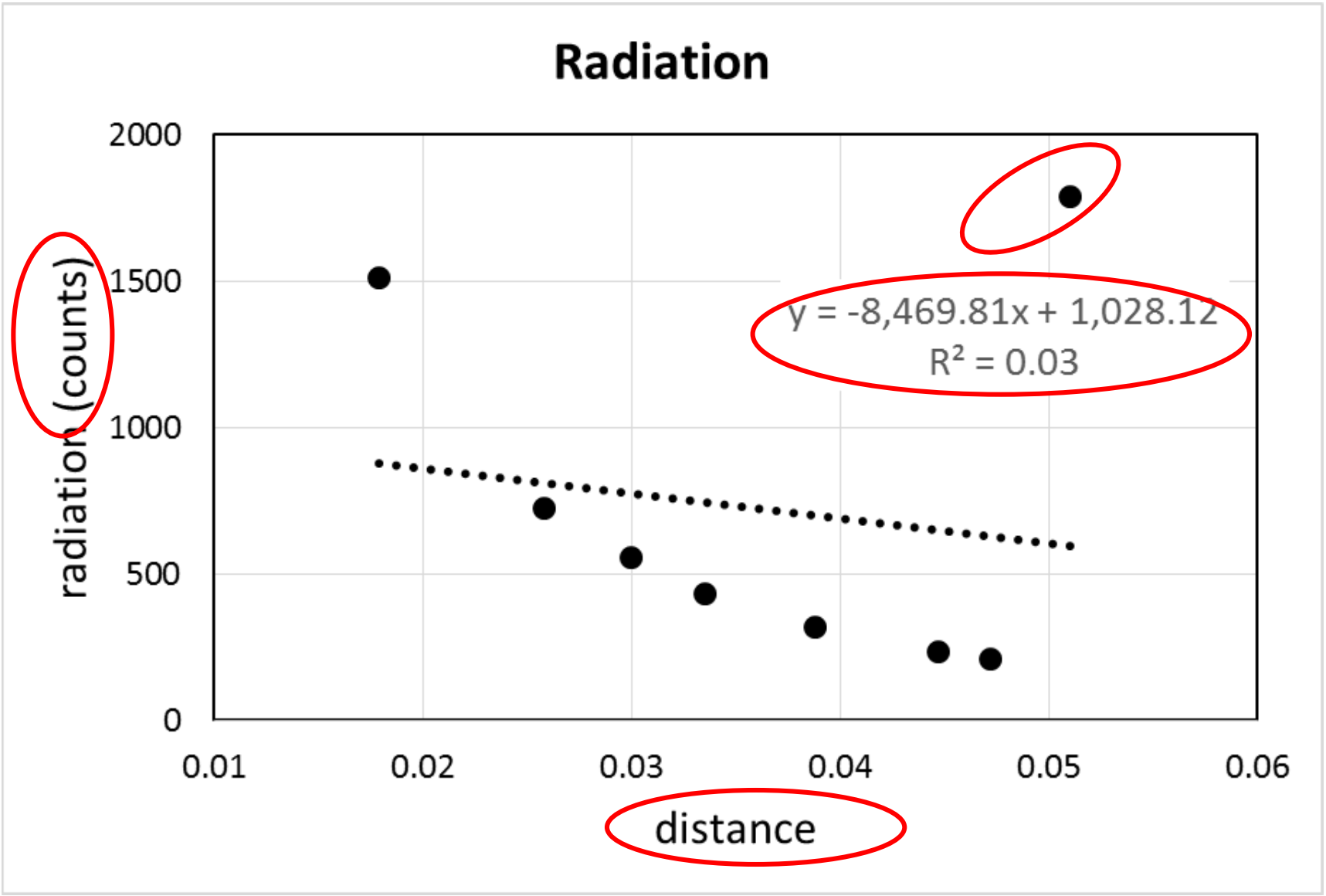


Example: Radioactive Decay



(Area of a sphere = $4\pi R^2$)

Example: Radioactive Decay



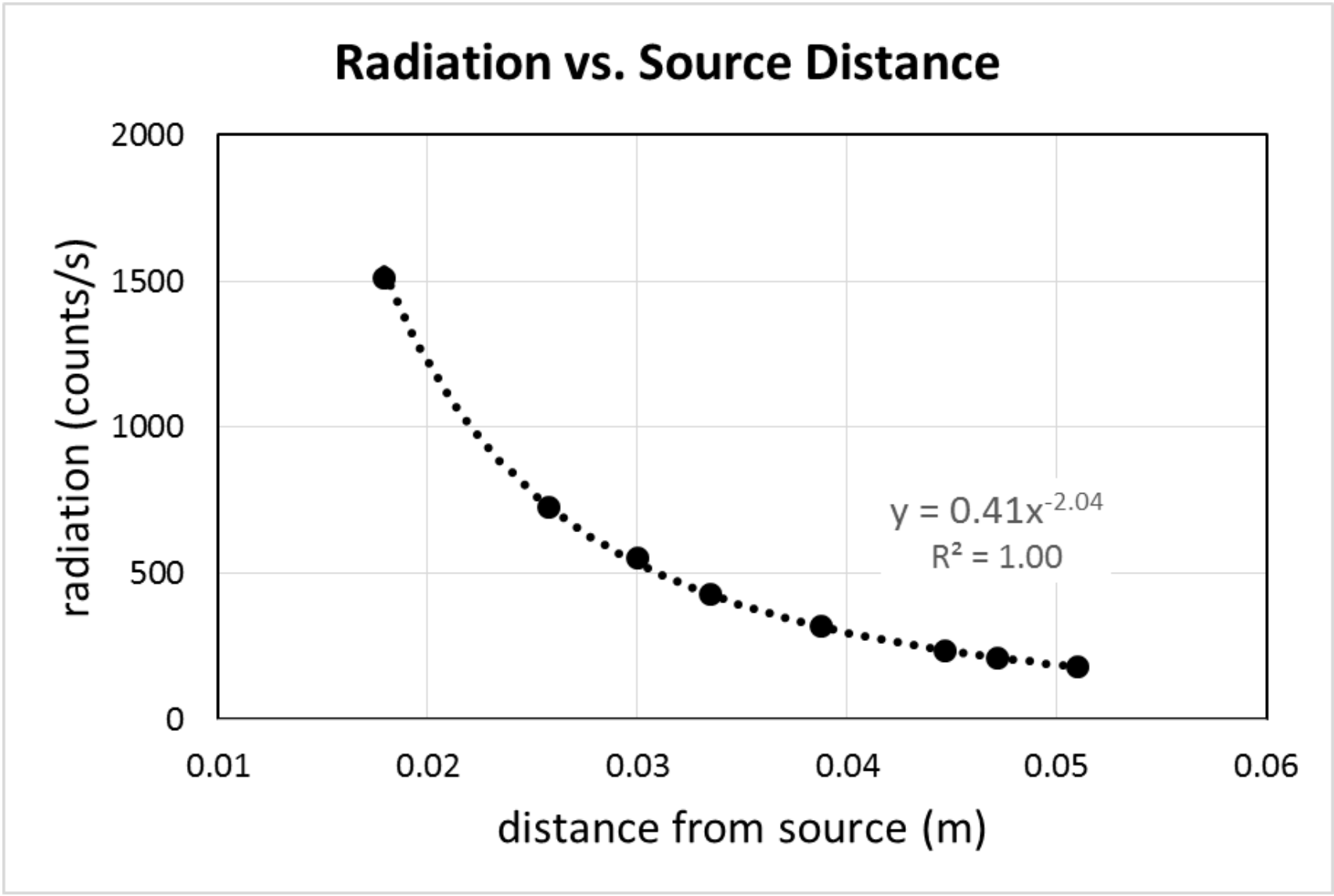
Quantitative Reasoning Skills: ISLO-2

Component	Meets or Exceeds Expectations	Does Not Meet Expectations
Points	**1**	**0**
Apply an appropriate model to the problem to be solved	Accurately applies a model to the problem to be solved but: 1)May lack support or justification 2)May make minor calculation errors.	Presents an **inappropriate model for the problem to be solved** or presents an appropriate model but makes major mistakes in its application or significant calculation errors.

Quantitative Reasoning Skills: ISLO-2

Component	Meets or Exceeds Expectations	Does Not Meet Expectations
Points	**1**	**0**
Interpret information presented in mathematical and/or statistical forms	Correctly interprets information when presented in mathematical and/or statistical form.	**Inconsistently** or rarely **interprets information** presented in mathematical and/or statistical form.

Example: Radioactive Decay



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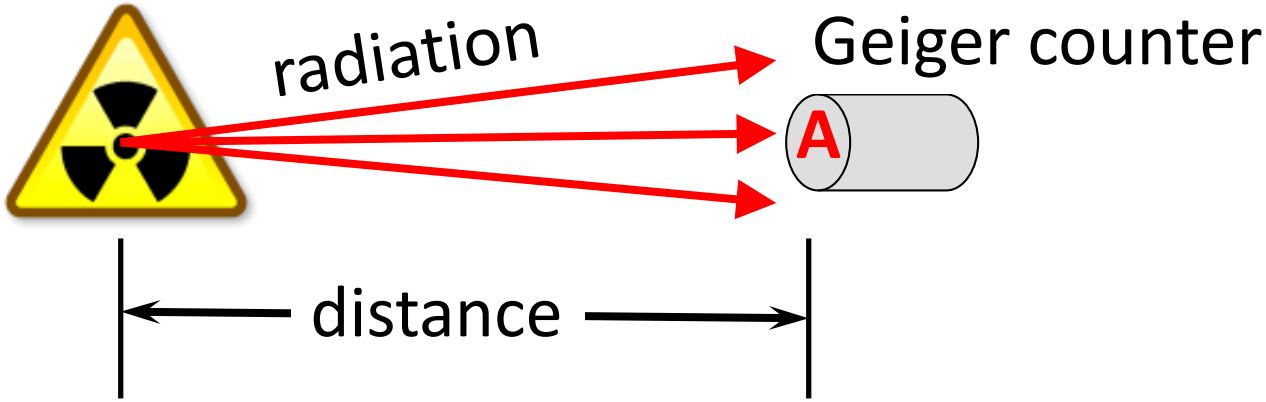
Example: Radioactive Decay



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a) measure radiation intensity (counts/sec) for different distances between a Geiger counter and a radioactive source

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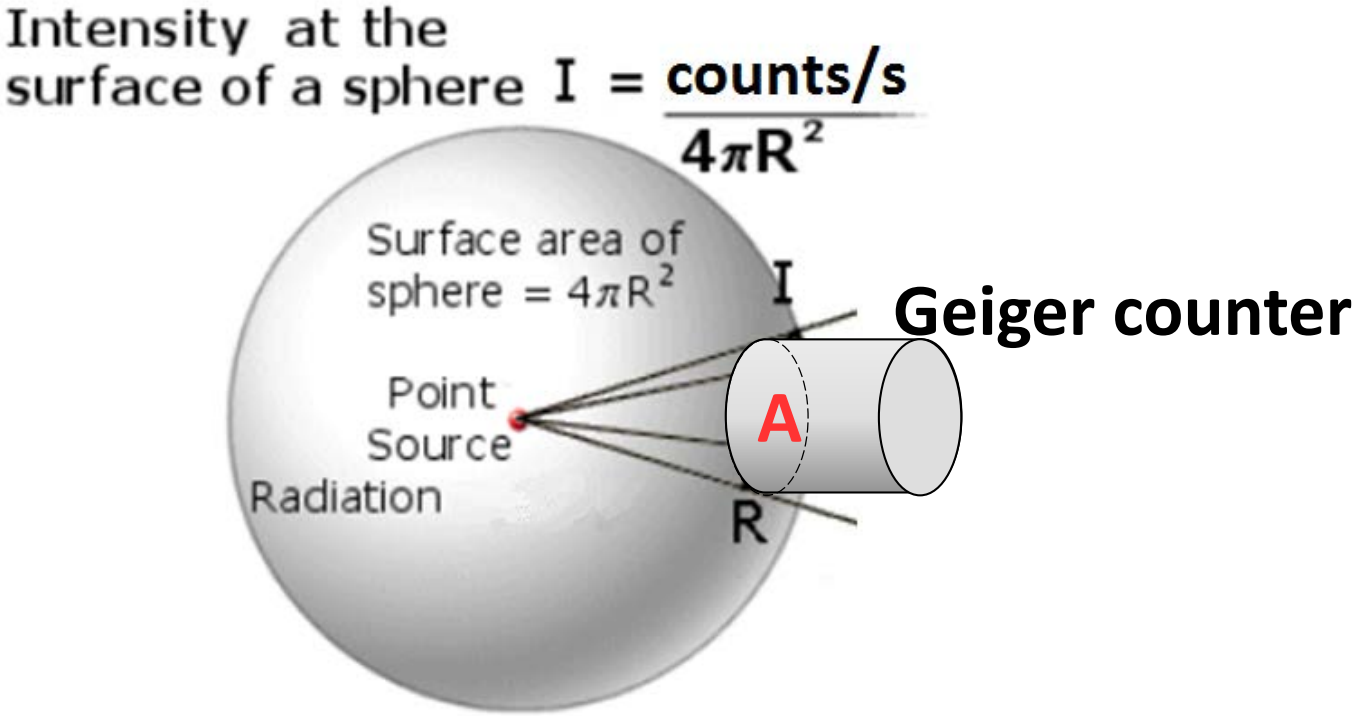
c) calculate the "Activity" of the radioactive source

Example: Radioactive Decay

$$\frac{\text{counts}}{\text{s}} = \textbf{Activity}\left[\frac{\text{decays}}{\text{s}}\right] \times \frac{\textbf{A}}{4\pi R^2} \times \frac{\text{counter efficiency}}{(\text{decays/count})}$$



Example: Radioactive Decay

$$\frac{\text{counts}}{\text{s}} = \textbf{Activity}\left[\frac{\text{decays}}{\text{s}}\right] \times \frac{\textbf{A}}{4\pi R^2} \times \frac{\text{counter efficiency}}{\text{(decays/count)}}$$

Then, solving for Activity gives:

$$\textbf{Activity (Bq)} = \frac{\text{counts}}{\text{s}} \times \frac{4\pi R^2}{\textbf{A}} \times \frac{\text{(decays/count)}}{\text{counter efficiency}}$$

Example: Radioactive Decay

Area of counter = 1.0 cm^2 **Counter efficiency = 75%**

Analysis Table

Distance (m)	Counts/s	$4\pi R^2/A$	Activity (Bq)
0.018	1513	40	4.6E+04
0.026	726	84	4.6E+04
0.030	554	113	4.7E+04
0.034	430	141	4.5E+04
0.039	319	189	4.5E+04
0.045	235	251	4.4E+04
0.047	211	280	4.4E+04
0.051	179	327	4.4E+04
		Average =	**4.5E+04**
		Standard Deviation =	**1.0E+03**

Quantitative Reasoning Skills: ISLO-2

Component	Meets or Exceeds Expectations	Does Not Meet Expectations
Points	**1**	**0**
Determine when computations are needed and execute the appropriate computations	Determines when computations are needed and may make occasional errors in computations.	Inconsistently or rarely determines when computations are needed and/or makes many errors in computations.

Quantitative Reasoning Skills: ISLO-2

Learning Objectives:

At the conclusion of this session, participants should be able to:

1. Describe Quantitative Reasoning (QR) skills.
2. Explain to their students how their QR skills will benefit them and society.
3. Identify and score activities (in a physics experiment) that match rubric components for ISLO-2 QR skills.

Quantitative Reasoning Skills: ISLO-2

Learning Objectives:

At the conclusion of this session, participants should be able to:

1. Describe quantitative reasoning (QR) skills.
    a) QR is a skill with practical applications that include many everyday areas of life.
2. Explain to their students how their QR skills will benefit them and society.
    a) QR skills are applied in daily contexts for decision making such as: estimating the cost and duration of a project, selecting the best value product in the marketplace, or determining the safe distance and time to limit exposure to radiation from a deadly gamma ray source.
3. Identify activities in a physics experiment that match rubric components for ISLO-2 Quantitative Reasoning Skills.

ISLO 2 FORUM:

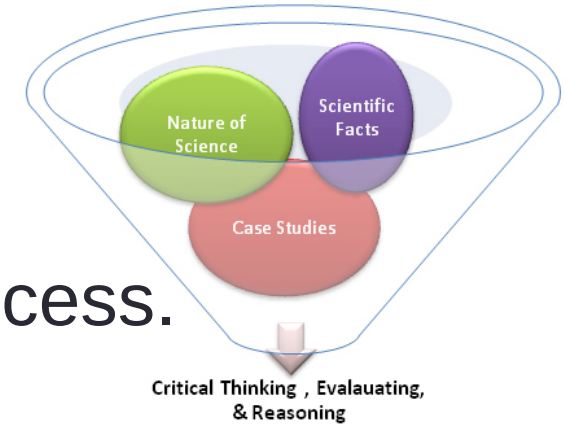
SCIENTIFIC REASONING AND QUANTITATIVE ANALYSIS

Chloe Branciforte

Geosciences

March 10th, 2015

What is Science?



- Both a body of knowledge and a process.
- What is **scientific reasoning**?
  - Foundation which supports entire logic structure in science.
- Why is it important?
  - Applicable to everyday life!

Science checklist:
How scientific is it?

- ☑ Focuses on the natural world
- ☑ Aims to explain the natural world
- ☑ Uses testable ideas
- ☑ Relies on evidence
- ☑ Involves the scientific community
- ☑ Leads to ongoing research
- ☑ Benefits from scientific behavior

The Scientific Method

Idea

STEP 1: Ask a question

STEP 2: State a hypothesis

Actual observations

STEP 3: Conduct an experiment

STEP 4: Analyze the results

STEP 5: Make a conclusion

Expectations

The Scientific Method: An Example in Geology

- Formulation of problem
  - “Were the African & South American continents once connected?”
- Development of a hypothesis
  - Continental Drift Hypothesis – 1915

- Observation and/or experimentation
  - Fit of continental shelves, correlating rocks & fossils, paleomagnetism, age of seafloor, ridge push & slab pull, etc. – data collection is ongoing and never complete!
- Theory formation
  - Plate Tectonic Theory – after 100 years of work, the theory was established. Scientific Method continues to be applied as our knowledge base improves.

Tips for teaching:

- Real world applications and active learning.
- Pair instruction with writing & critical reading.
- Use technology!
- Collaborate - Group work!

"What I hear, I forget; what I see, I remember; what I do, I understand.“ – Chinese Proverb