



Alzheimers and Aluminum: Lesson Plan

Handouts:

1. NY Times op-ed
2. Martyn, 1989 article in *The Lancet*
3. You-tube video on correlation vs. cause and effect

Assignments

1. Questions to guide reading of NY Times op-ed (individual)
2. Group report on NY Times op-ed
3. Questions to guide reading of Martyn et al 1989
4. List of 4 topics for further research to explore mechanistic link between Alzheimer's and aluminum
5. Brief proposal expanding on one of the topics in #4

Assessment

- (10 pts) Faculty grade on assignment #1
- (20 pts) faculty score on assignment #2
- (20 pts) self score on assignment #2
- (10 pts) faculty score on assignment #3
- (20 pts) faculty score on assignment #4
- (20 pts) faculty score on assignment #5

"meta" lessons

- Critical reading of popular media presentation of science
- Correlation vs. causation
- Hypothesis testing, life and death of scientific theories
- 95% confidence interval
- How to read a scientific paper

Inception (end of previous lecture period)

Assign students to read the NY Times Op-Ed "Evidence Points to Aluminum's Link With Alzheimer's Disease" from 1989. Provide handout of article and assignment, assignment due at start of next class (assignment #1)

Engagement (during Day 1 lecture period)

1. Begin class with a vote: how many students now believe that there may be a connection between aluminum and Alzheimer's Disease?
2. Open floor to discussion: what are the lines of evidence provided by the author of the NY Times editorial? (write these on board)
Continue this through ~8 examples
3. Break into groups of 4-6: each group should spend 15 minutes to write a brief report (assignment #2) on:



What understanding, information or logic would you need to establish proof that aluminum is a cause of Alzheimer's Disease?

Guidelines for report:

- One paragraph in length.

- Take one (or more) of the assertions from the editorial, and explore

What additional information, understanding or logic would be needed to establish proof. Be specific

Reports must be completed within class and uploaded to the iCons page on SPARK by the end of class

Grading rubric for report: 20 points total

0-5 pts (style, grammar, length)

0-2 pts (identify and articulate a specific assertion in editorial)

0-8 pts (develop clear description of approach need to establish proof)

0-5 pts (reasonable expectation that this approach could be done)

End of Day 1

Day 2

Each group presents a brief (5 minute) verbal summary of their report from assignment #2. At conclusion of the presentations, each group grades *their own* report, using the rubric above.

Research (during Day 2 lecture period)

Pass out the handout for Martyn et al *Lancet* article.

Go into a brief primer on reading a scientific article:

Structure of an article: title

authors

summary/abstract

introduction/background

methods

results

discussion/conclusion

acknowledgements

citations/references

Assignment #3 – Each student will complete the questions provided with the Martyn et al handout, due at the start of the next class.

End of Day 2

Day 3



Survey : How many students think that “95% confidence interval” means that the authors are 95% confident that their conclusion is correct?

It would be great to get in some demonstration or exercise about statistics: means, confidence interval, etc. This is a great opportunity for a guest presentation.

Examine the 1st sentence of the last paragraph of Martyn et al– is this true?

Watch video of correlation vs. cause-and-effect
(<http://www.youtube.com/watch?v=42c7FAnANdk>)

Create (during Day 3 lecture period)

Return to groups from previous day, and revisit your report from *engagement*.
In the video, what is needed for a correlation to rise to the level of a cause-and-effect relationship? – A Mechanism!

What do we mean by a mechanism?

Open to group discussion – how would you prove or investigate a mechanism between two things that may be correlated?

As a group, brainstorm and develop a list of 4 topics for further research that could explore a mechanistic link between aluminum and Alzheimer’s (assignment #4).
This list must be uploaded to SPARK by the end of the lecture period.

Choose one of these to expand into a brief proposal that includes:
a beginning that states the scientific question for each topic
a specific set of objectives and tasks for each question
a description of the expected outcome of the project.

The proposal should be 2-3 pages in length, and must be handed in at the start of the next lecture period. (Assignment #5).

End of Day 3

DAY 4

Creation (reflections on experimental plans)

Open up a discussion with students:

How do you figure out if your data support your question?

What kinds of data analysis tools do you need?

How many data points do you need?

Open up discussion to include various teams’ experimental plans. Let students volunteer what kinds of data and what kinds of data analysis would be needed.

Mini-lecture –

I. Correlations and regressions

t-test and ANOVA, Principal Component Analysis (PCA)

II. Observation vs. retrospective studies



Controlled variables, iterations, incremental approach

Uncontrolled (uncontrollable) variables – human subjects, natural world

Correlations, burden of proof, lacking mechanisms

III. Experiment types: analog models, controlled experiments/measurements, models and simulations.

Reflection:

Having now been through the process three times, show students the format (inception, engagement...) of each case study so they can put words to the processes they've been using. Take the list of student goals and match them to each case study. Which case study highlighted which goals?

-No value judgment is necessary. It's not right or wrong if a student believes that a case study addressed certain learning goals, but their rationale must be defensible.

Time: 30 minutes