

Welcome!

Please sign in.

Take an index card that best describes
your discipline →

Have a seat anywhere.

Oceanography

Geology

Atmospheric
Science

All / Other

Getting the Most out of Analogies in the Geoscience Classroom

1:30 - 4:00 pm
Coker 005



Nicole D. LaDue



Caden Rhoades

Agenda

1. Introductions
2. What are analogies?
3. Activity: How do we classify analogies?
4. What are recent findings about using analogies?
5. Break
6. Activity: What analogies have you used?
7. Things to consider when using analogies
8. Activity: Developing an analogy for your classroom

Introductions

Name

Discipline

How many EERs have you attended?

Handout

Name: _____

Date: _____

Getting the Most Out of Analogies in the Geoscience Classroom

Definition of Analogy

Main Findings & Best Practices

Analogies from Your Discipline

Why are analogies important in geoscience?

- Many fundamental geoscience processes are unobservable and/or spatially complex ^{1,2,3}
 - Geologic time, macro and micro scale phenomena, etc.
- Analogy built on everyday knowledge provide a foundation of understanding on which to build new knowledge ^{4,5}
- Causal analogies enable simplified and accessible explanations for complex causal processes which is the basis of scientific knowledge.⁶

What is an analogy?

A mapping of knowledge from one domain (source) into another domain (target) such that a system of relations in the source maps to a system of relations in the target.^{4,7}

Structure Mapping Theory



Structure Mapping Theory

Magma solidifying is like water freezing to ice because water is turning into a solid due to crystallization as a result of cooling, like magma cooling and crystallizing into rock.



Structure Mapping Theory

Magma solidifying is like **water freezing to ice** because water is turning into a solid due to crystallization as a result of cooling, like magma cooling and crystallizing into rock.



Structure Mapping Theory

Magma solidifying is like water freezing to ice because water is **turning into a solid due to crystallization as a result of cooling**, like magma cooling and crystallizing into rock.

Source

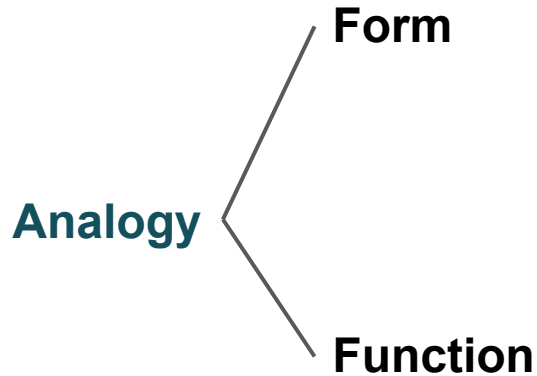
Familiar Concept



Target

New Concept

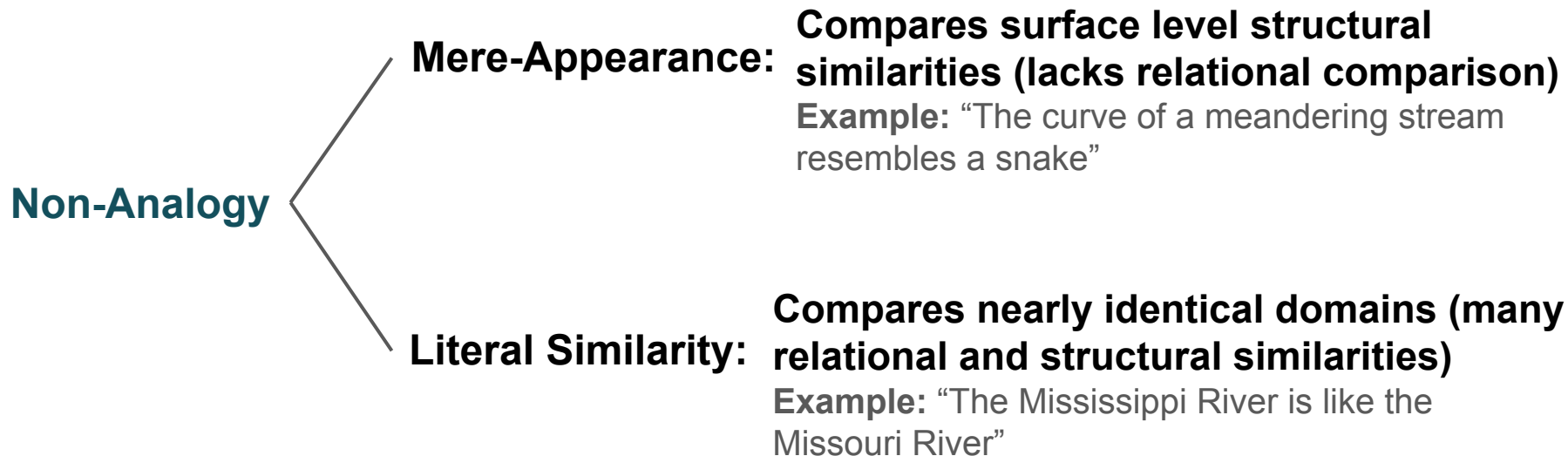
Types of Analogies



“When rivers flow they develop a dendritic network that looks like the pattern of branches connecting to the trunk of a tree.” (Essentials of Geology, Marshak)

“When the stream channel narrows but discharge remains constant, the same volume of water must flow through a narrower space causing the velocity to increase, similar to putting a thumb over the end of a backyard water hose.” (Introduction to Geology, Johnson et al.)

Other Comparisons



Activity: How do we classify analogies?

On your own, read through the worksheet.

Think: In general, what do you notice about the analogies versus the non-analogies?

Activity: How do we classify analogies?

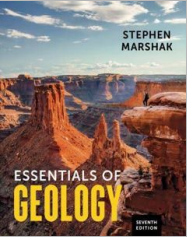
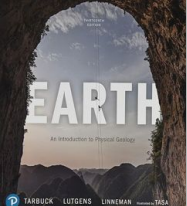
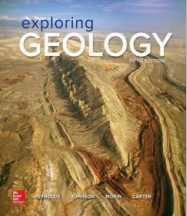
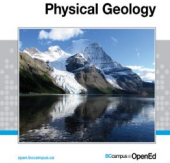
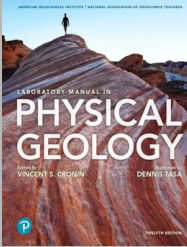
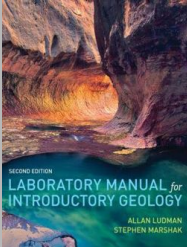
Share: In your table groups, discuss any differences you see between the analogies.

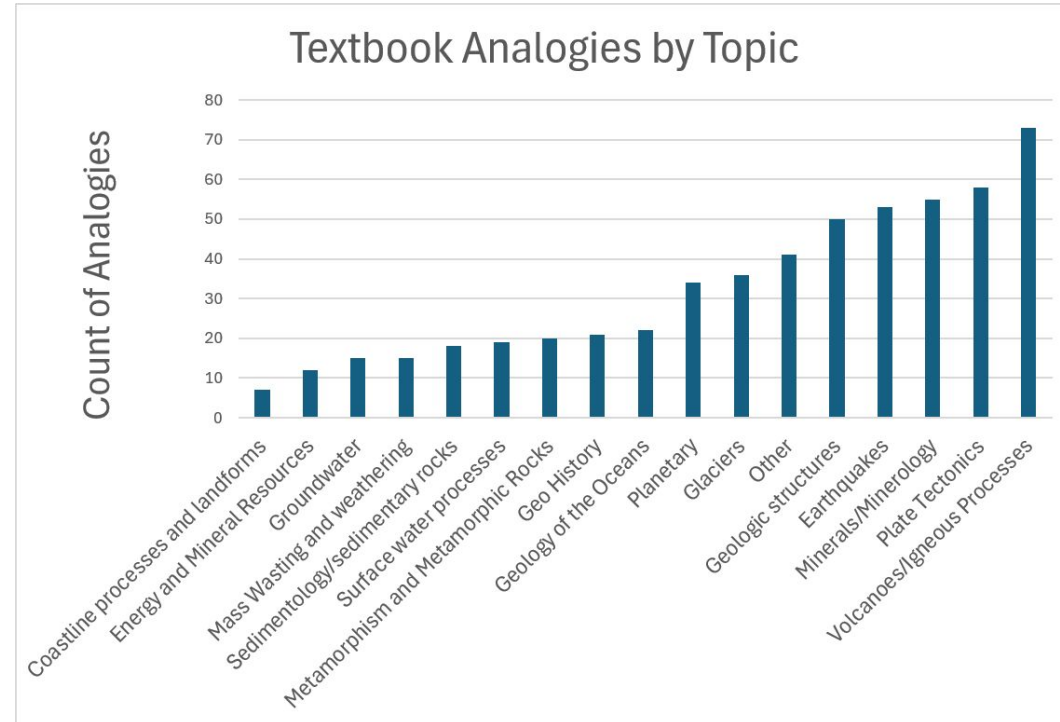
Which have more mappings?

Which are more “scientific”?

Which are familiar to students?

What type of analogies are included in geoscience textbooks?

Print	Open-Source	Lab
367	75	108
  	 	 



Types of Analogies

Richness	Relation	Source
Simple Typically 1 mapping between source & target	Form Compares superficial features of physical structure	Everyday Relates to common concepts
Enriched Two or more mappings between source & target	Function Cause and effect relationships, how or why	Geology Relates to other geology concepts
	Both	Science Relates to other science concepts

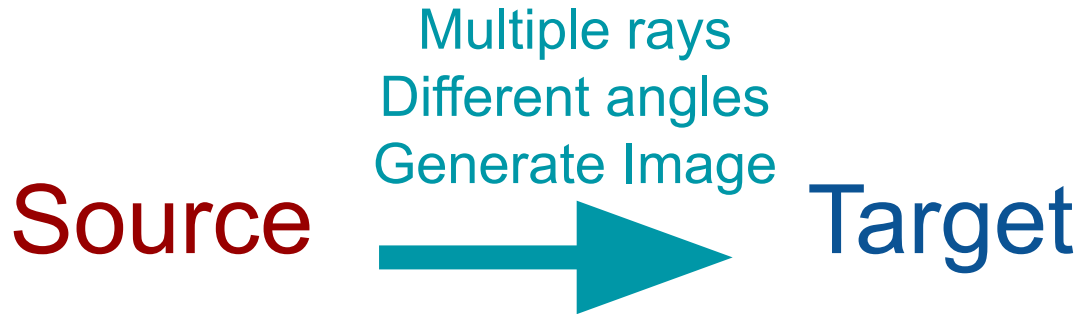
Example. Simple, Function, Everyday

Continental lithosphere cannot be subducted, because it is too buoyant; its low-density crust acts like a life preserver keeping the continent afloat.



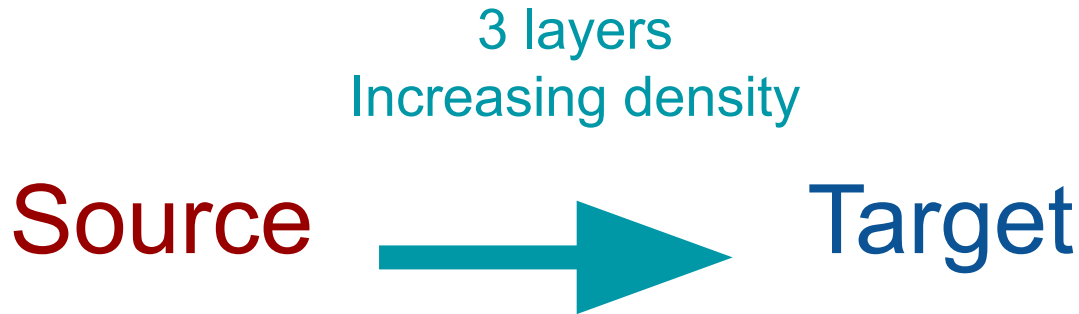
Example. Enriched, Function, Everyday

Very much like a **CT (Computed Tomography) scan** uses X-rays at different angles to image the inside of a body, **seismic tomography** uses seismic rays from thousands of earthquakes that occur each year, passing at all angles through masses of rock, to generate images of internal Earth structures.



Example. Enriched, Form, Everyday (familiar)

We conclude that **the Earth** resembles a **hard-boiled egg**, in that it has **three principal layers**: a not-so-dense crust (like an eggshell), a denser solid mantle in the middle (like an egg white), and a very dense core (the egg yolk).



What type of analogies are included in geoscience textbooks?

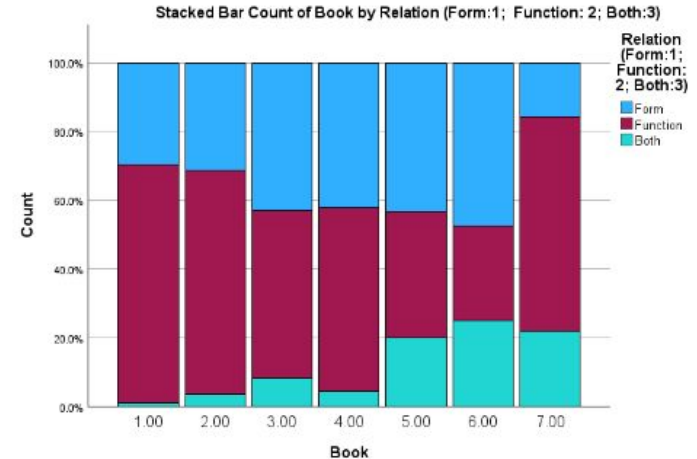
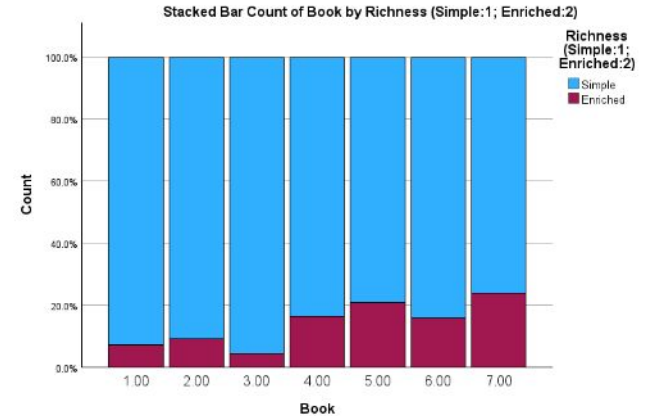
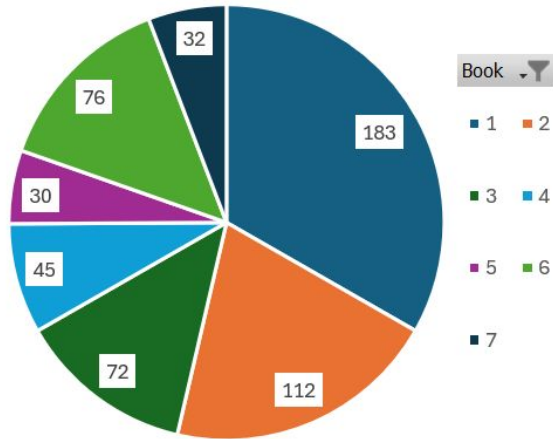
More enriched
analogies in the lab
manuals

χ^2 (2, N=550) 26.34, $p < .001$, Cramer's $V = .22$

There were more
function analogies
than form

χ^2 (1, N=504), 13.49, $p < .001$, Cramer's $V = .16$

Total Analogies By Book



Activity: How do we classify analogies?

Try it: Select an analogy and classify it

Richness	Relation	Source
Simple Typically 1 mapping between source & target	Form Compares superficial features of physical structure	Everyday Relates to common concepts
Enriched Two or more mappings between source & target	Function Cause and effect relationships, how or why	Geology Relates to other geology concepts
	Both	Science Relates to other science concepts

ECR-EDU Core Research: Effects of instructional analogies on illusions of understanding in Introductory Geoscience



Cognitive
Scientists

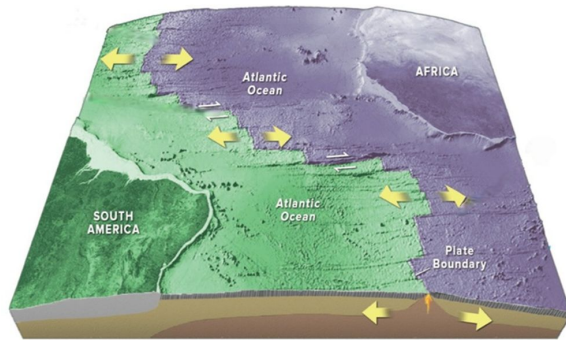
Geoscience
Education Researchers



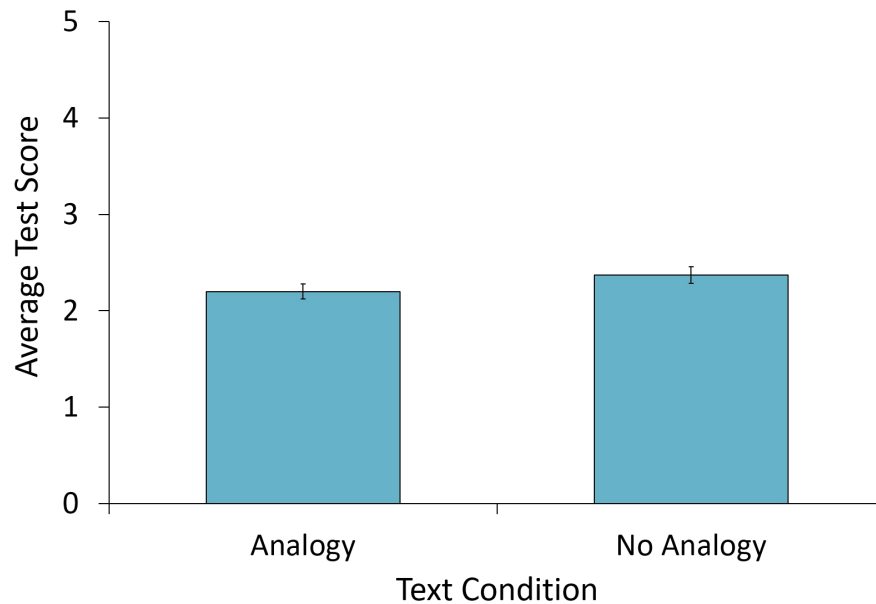
Northern Illinois
University

How do analogies in texts impact understanding?
Does the type of analogy matter?
Does it help to add images?

Example Text: Mid-ocean ridges have a zigzag character due to the way tectonic plates diverge and spread apart. The breaks in the Earth's crust do not follow a straight line but take jogs where the crust is weakest...To understand the zigzag character of diverging tectonic plates at mid-ocean ridges, imagine how two parts of a square-cut pizza pull apart. As you pull the pizza apart, the break doesn't follow a straight line down the center but takes jogs where the pizza is weakest.

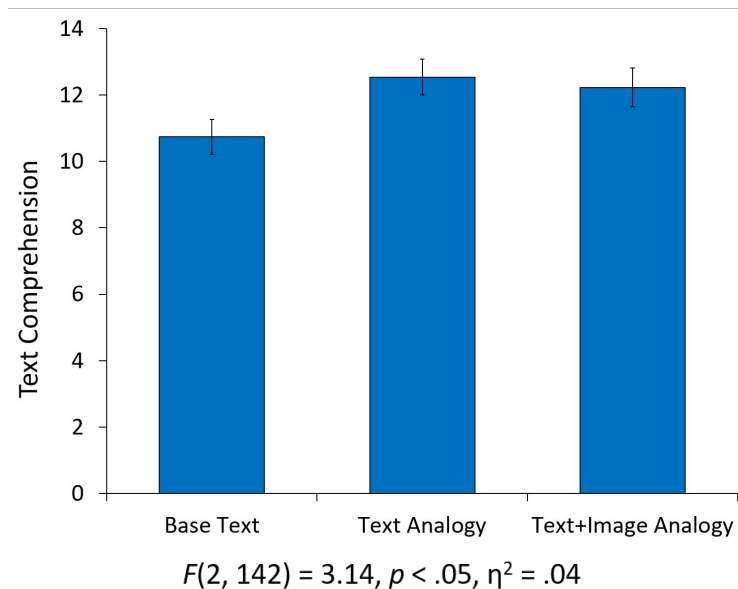


Simple analogies do not improve understanding



$t(191) = 1.70, p = .09$

Enriched analogies improve understanding, but added images don't help.



Analogies in texts create “illusions of comprehension”- overconfidence in understanding.

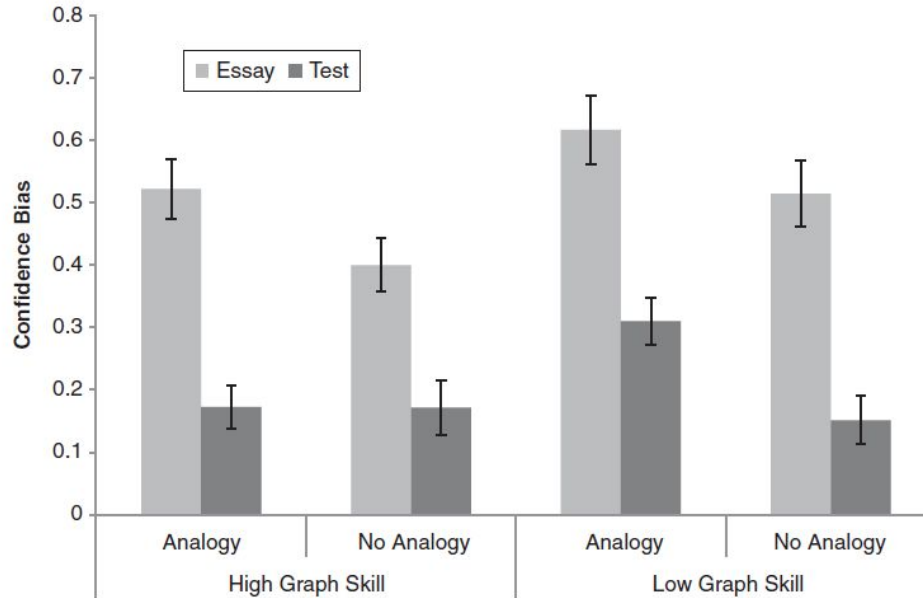
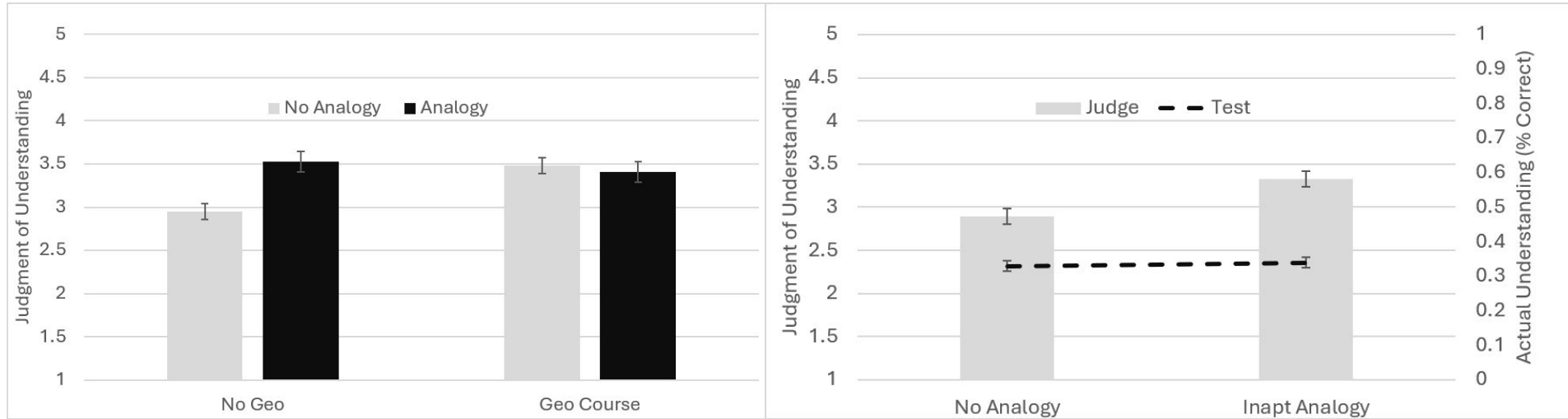


FIGURE 2 The effect of analogy and graph interpretation skills on confidence bias for tests and essays. Error bars represent standard error.

Simple analogies inflate judgements for novices, even when the analogies make no sense.



Let's take a break!



After break, please sit in discipline groups.
Look for the same color index cards.

Activity: What analogies have you used in your classes?

In your discipline groups, discuss what analogies you have used in your classes.

Write 1-2 analogies at the bottom of your note sheet.



Things to consider when using analogies...

1. Engage students in mapping the analogy

Model	Earth
Wood Blocks	
Spaghetti bending	
Spaghetti breaking	
Clamp	



Things to consider when using analogies...

1. Engage students in mapping the analogy
2. Identify incorrect inferences, or features that do NOT map

We conclude that **the Earth** resembles a **hard-boiled egg**, in that it has **three principal layers**: a not-so-dense crust (like an eggshell), a denser solid mantle in the middle (like an egg white), and a very dense core (the egg yolk).

How is the Earth NOT like a hard-boiled egg?

Things to consider when using analogies...

1. Engage students in mapping the analogy
2. Identify incorrect inferences, or features that do NOT map
3. Use familiar sources

As lithosphere thickens and gets cooler and denser, it sinks down into the asthenosphere, like **a ship taking on ballast**. Like the ballast of a ship, older (thicker) lithosphere sinks deeper into the mantle.

Things to consider when using analogies...

1. Engage students in mapping the analogy
2. Identify incorrect inferences, or features that do NOT map
3. Use familiar sources
4. Consider cultural context

Subduction is like... “going underground because the traffic is so bad above.”

- Referring to Lower Wacker Drive in Chicago



Things to consider when using analogies...

1. Engage students in mapping the analogy
2. Identify incorrect inferences, or features that do NOT map
3. Use familiar sources
4. Consider cultural context



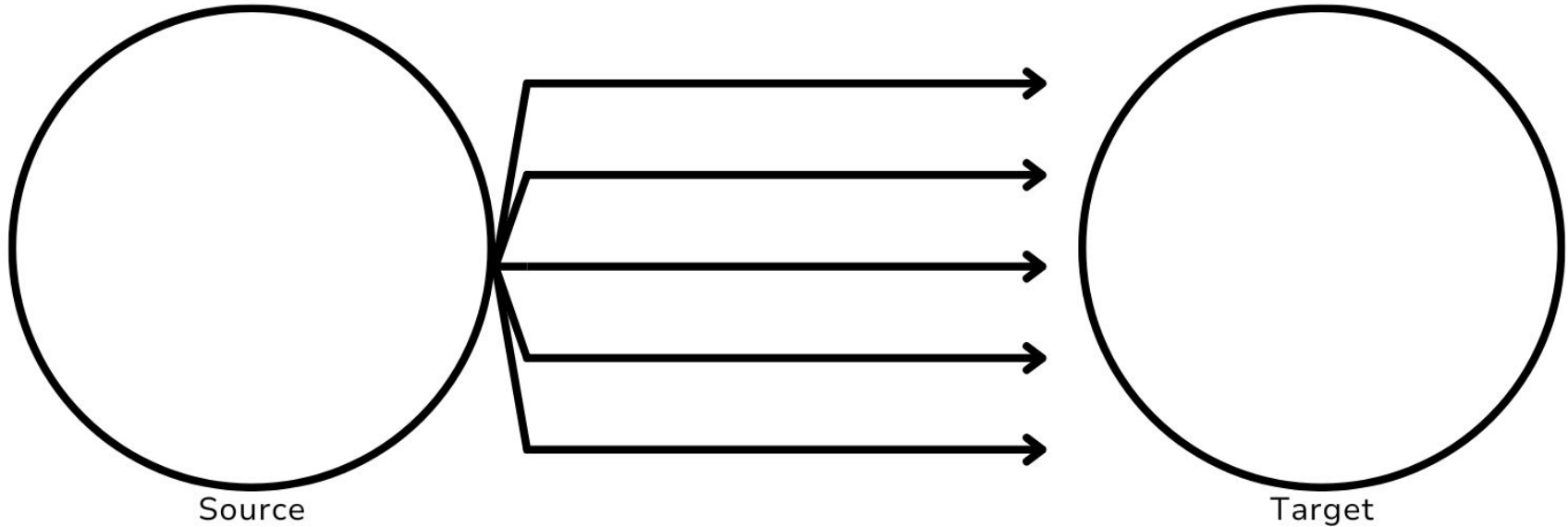
Subduction is like... “chocoflan, flan (custard) is denser so it sinks to the bottom just as oceanic plate does, as opposed to the cake batter that is less denser [sic] and “floats” above the custard similar to the continental plate”

Things to consider when using analogies...

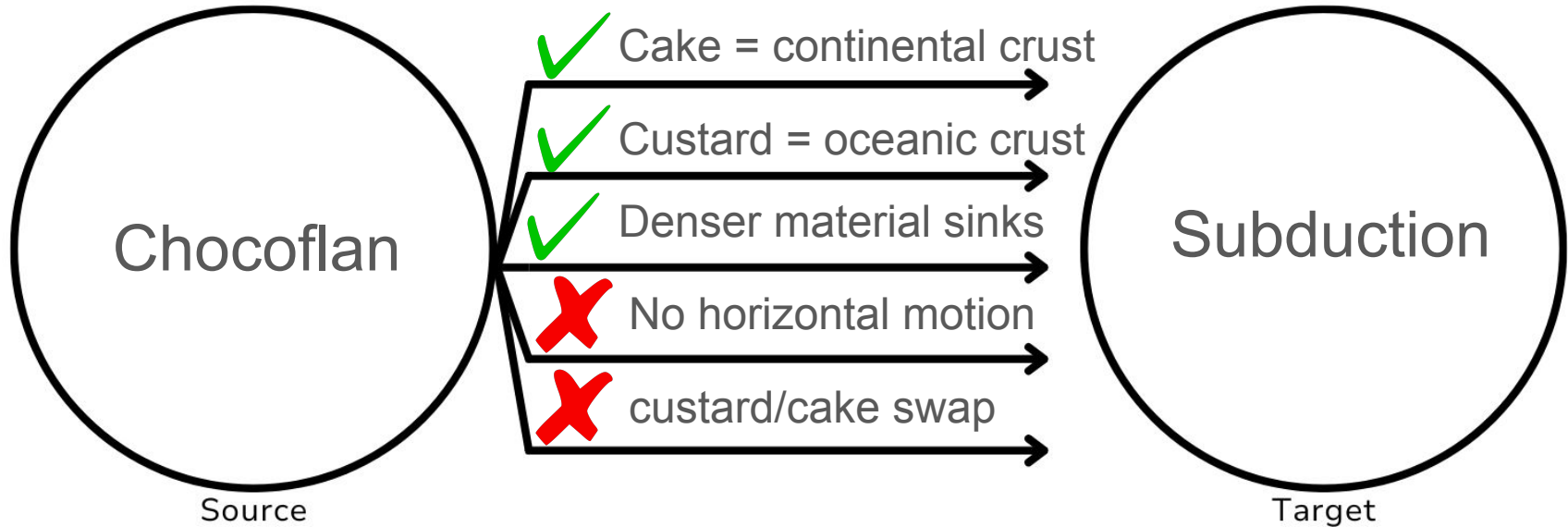
1. Engage students in mapping the analogy
2. Identify incorrect inferences, or features that do NOT map
3. Use familiar sources
4. Consider cultural context
5. What evidence will tell you if students understand the analogy correctly

Assessment?
In-class Analogy Mapping Activity?

Activity: Developing an Analogy for Your Classroom



Activity: Developing an Analogy for Your Classroom



Activity: What analogies have you used in your classes?

Use the concept map to identify the mappings in the analogies you previously wrote down.

Activity: What analogies have you used in your classes?

When you have an analogy you like, with strong causal mappings, have one group member put them on the wall.

Wrap up

Do YOU teach any of the following courses?

- Mineralogy
- Petrology
- Structure
- Sedimentology
- Stratigraphy



We would love to interview YOU if you teach...

- One or more of the upper-level courses above
- At an R1, R2, or PUI

*Those who complete the pre-interview survey
AND interview will be compensated with a
\$75 Amazon giftcard.*

Wrap up

Please complete the EER Workshop survey.

The link is on the workshop page or use the QR code



Thank you!!



**Northern Illinois
University**



#2300992



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UNIVERSITY™

Workshop Development

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Grant Collaborators

Lead PI - Dr. Thomas Griffin, UIC

Co-PI - Dr. Jennifer Wiley, UIC

Co-PI - Dr. Allison Jaeger, Mississippi State
University

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Independent Contractor Certified Work Statement

Independent contractor status must be determined before any work is performed. Please use the **Independent Contractor Questionnaire** to assist in making this determination. This form must then be signed by the independent contractor and sent with the check request/requisition to the Accounting Office for processing.

Date: <u>7/20/2027</u>	Department: <u>Earth, Atmos & Environment</u>
Name of Service Provider: _____	
Address of Service Provider: _____	
Email Address: _____	
Type of Service to be Provided (complete description required): <u>Participant in 2026 Earth Educators' Rendezvous workshop on analogies</u>	
Date Service to Begin: <u>7/20/2027</u>	Completion Date: <u>7/20/2027</u>
Hourly/Salary Rate (if applicable): \$ _____	Total Amount to be Paid: \$ <u>200</u>

Name
Address
Email



Department Certification and Approval for Payment

In accordance with University policies and procedures, I certify that the individual named above will be engaged as an independent contractor to render services to Northern Illinois University. I further certify that, to the best of my knowledge, this individual is not a current employee of Northern Illinois University and is otherwise eligible to be considered an independent contractor, based on a thorough assessment of the employment conditions. This statement is therefore approved for payment.

Nicole LaDue

Printed Name of Authorizing Person Authorizing Signature Date Budget Acct.

Independent Contractor Certification Statement

I certify that I have been engaged as an independent contractor and performed the service(s) identified above for Northern Illinois University. I further certify that I am not currently employed by Northern Illinois University and that, to the best of my knowledge, this independent contractor designation is in accordance with applicable policies and guidelines. I also understand that the University will report to the Internal Revenue Service on Form 1099 all payments made to me during this calendar year.

Sign & Date



Printed Name of Contractor Independent Contractor Signature Date