PROJECT IGELS

The IGELS Project

A Vision for Change in Introductory Life Science Courses

NSF-DUE #2126154

VISION & CHANGE

GELS

RELEVANCE

REASONING

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IGELS Mission Statement

The national network for the Interactions in General Education Life Science Courses (IGELS) is a coalition of biologists and biology educators collaborating to support and mentor “non-major biology” instructors.

IGELS promotes the use of evidence-based and equity and inclusive teaching and learning methods in order to develop STEM-ready, scientifically literate students who

- understand the nature of science,
- who possess metacognitive, critical thinking, and science process skills,
- who can apply essential content and evidence-based reasoning to their lives,
- and who demonstrate civic responsibility as stakeholders in their community.

IGELS Steering Committee

PI
Gordon Uno, David Ross Boyd Professor of Botany, University of Oklahoma

Co-PIs
Karla Fuller, Associate Professor of Biology, Guttman Community College
Tamar Goulet, Professor of Biology, University of Mississippi
Heather Rissler, Program Manager of Faculty Development, KUMC; Adjunct Instructor, NIACC
Davida Smyth, Associate Professor of Microbiology, TAMUSA

Senior Personnel
Bryan Dewsbury, Assoc Prof of Biology, Assoc Dir of STEM Transformation Inst, Florida International University
Sam Donovan, Director of Outreach and Strategic Engagement, BioQUEST Curriculum Consortium
Tara Jo (TJ) Holmberg, Professor of Environmental Science and Biology, Northwestern CT Community College
Justin Hoshaw, Associate Professor of Biology, Waubonsee Community College
Kristin Jenkins, TIDES Executive Director, The University of Texas at Austin
Jacki Reeves-Pepin, Executive Director, NABT
John Moore, Professor Emeritus, Taylor University

Project Evaluator Amanda Gonczi

Working Groups and Members

Curriculum Resources
Chairs: Sam Donovan, John Moore
Members:
Vedham Karpakakunjaram, Montgomery College
Sarah Lehman, Bluffton University

Program to Course Outcomes and Assessment
Chairs: Karla Fuller, Justin Hoshaw
Members:

Equity and Inclusion
Chairs: Bryan Dewsbury, Kristin Jenkins
Members:
Elizabeth Harrison, Kennesaw State University
Gabi Kammerlinck, University of Florida

Working Groups and Members

Surveys
Chairs: Gordon Uno, Tamar Goulet
Members:

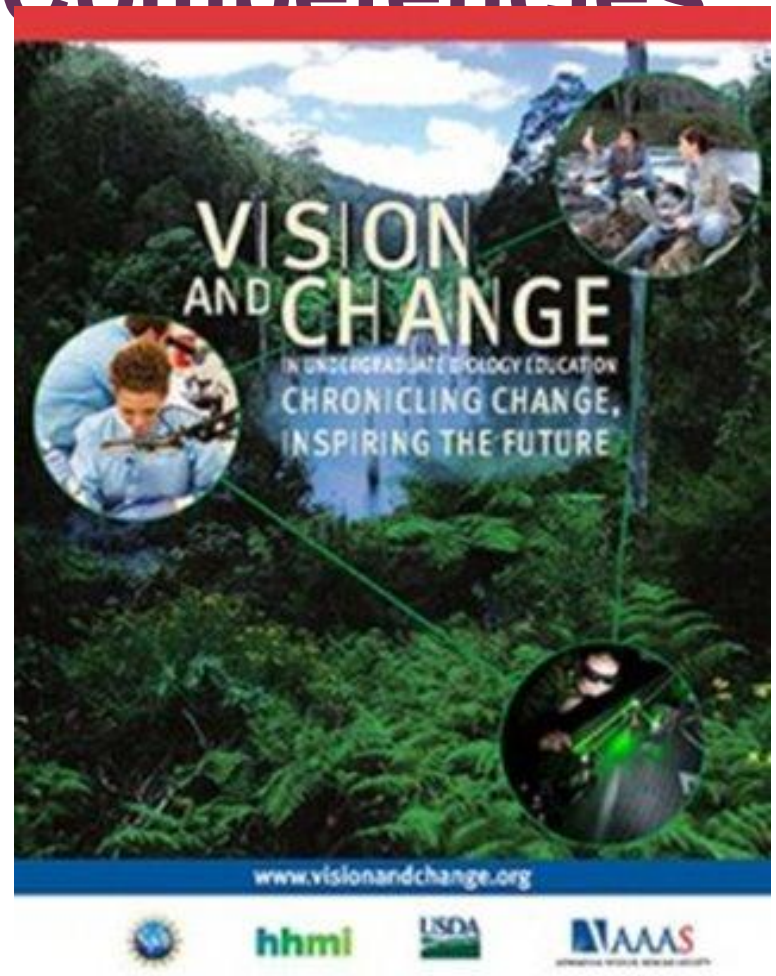
Faculty Professional Development
Chairs: Davida Smyth, Heather Rissler
Members:

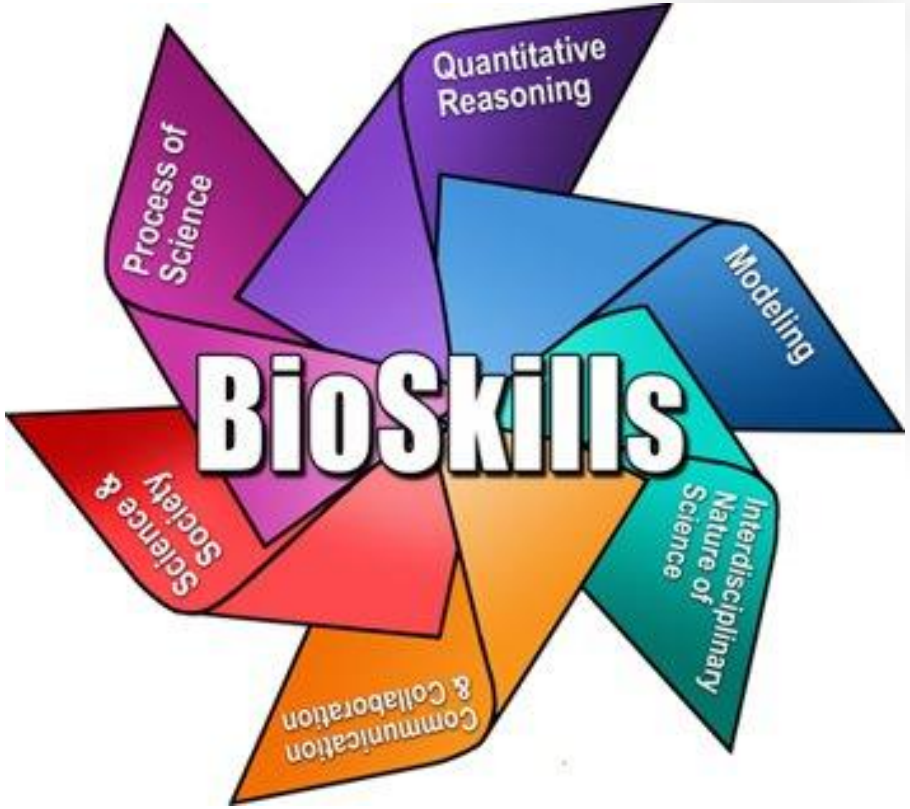
Online Presence and Network
Chairs: Tara Jo Holmberg, Jaclyn Reeves-Pepin
Members:
Anna Hiatt, University of Nebraska - Lincoln

Agenda

Intro - Heather
Creating Inclusive Classes - Bryan and Liz
Focusing on Civic Engagement - Davida and Tammy
Reasoning and Relevance - John and Sam
Using Alternative Assessments -Justin and Karla
Conversation with the Community - Gordon

Vision and Change: Concepts & Competencies





https://qubeshub.org/publications/1305/5

IGELS Alignment with Vision and Change

Reasoning:

-Quantitative Reasoning

-Modeling

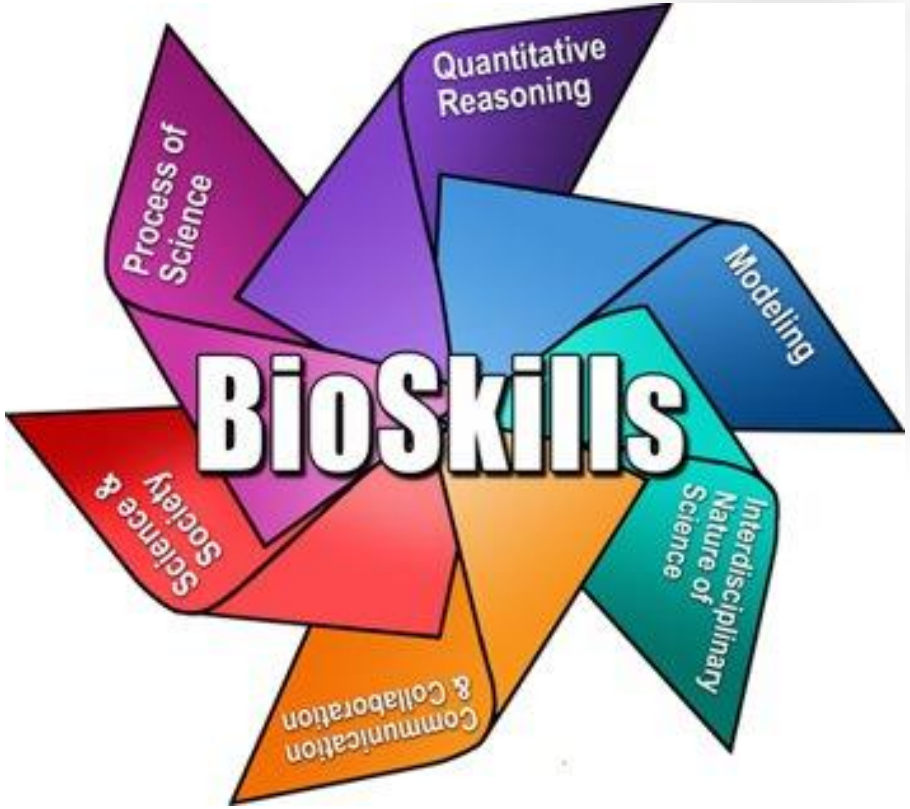
-Process of Science

Relevance:

-Science and Society

-Communication & Collaboration

-Interdisciplinary Nature of Science



https://qubeshub.org/publications/1305/5

Major Goals

- Assess awareness and acceptance of the V&C principles by instructors teaching GELS courses
- Investigate targeted research questions in order to facilitate adoption and adaptation of V&C principles in GELS courses
- Identify, review, and modify existing educational resources that address V&C principles and facilitate their implementation in GELS courses that promote science literacy, skills, civic engagement, and application of knowledge
- Facilitate adoption of V&C in GELS by PD and mentoring
- Facilitate adoption of V&C in GELS by improving equity and inclusive teaching and learning
- Facilitate sustainable and long-term adoption of V&C in GELS by creating a collaborative network

Current and Future Work

Current Work:

- Working Group Meetings
- Surveys of faculty who teach GELS courses

Future Work

- Analyze survey data
- Develop core skillset and essential content to help students meet IGELS mission
- Establish a network of general education life science instructors
- Develop a model professional development workshop

DEI Working group: Inclusive, learning-centered syllabi

Outline

1. DEI Working Group introduction – Bryan Dewsbury
2. The importance of your syllabus
3. Examine and score your own syllabus or example syllabus
4. Additional resources to create learning-centered, inclusive syllabi
5. Wrap-up

DEI should be considered in ALL aspects of your course

- Creating an inclusive course includes all aspects of your course, from design and activities to assessment
- For many of your students, the first "interaction" they have with you is through your syllabus

The syllabus as an invitation to learn . . .

- “The syllabus becomes an invitation to share responsibility for successful learning” (Grunert O’Brien, Millis & Cohen, 2008, p.22).
- Palmer, Wheeler & Aneece suggest that the syllabus’ “primary function should be as a learning tool, one that is carefully crafted through a systematic course design process” (2016, p. 37).
- “A well-crafted syllabus can be the beginning of a promise fulfilled and part of the difference between just another course and one that changes lives” (Canada, 2013, p. 37).

A learning focused, inclusive syllabus...

- Sets tone for course
- Establishes early point of contact and connection
- Displays your philosophy of teaching
- Provides rationale for course design and assessment
- Clarifies your expectations for your students
- Explains student responsibilities to produce success
- Describes learning resources and technology used in course
- If inclusiveness is a priority, your syllabus should reflect that

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The Plan:

1. Examine syllabus rubric by Palmer et al. (2014)
2. Score your own syllabus or the example syllabi using the syllabus rubric scoring sheet
3. Write a plan for revising your syllabus to emphasize at least 2-3 of the rubric components.

Palmer, M., Bach, D., & Streifer, A.Guide to Assessing the Focus of Syllabi. University of Virginia, Teaching Resource Center

- Syllabus components are designated as essential, important, and less important
- Components rated based on evidence found across the syllabus
- Used sample syllabi to normalize ratings
- Necessary prior knowledge includes Fink's Taxonomy of Significant Learning (2013), Goals and Objectives[1], Alignment.

Criterion	Component
Learning Goals & Objectives	1. Learning goals encompass full range of Fink's dimensions of significant learning
	2. Course level learning objectives are clearly articulated and use specific action verbs
	3. Learning objectives are appropriately pitched[1]
Assessment Activities	4. Objectives and assessments are aligned
	5. Major summative assessment activities are clearly defined
	6. Plans for frequent formative assessment with immediate feedback
	7. Assessments are adequately paced and scaffolded
	8. Grading information is included but separate from assessment; it is aligned with objectives
Schedule	9. Course schedule is fully articulated and logically sequenced
Classroom Environment	10. Tone is positive, respectful, inviting
	11. Fosters positive motivation, describes value of course, promotes content as a vehicle for learning
	12. Communicates high expectations, projects confidence of success
	13. Syllabus is well organized, easy to navigate, requires interaction

- Consider your own syllabi
  - What might be difficult or discouraging for students? Why?
  - How could you make your syllabus more learning-centered and inclusive using this rubric?

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QR code to resources:
DEI Syllabus Session folder

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What does your score mean?

- 0-16: content-focused syllabus
- 17-30: transitional
- 31-46: learning-focused

Syllabus examples before and after using rubric

BME 2240: Biotransport

[Course Information]
[Instructor Information]
[TA Information]

Objectives:

To introduce principles and mathematics governing biological and biomedical transport processes; to apply classical engineering solutions and governing equations from simple transport problems to more complex biomedical transport processes; and to integrate knowledge of cell and organ physiology with mathematical expression of transport principles.

Pre-requisites: APMA 2120, 2130.

Co-requisites: BME 2220, BME 2104 or instructor permission.

Textbook: R.L. Fournier, Basic Transport Phenomena in Biomedical Engineering, 3rd ed., Boca Raton, FL: Taylor & Francis, 2012, ISBN 978-1-4398-2870-6

Format:

Lecture materials will be supplemented with readings from the textbook.

Supplemental materials and slides containing figures for discussion in class will be posted on the class webpage on UVa Collab.

Friday Discussions will include supplemental lecture material, mathematical derivations, extra example problems, and homework help.

Homework problem sets may be individual or group projects as specified in each assignment. Homework will not be accepted late without prior arrangement with [professor].

Two midterm tests will consist of short explanation or analysis questions. The final exam will be comprehensive. You must work alone; you may not use your notes or any other source of information except as specified in the test instructions. Review sessions will be offered before each test.

All work is to be your own work (see the Honor Statement below). If you consult published material, then you must cite those sources appropriately.

Honor Statement:

I trust every student in this course to fully comply with all of the provisions of the UVa Honor System. In addition to pledging that you have neither received nor given aid on an assignment, your signature also affirms that you have not knowingly represented as your own any opinions or ideas that are attributable to another author in published or unpublished notes, study outlines, abstracts, articles, textbooks, or web pages. In other words, I expect that all assignments and reports are your original work and that references are cited appropriately. All alleged honor violations brought to my attention will be forwarded to the Honor Committee.

BME 2240 Biotransport
Learning Guide

[Instructor:]
[Teaching Assistant:]

When and where do we meet?

[Class discussions:]
[Coaching sessions:]
[Office hours:]
[TA office hours:]

Why should you care about Biotransport?

How can you deliver a drug to kill tumors without killing the patient? How can you harness nanotechnology to design inexpensive kits to diagnose diseases in low-resource countries? How do new blood vessels grow? These are examples of "grand challenges" faced by practicing biomedical engineers that require us to design mathematical and experimental approaches for predicting, measuring, and interpreting flow phenomena quantitatively. In this course, you will combine your knowledge of applied mathematics and human physiology from the molecule to cell to whole body length scales to begin exploring how to answer grand challenge questions such as these.

How will this course help you succeed?

Grand challenges are fundamental questions in biotransport with broad applications to science, engineering, and human health. This course will help you acquire a conceptual and practical framework that you can apply to solve complex grand challenges in your future research, engineering practice, or clinical practice. By the end of the course, you will be able to answer the following questions:

1) How do I use math to figure out how, why, and where stuff flows in the body?
2) Some equations in physics and engineering are easy, like $F = ma$. When and how can I use simple common sense equations for flows in my complicated biology models or medical device designs?
3) I've taken classes like calculus and cell biology, but I don't know what those classes have to do with each other. How do I put stuff from other classes together to solve real-world biology problems or to design medical devices?
4) Can I use equations and answers that I found using Google and Wikipedia to solve homework problems and to do engineering design?
5) How do I use equations and answers from this class to solve problems in research and medicine next year in my Senior Capstone Project or after I graduate?

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Other syllabus features to consider

- Explain what students can expect from you
- For example, how soon will assignments be graded?
- What will you do to support your students?
- Define all terms/jargon phrases like “office hours”
- Use 12-14 point, sans serif fonts for better reading comprehension and to support dyslexic students
- Add Table of Contents and Header text with links to other parts of the document
- Use check boxes when listing student assignments
- Add alt text to images and tables. Check document for accessibility

References and Resources

•Syllabus rubric guide:

https://cte.virginia.edu/sites/cte.virginia.edu/files/Syllabus-Rubric-Guide-2-13-17.pdf

•Syllabus rubric scoring sheet: https://cte.virginia.edu/sites/cte.virginia.edu/files/Scoring-Sheet-Excel-6-9-15.xlsx

•Designing inclusive digital syllabi by Justin Hoshaw: https://docs.google.com/document/d/1T2ZoD89MtpOn45Hpu_9t1AA3a18AzG6XI0MjteoRBLU/edit

•Example syllabus before using rubric: https://drive.google.com/file/d/1s7d7DGXrIZetM40rMNM8ZmC3pUlcv90N/view?usp=share_link

•Annotated scored syllabus example: https://drive.google.com/file/d/1jcBlUMJ55RfjkjcflTeZ7xn3bKLCuzPj/view?usp=share_link

•Palmer, M. S., Bach, D. J., & Streifer, A. C. (2014). Measuring the promise: A learning-focused syllabus rubric. *To improve the academy: A journal of educational development, 33 (1),* 14-36.

•Palmer, M. S., Streifer, A. C., & Duncun, S. (2016). Systematic assessment of high impact course design institute. *To Improve the Academy, 35*(2), 339-361. http://dx.doi.org/10.1002/tia2.20041

•Fink, L. (2003) *Designing significant learning experiences*. San Francisco: Jossey-Bass.

•University at Buffalo graphic about Fink's significant learning outcomes: https://www.buffalo.edu/catt/develop/design/learning-outcomes/finks.html

•Weimer, M. (2013). *Learner-centered teaching: Five key changes to practice*. (2nd ed.). San Francisco: Jossey- Bass.

•Grunert, J. (1997) " The Course Syllabus: A Learning-Centered Approach." Boston, MA: Anker.

Acknowledgements

- NABT
- Center for Excellence in Teaching and Learning at Kennesaw State University
- Justin Hoshaw
- DEI Working Group, IGELS
- Thank you!

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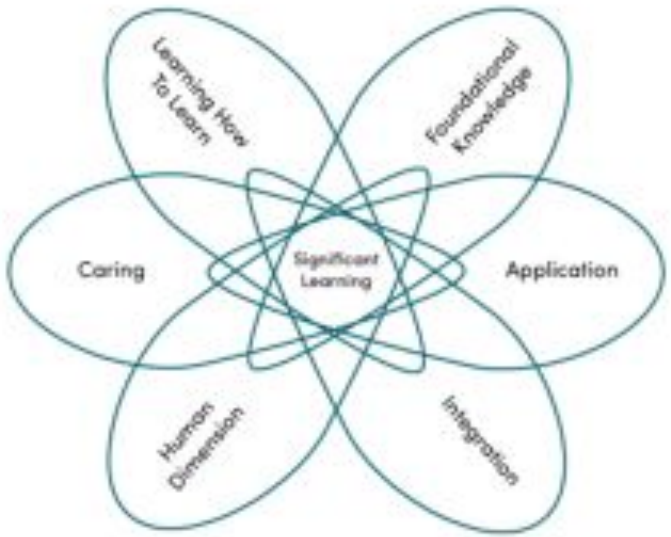
Optional supplementary rubric and scoring

- To help assess the quality of individual classroom activities

Learning Activities	14. Classroom activities, assessments, and objectives are aligned
	15. Learning activities are derived from evidence-based practices
	16. Learning activities likely to actively engage students

- Scoring if you used the supplemental rubric,
  - 0-18: content-focused
  - 19-40: transitional
  - 41-58: learning-focused

Fink's Taxonomy of Significant Learning



Significant Learning Category	Questions to Ask
Foundational Knowledge	What key information (facts, terms, formula, concepts, relationships…) is important for students to understand and remember in the future?
Application	What kinds of thinking are important for students to learn here: • Critical thinking, in which students analyze and evaluate? • Creative thinking, in which students imagine and create? • Practical thinking, in which students solve problems and make decisions? What important skills do students need to learn? What complex projects do students need to learn how to manage?
Integration	What connections (similarities and interactions) should students recognize and make… • Among ideas within this course? • Among the information, ideas, and perspectives in this course and those in other courses or areas? • Between material in this course and students' own personal, social, and work lives?
Human Dimension	What can or should students learn about themselves? What can or should students learn about interacting with people that they may actually encounter in the future?
Caring	What changes would you like to see in what students care about, that is, any changes in their… • Interests? • Values? • Feelings?
Learning How to Learn	What should students know about learning… • How to be a good student in a course like this? • How to engage in inquiry and construct knowledge with this subject matter? • How to become self-directed learners relative to this subject? That is, have a learning agenda of what else they need and want to learn and a plan for learning it?

Adapted from Fink 2013.

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Focusing on Civic Engagement

2 mins

Let's brainstorm

- If you had the opportunity to teach about a complex civic problem in your course, what might intrigue you AND your students?
  - Consider issues that you think are important for all students to engage with

Try not to be constrained by your own expertise in identifying these themes.

- For the next two minutes, write down as many different problems/issues on Post Its – each problem on a single Post It …

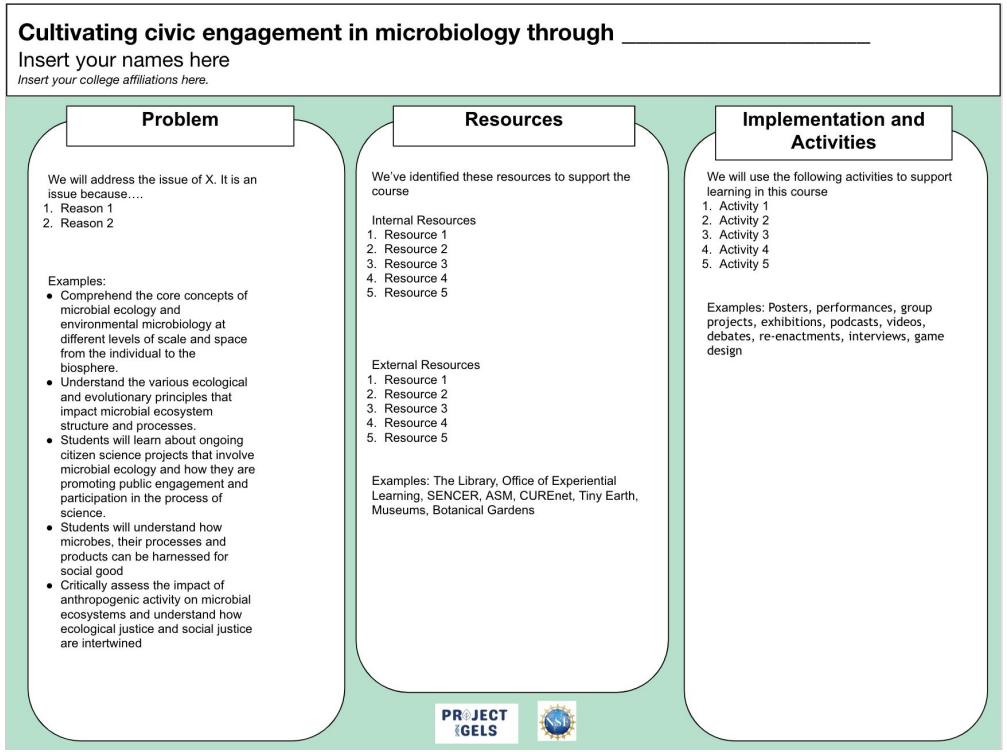
What did we find?

Report out ….pick a random person from each group

Let's choose a theme (5 mins)

- You will choose a theme that resonates with you and your teammates (and join the google slide with that theme) - you will all then collaborate to design your theme-focused activity
- Each "group" needs to select a scribe (who will be responsible for the google slide "poster,") and a timekeeper will keep everyone on track
- Each group can record their work in each of the columns on the slide. You'll be able to see the slides of other groups as well.

Let's choose a theme (5 mins)



Cultivating civic engagement in microbiology through _____

Insert your names here

Insert your college affiliations here.

Problem

We will address the issue of X. It is an issue because….
1. Reason 1
2. Reason 2

Examples:
- Comprehend the core concepts of microbial ecology and environmental microbiology at different levels of scale and space from the individual to the biosphere.
- Understand the various ecological and evolutionary principles that impact microbial ecosystem structure and processes.
- Students will learn about ongoing citizen science projects that involve microbial ecology and how they are promoting public engagement and participation in the process of science.
- Students will understand how microbes, their processes and products can be harnessed for social good
- Critically assess the impact of anthropogenic activity on microbial ecosystems and understand how ecological justice and social justice are intertwined

Resources

We've identified these resources to support the course

Internal Resources
1. Resource 1
2. Resource 2
3. Resource 3
4. Resource 4
5. Resource 5

External Resources
1. Resource 1
2. Resource 2
3. Resource 3
4. Resource 4
5. Resource 5

Examples: The Library, Office of Experiential Learning, SENCER, ASM, CUREnet, Tiny Earth, Museums, Botanical Gardens

Implementation and Activities

We will use the following activities to support learning in this course
1. Activity 1
2. Activity 2
3. Activity 3
4. Activity 4
5. Activity 5

Examples: Posters, performances, group projects, exhibitions, podcasts, videos, debates, re-enactments, interviews, game design

- Navigate to the google drive and make a copy of the google slide template and name it for the theme of your group
- Add your names and college affiliations at the top of the slide, try not to write over other people's info
- We'll work here for the remaining time

How do we make learning relevant?

Jackson's water crisis put new attention on its longstanding lead contamination issue

WWNO - New Orleans Public Radio | By Danny McArthur
Published September 28, 2022 at 3:31 PM CDT

▶ LISTEN • 3:54

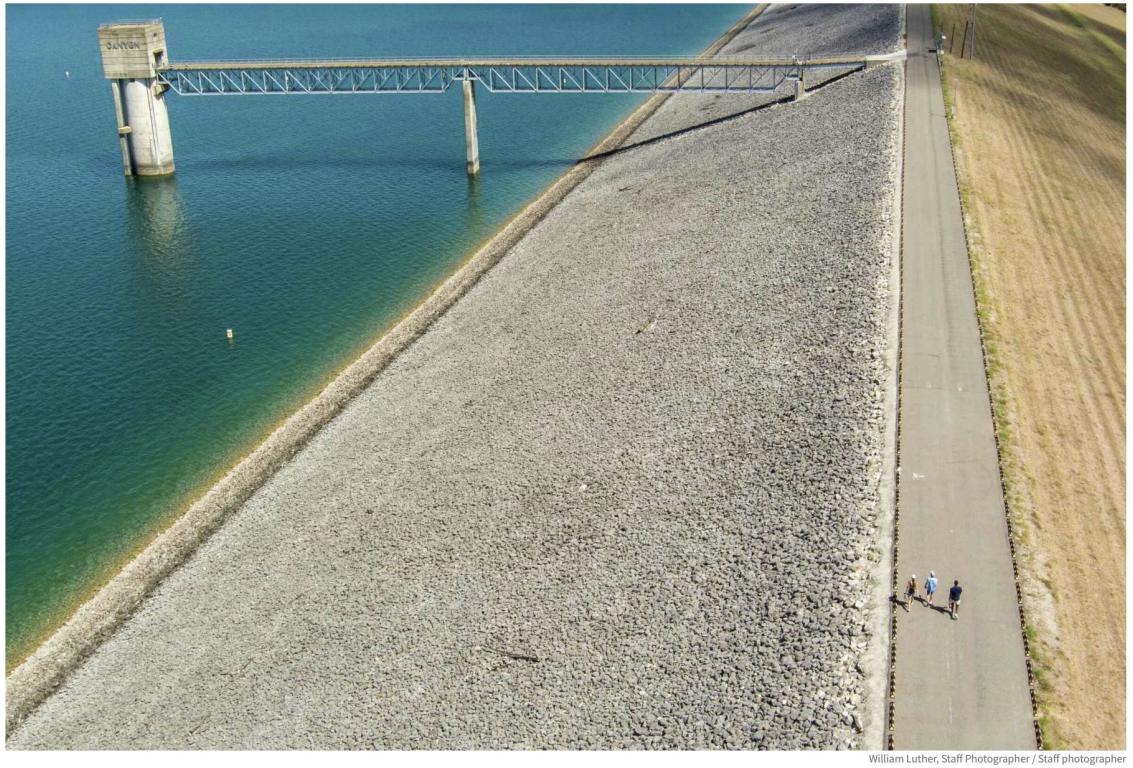
Bobbi-Jeanne Misick/Gulf States Newsroom /

In this file photo, South Jackson resident Baylis McDaniels runs water from the tap in her home, Feb. 2021. McDaniels said she only uses it to bathe and wash dishes. Over the past year, nearly 1,800 lawsuits have been filed against city and state officials over lead exposure from the city's water.

Over the last month, Jackson's city water system collapsing has garnered international attention and the threat of potential federal legal action. For residents, it's just another example of their years-long struggle with the city's water infrastructure.

NEWS // LOCAL

Drought is here. But is San Antonio truly water-secure?



William Luther, Staff Photographer / Staff photographer

ELENA BRUESS, SAN ANTONIO EXPRESS-NEWS Aug. 21, 2022 | Updated: Aug. 31, 2022 11:03 a.m.

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Teaching through the issue …..

- What types of implementation and activities will give students practice in applying knowledge

Civic Issue
- **Water**
- **Food security**
- **Vaccines**

Core Concepts
- **Evolution**
- **Structure & Function**
- **Information**
- **Energy**
- **Systems**

Core Competencies
- **Apply the process of science**
- **Use quantitative reasoning**
- **Employ modeling and simulation**
- **Experience interdisciplinary science**
- **Communicate with other disciplines**
- **Integrate science and society**

Let’s share examples of activities…..

Consider how these activities would connect to the issue, help explore the content and align with V&C competencies

Promote critical thinking and reasoning

- ePortfolios for reflection
- Authentic research experiences - civic twist
  - Tiny Earth
  - REMNet
- Field trips to wastewater treatment plants
- Daily news report discussions
- Case studies
- Collaborative projects - inform the public
  - Brochures
  - Poster presentations
- Think Pair Share
- Concept Mapping - portable white boards
- Peer Review
- Discussions/Seminars
- Authentic research projects
- Sketchnoting/Diagraming/Visual Narratives
- Debates
- Shared annotating
- Formulate questions
- Run simulations

Now let's consider what resources you have

Your students – past/present

Other Dept Faculty

Faculty at College

Staff and Colleagues

Local environment

Local Organizations

Museums/Galleries

Urban/Rural

Career services

Office of Civic Engagement

Library/Librarians

Student clubs/orgs

IGELS can help!

SENCER
NABT
QUBES/BioQUEST
HHMI
SERC
POGIL

Resources we hadn't considered?

What's there at your own institution….

Let’s take some time to finish our slides

This will help you get started

Questions and answers ….

Curriculum Resources to Support Relevance and Reasoning - John, Sarah, and Sam

Relevance: Provides foundation and engagement.

- How do we put ourselves into the “shoes” of others who are very different from us.
- As biologists we “see” all the connections between the biological principles and things we experience in the natural world. (mutations, cell cycle, cancer)
- Community
- Working with new faculty or adjunct faculty
- Working on small units

Climate Change

Vaccines

Importance of Relevance:

Means of Engaging students into Meaningful Learning:

Meaningful Learning

Relating of information to an image, experience, concept, or proposition already existing in the learner's cognitive structure (David P. Ausubel, 1963)

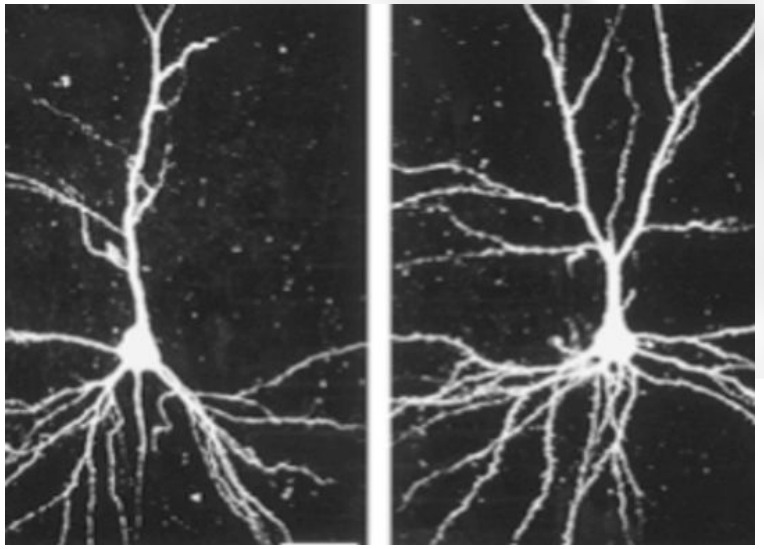
Three Conditions for Meaningful Learning

1. Relative Cognitive Structure – *Teacher and Student*
2. Meaningful Learning Set – *Student Only*

   new information is actively linked to the existing information challenging incorrect links
3. Relative Information – *Teacher and Student*

   How the new material relates to the existing cognitive structure

Importance of Relevance:



Means of Engaging students into Meaningful Learning:

Physiology of Learning

Eric R. Kandel M.D., Noble Prize Physiology of Medicine

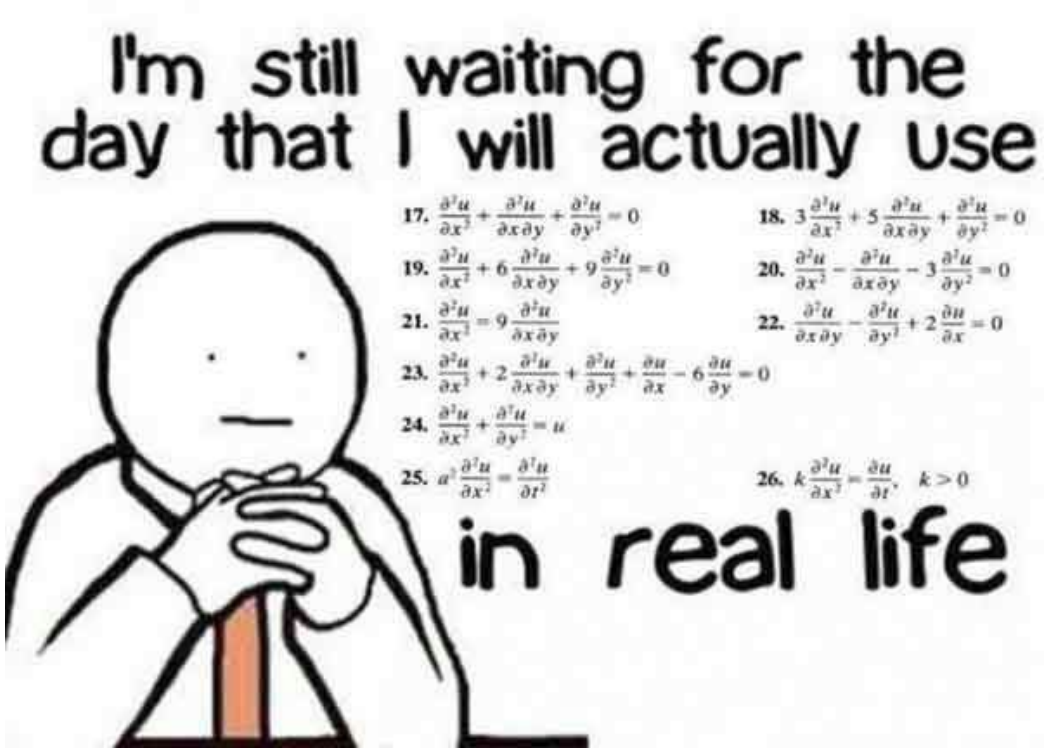
Nerve growth requires the expression of Genes.

Modulated by attention

<u>Must be of interest to you/Value/Meaningful</u>

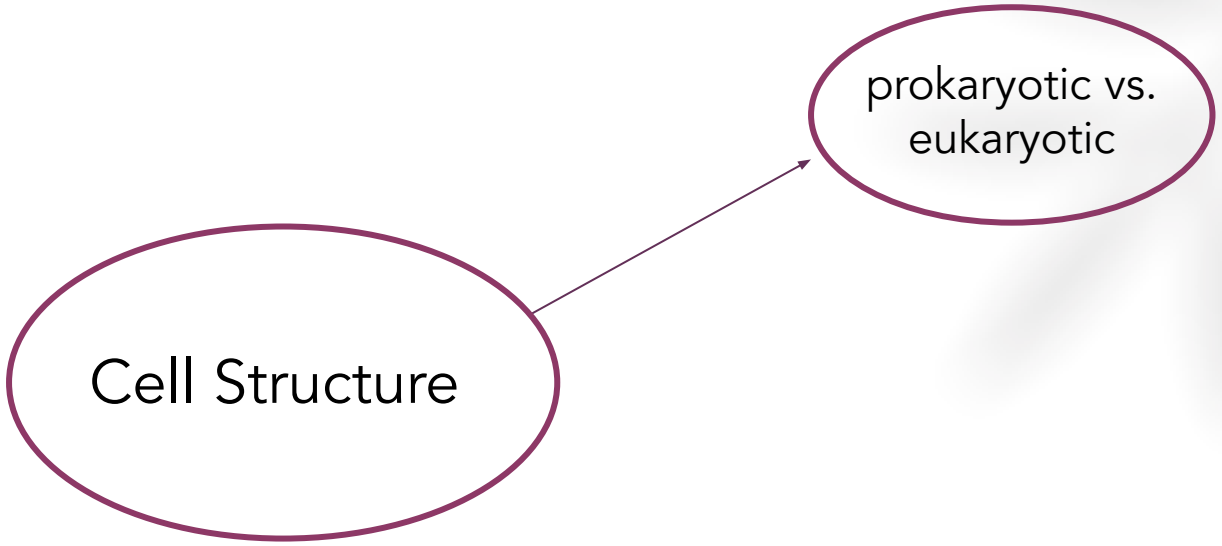
Genes are activated Allows the release of gene expression

Implementing Relevance:

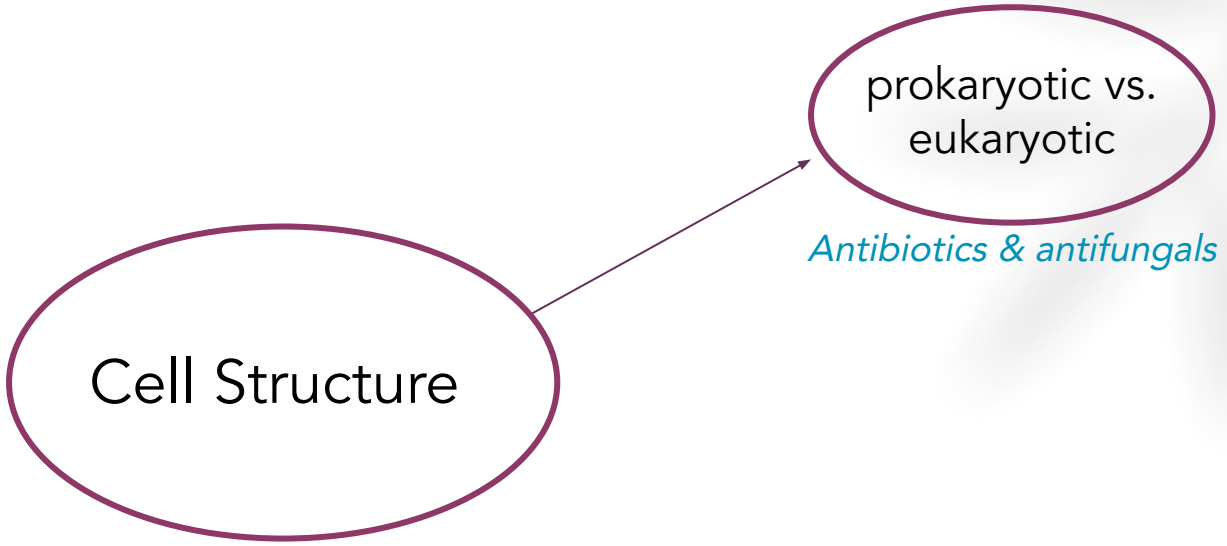


https://www.opencolleges.edu.au/informed/features/how-to-make-learning-relevant/

Implementing Relevance:



Implementing Relevance:



Implementing Relevance:

- Relevance must be *intentional*
- Good sources for adding in relevance:
  - Case studies
  - HHMI activities/films
  - Research
- Tips for increasing relevance (Briggs, 2014)
  1. Student-directed
  2. Connect it to their lives and what they already know
  3. Provide utility value ("When am I going to use this"?)
  4. Build relatedness ("What does this have to do with *me*"?)
- How can I evaluate/make even more personal?
  - Concept maps
  - Discussion prompts
  - Relevance writing prompts (Mara et al., 2021)

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1. *What aspect of the material in this unit can you relate to your life?*
2. *What in your life did you connect it to?*
3. *The connection between that aspect of the unit and your own life.*
4. *Why and how much the connection is meaningful to you.*

Reasoning: A Focus For Student Engagement

- What should students be doing?
- We want them to do science!

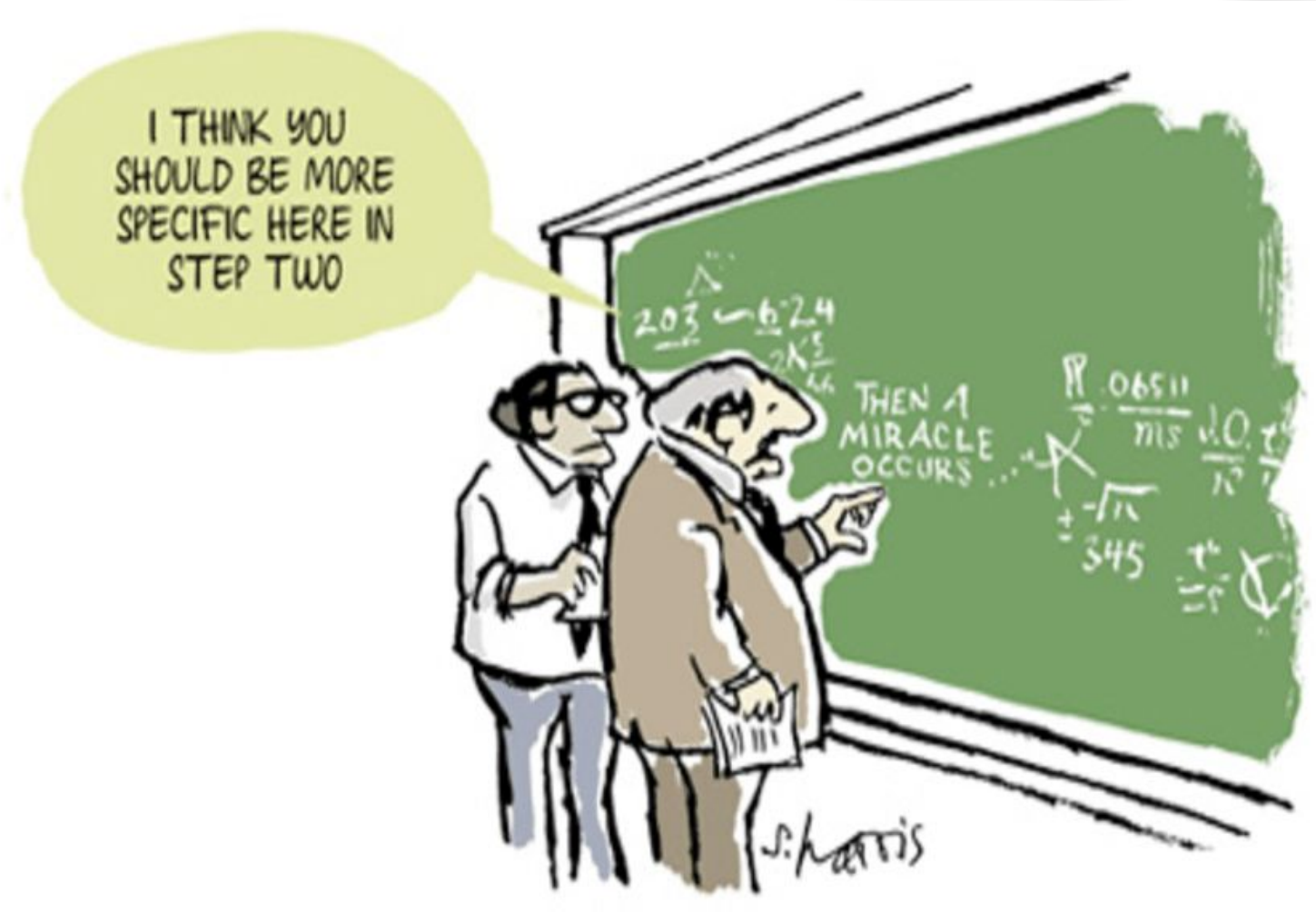
https://childventures.ca/wp-content/uploads/2013/08/ScientificReasoning-Childventures-daycareVaughan.png

Importance of Reasoning:

- Teaching scientific knowledge does not lead to increased capacity for scientific reasoning.[1]
- Science is a diverse collection of practices that reflect shared beliefs and strategies used to systematically explore natural systems and build explanatory models.
- Doing science builds identity and gives students direct experience with reasoning skills that can be used in their lives.[2]

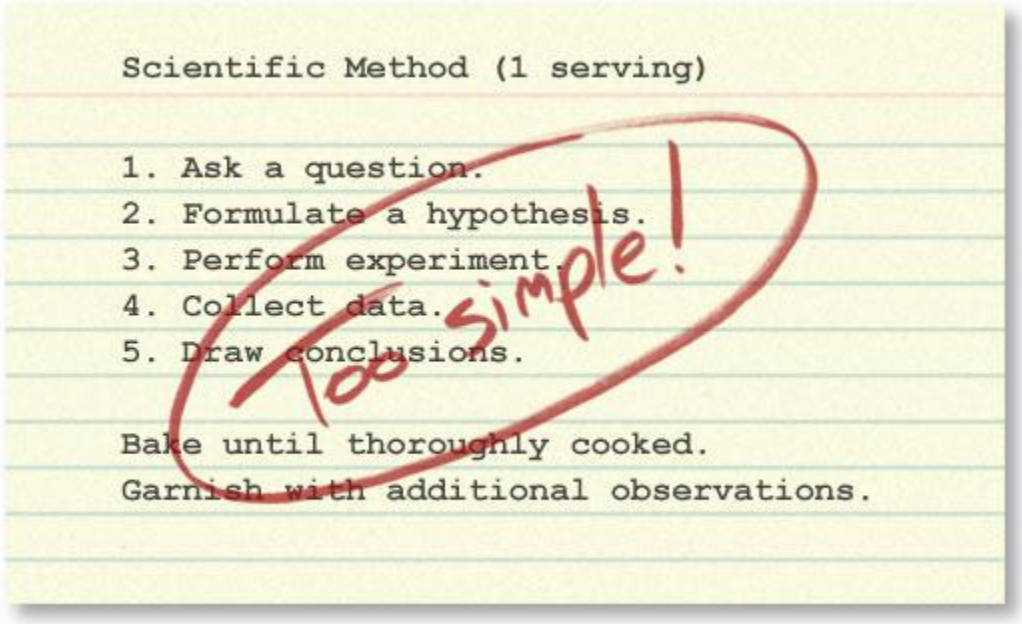
1. L. Bao, T. Cai, K. Koenig, K. Fang, J. Han, J. Wang, Q. Liu, L. Ding, L. Cui, Y. Luo, Y. Wang, L. Li, N. Wu (2009). PHYSICS: Learning and Scientific Reasoning Science, 323 (5914), 586-587 DOI: **10.1126/science.1167740**
2. Vincent-Ruz, P., & Schunn, C. D. (2018). The nature of science identity and its role as the driver of student choices. *International journal of STEM education*, *5*(1), 1-12.

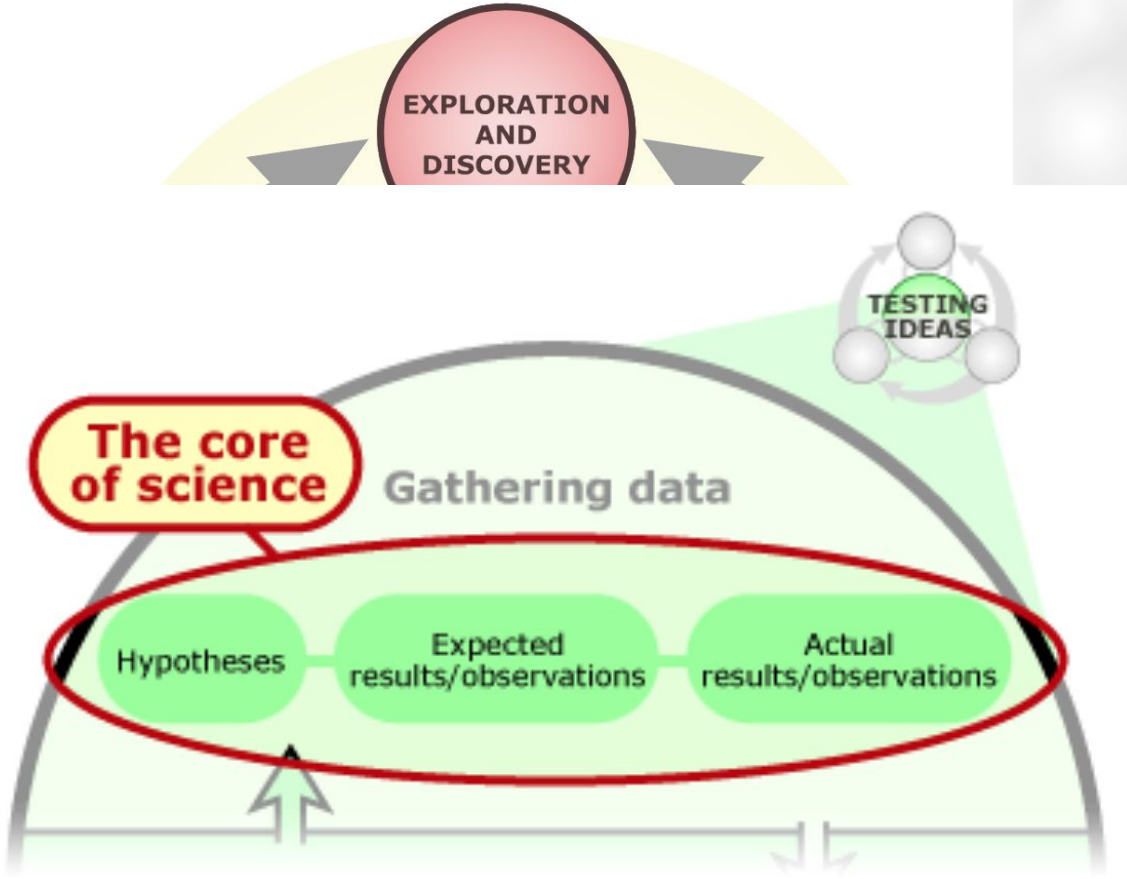
Implementing Reasoning:



https://www.researchgate.net/profile/M-Tarbell/publication/333061528/figure/fig2/AS:787157769801731@1564684445486/Where-AI-stands-today-Then-a-miracle-occurs-C-Sidney-Harris-in-American-Scientist.png

Representing Reasoning: Understanding Science





https://undsci.berkeley.edu/understanding-science-101/how-science-works/
https://undsci.berkeley.edu/science-flowchart/

Representing Reasoning: 3 Ps

BIOQUEST CURRICULUM CONSORTIUM

- Problem Posing
- Problem Solving
- Peer Persuasion

Representing Reasoning: Vision & Change

Core Competencies and Disciplinary Practices

- Ability to apply the process of science
- Ability to use quantitative reasoning
- Ability to use modeling and simulation
- Ability to tap into the interdisciplinary nature of science
- Ability to collaborate and communicate with difference disciplines
- Ability to understand the relationship between science and society

Representing Reasoning: Vision & Change

Table 2.1: Core Competencies and Disciplinary Practices. A competency-based approach to undergraduate biology education focuses on demonstrating analytical, experimental, and technical skills as measurable outcomes of student learning. Biology literacy is defined primarily in terms of acquired competencies, demonstrated within the context of fundamental biology concepts.

Core Competency	Ability to apply the process of science	Ability to use quantitative reasoning	Ability to use modeling and simulation	Ability to tap into the interdisciplinary nature of science	Ability to communicate and collaborate with other disciplines	Ability to understand the relationship between science and society
Instantiation of Ability in Disciplinary Practice	Biology is an evidence-based discipline	Biology relies on applications of quantitative analysis and mathematical reasoning	Biology focuses on the study of complex systems	Biology is an interdisciplinary science	Biology is a collaborative scientific discipline	Biology is conducted in a societal context
Demonstration of Competency in Practice	Design scientific process to understand living systems	Apply quantitative analysis to interpret biological data	Use mathematical modeling and simulation tools to describe living systems	Apply concepts from other sciences to interpret biological phenomena	Communicate biological concepts and interpretations to scientists in other disciplines	Identify social and historical dimensions of biology practice
Examples of Core Competencies Applied to Biology Practice	Observational strategies Hypothesis testing Experimental design Evaluation of experimental evidence Developing problem-solving strategies	Developing and interpreting graphs Applying statistical methods to diverse data Mathematical modeling Managing and analyzing large data sets	Computational modeling of dynamic systems Applying informatics tools Managing and analyzing large data sets Incorporating stochasticity into biological models	Applying physical laws to biological dynamics Chemistry of molecules and biological systems Applying imaging technologies	Scientific writing Explaining scientific concepts to different audiences Team participation Collaborating across disciplines Cross-cultural awareness	Evaluating the relevance of social contexts to biological problems Developing biological applications to solve societal problems Evaluating ethical implications of biological research

https://visionandchange.org/wp-content/uploads/2013/11/aaas-VIShange-web1113.pdf

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Breakout Discussion on Teaching Reasoning

What are some other representations of reasoning that you use?

How do you evaluate a curriculum resource to see if it fosters reasoning?

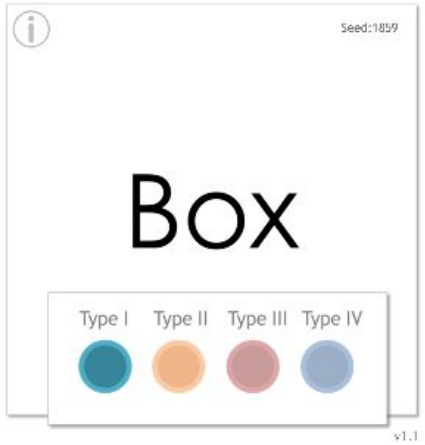
How do you foreground reasoning in your assignments?

How do you evaluate students reasoning skills?

Breakout Discussion on Teaching Reasoning

Quick debrief and sharing.

One Place to Start



Mystery box puzzle for model based reasoning

Author(s): Sam S Donovan[1], Pravin Muthu[2]

1. University of Pittsburgh 2. Emory University

Collect

Watch resource

Summary:
This is a computer based problem solving activity that I use to engage introductory biology students with discussions about model based reasoning.

https://qubeshub.org/publications/2767

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Why Alternative Assessments are Better

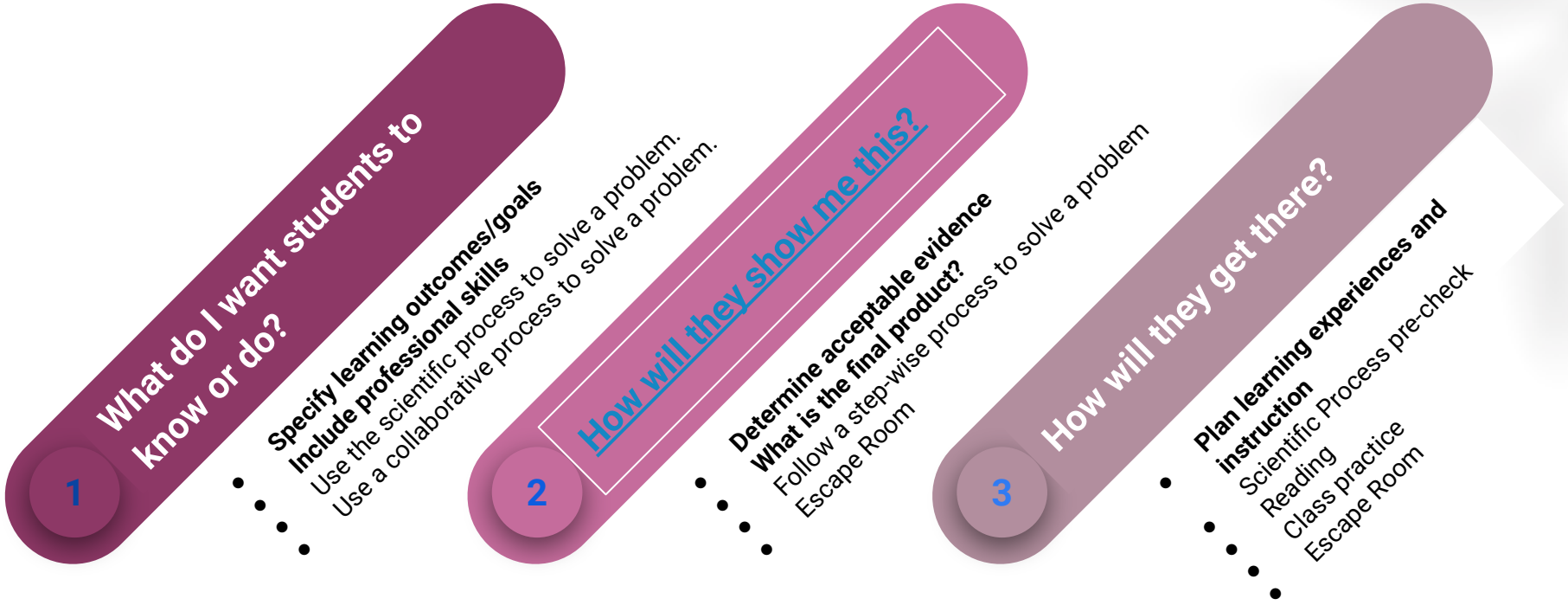
- learning outcomes-focused
- non-content & metacognitive student competency
  - information processing
  - problem-solving
  - critical thinking
  - collaboration
  - communication
- engaging!

Types of Alternative Assessments

- Peer/self-assessment
- Authentic experiences
  - professional practice
  - social context
  - physical context
  - evidence
  - criteria/standards
- Creative Works

Traditional Assessment	vs.	*Alternative Assessment*
one-shot standardized exam		continuous and longer-term
timed (pressured)		untimed
decontextualized items		contextualized for communication
scores mistaken for feedback		feedback driven / revision opportunities
right answer-focused		process-focused
summative		formative
non-interactive		interactive
extrinsic motivation		intrinsic motivation

Backwards Design



We are not in a Vacuum!

Let's communicate!

	Proficient	Progressing	Beginning	Entry	Insufficient
Answering posted questions or shares perspectives (Comprehension)	Critically understands the depth of issues found in the situation/material by expanding on the topics and explaining the significance in a professional manner. Correctly addresses each side by summarizing each sides' stance and justifies their personal position.	Comprehends the breadth of issues found in the situation/material by thoroughly explaining the topic(s) and their personal position.	Identifies the basics of the information in the situation/material by briefly mentioning or listing topics as they state their personal position.	Misunderstands the situation/material by presenting ideas or definitions that are flawed or incorrect and/or only responds with a short and direct personal position.	Does not respond.
Additional Article (Critical Research)	Links to a primary scientific source (journal article). Names the source of the material and author. Shows mastery in identifying the qualifications of an appropriate source (specific credentials, prior papers, published in a peer reviewed journal, time spent in profession) and examines any biases (has a financial stake in the outcome).	Links to a secondary source (news article or blog style website). Names the source of the material and author. Identifies source's qualifications (relevant credentials, prior work, or time spent in profession) and examines any biases (has a financial stake in the outcome or publication).	Links to a secondary source (news article or blog style website). Names the source of the material and author. Superficially identifies source's qualifications (reputation of source) or examines any biases (has a book to sell or gets advertiser money from article's adds).	Links to a secondary source (news article or blog style website). Names the source of the material and author.	Does not provide a link and/or state the source of the resource. (it's a package deal).
Additional Article (Reflective Summary)	Thoroughly describes/summarizes the resource's content and explains its importance/relevance.	Thoroughly describes/summarizes the resource's content.	Lists (3 or more) general topics from the resource.	Identifies 1 or 2 general topics discussed in the resource.	Keeps the content of the resource a secret.
Relate to the course concepts (Clarifying Understanding)	Explains how key concepts connect to the chapter and how this information will be important to the student moving forward.	Explains how key concepts connect to the chapter.	Identifies key issue(s) from the chapter but does not explain the relationship and/or significance.	Incorrectly explains and or identifies key issues.	Does not raise key issues.
This criterion is linked to a Learning OutcomePost a question (Clarifying Questions- Quality)	Offers a question with the core of a scientific hypothesis or results from extended thought and synthesis of information.	Question seeks more information than is available in the textbook or for which the answer is a functional explanation.	Asks about a simple or complex definition, concept, or fact that could be looked up in the textbook.	Question requires only a simple answer, does not make logical or grammatical sense, or is based on a basic misunderstanding or misconception.	Does not ask question.
Student Response (Finding Significance)	Extends the conversation by responding to two students and suggests possible consequences and implications of the topic.	Extends the conversation by responding to two students and identifies the significance of the information.	Responds to one or two students and reflects back on the information provided without offering new information. e.g. Student says "I agree", "I learned about", or "That was fascinating" and repeats the topic without any extended discussion.	Responds to only one student or a response contains inaccuracies or oversimplification in how the information is discussed.	Does not respond to anyone.
Spelling and Grammar	(0 Points) 0 - 2 spelling / grammar issues.		(-1 Points) 3 or more spelling / grammar issues.		

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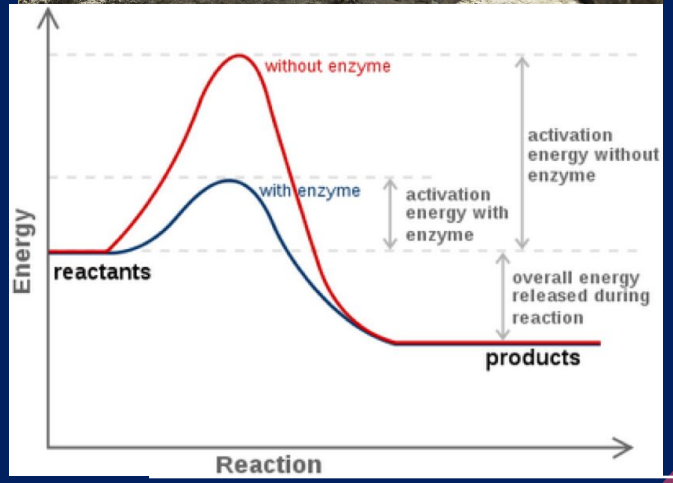
What I've Learned



- People are creatures of habit
- Energy investment hump
- I can lead a horse to water...

Benefits of Rubrics

Improved communication of expectations and assignment goals

Faster, more accurate, unbiased, and more reliable scoring of student work

Less time spent writing individual comments also leads to better student feedback

Improved (and easier) assessment of assignment/students' strengths and weaknesses

Different types of rubrics

Descriptive rubrics

Sample 5: Literature Essay Exam						
	Excellent 5	Very Good 4	Adequate 3	Marginal 2	Inadequate 1	Score
Position	Student takes defensible position that does not merely state the obvious or parrot one of the readings	Student takes defensible position that is somewhat obvious or closely paralleled one of the readings	Student takes a defensible position that states the obvious or simply paraphrases one of the readings	Student takes a defensible position that is ambiguous, carelessly stated, or must be inferred	Student does not clearly state a position or the position is not defensible or is irrelevant	
Support	Support for the position is imaginative, thorough, relevant, and clearly stated; includes all relevant evidence	Support is thorough, but evidence may not be smoothly integrated; includes most relevant evidence	Support is adequate; some evidence is inaccurate; may omit some relevant evidence	Support is barely adequate; omits major relevant evidence from the readings	Support is absent or slim; textual references are inaccurate or unrelated to the writer's point	
Alternative points of view	Acknowledges and accurately summarizes all alternate points of view thoroughly and creatively	Acknowledges and mostly accurately summarizes most alternate points of view	Acknowledges at least one alternate point of view; summary is substantially accurate	Acknowledges at least one alternate point of view; summary is substantially inaccurate	Acknowledges no alternate points of view	
					Total Score	

Holistic rubrics

Sample 6: Graphics Design Portfolio	
Level 5	Excellent. Level 5 work clearly differentiates itself from other work and requires extra effort. It has memorable impact and pursues concepts and techniques above and beyond what is discussed in class. Content is exceptional with outstanding critical thinking, superb formal mediation of the concept, and impeccable craft. Ideas are original, thoughtful, and imaginative.
Level 4	Good. Level 4 work is good/very good and requires extra effort. Impact is good. Work demonstrates an ability to pursue ideas and suggestions presented in class and work with extra effort to resolve required projects. Content is good. Work demonstrates better than average design sensitivity. Methods are good, demonstrating an understanding and utilization of process.
Level 3	Satisfactory. Level 3 work is average and competent. Work has fulfilled the requirements of the project, has acceptable levels of impact, conceptual development, and visual interest. Content is sufficiently developed. Work doesn't demonstrate the additional effort needed to excel. Lacks thoughtful, original, and imaginative resolution or attention to detail and craft.
Level 2	Below Average. Level 2 work is lacking in many or most areas that show any understanding of design. The impact is weak with unsound, unoriginal, or unimaginative thinking. There is a lack of understanding of general design principles including form, typography, or image making. Problems may include lack of interest, procrastination, poor planning, and poor craft.
Level 1	Unacceptable. Level 1 work shows no overall understanding of the assignment on many levels. Work shows a severe lack of interest. Work that is so substandard that the project holds few if any redeeming characteristics.

Rating scale rubrics

Sample 4: Information Literacy Assignment						
	Excellent 5	Very Good 4	Adequate 3	Marginal 2	Inadequate 1	Score
Identify, locate, and access sources of information	Δ	Δ	Δ	Δ	Δ	
Critically evaluate information, including its legitimacy, validity, and appropriateness	Δ	Δ	Δ	Δ	Δ	
Organize information to present a central idea supported by relevant material in a logical order	Δ	Δ	Δ	Δ	Δ	
Clearly articulate information and ideas	Δ	Δ	Δ	Δ	Δ	
Use the work of others accurately and ethically	Δ	Δ	Δ	Δ	Δ	
					Total Score	

Checklist rubrics

Sample 2 Laboratory Practices	
	Did the student wear goggles?
	Did the student follow all safety procedures?
	Did the student clean up at the end of the lab?

Sample 3 Student Self-Assessment	
	Have I proofread my paper?
	Does my bibliography use proper formatting conventions?
	Did I include at least eight references?

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How are rubrics created?

STEP 1: DEVELOP A LIST OF CRITERIA

STEP 2: CREATE PERFORMANCE LEVELS

STEP 3: ARTICULATE PERFORMANCE DESCRIPTORS

STEP 4: USING RUBRICS FOR GRADES

STEP 5: REVIEW AND REVISE

Step 1: Develop a list of criteria

Questions to consider in step 1:

- Why are we giving students this assignment?
- What do we want students to learn by completing it?
- What are the knowledge and skills we want students to demonstrate in this assignment?
- What are the characteristics of good student work?
- What are the characteristics of good writing, a good presentation, or a good lab report?
- What specific characteristics do we want to see in completed assignments?

Use between 3 and 8 criteria.

Ensure that each criteria is only assessing one element.

Each criterion should be expressed using concrete terms and action verbs.

Step 2: Create performance levels

Exemplary, adequate, almost there, inadequate

Possible performance level terms:

- Exceeds standard, meets standard, approaching standard, below standard
- Complete evidence, partial evidence, minimal evidence, no evidence
- Excellent, very good, adequate, marginal, inadequate

Effective rubrics should have between four and five performance levels. If more than five levels are established, instructors may struggle to differentiate between the various levels.

Step 3: Articulate performance descriptors

What kind of work merits scoring a student's work for this criterion at this level?

Do: Use descriptions rather than judgments

Don't: Use vague or overly-subjective language

For example, "uses good grammar" is less clear and more subjective than "contains no grammatical errors." The latter expression is a much more effective descriptor.

Include student examples

Have a colleague review your rubric. Do they have any suggestions?

Step 4: Using Rubrics for Grades

Weighing the Criteria

More important criteria should be given more weight

Aligning Performance Levels to Grades

Converting rubric results to letter grades can be difficult because the point values of performance levels do not align to the intended letter grade equivalent.

Step 5: Review and revise

- Take a moment and appreciate what students got right
- Then, review the assessment results to see where students struggled
  - Can the directions or performance descriptors be clearer?
  - Would adding a student example help?
  - Should the point values be adjusted?
  - Could the assignment be scaffolded/broken down into a couple parts?

Bonus Step 6: Continue to review and revise

Did you:

- sufficiently convey expectation parameters, yet allow for creativity and unique perspectives,
- ensure that the descriptors are positive, informative, or clinical rather than negative or critical, and
- ensure that all terms and expectations are unambiguously defined, and
- ask your students what they think?

Did you norm your rubric?

Create Your Own Rubric Using a VALUE Rubric

https://www.aacu.org/initiatives/value-initiative/value-rubrics

https://facultydae.waubonsee.edu/instruction/assessment/institutional-learning-outcomes