TRESTLE Scholars Community Spring 2019: How can we develop and use illuminating classroom assessments?

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About the group

Facilitators

Erin Furtak (School of Education) and Stephanie Chasteen (Center for STEM Learning).

Erin Furtak is a Professor in the School of Education, and her research examines effective use of formative assessment practices in science and math classrooms. Stephanie Chasteen is an experienced faculty developer and researcher, focusing on supporting faculty in incorporating evidence-based practices into their teaching.

Group description

Are you lost in the sea of possible assessments of student learning? Are you struggling to fit together different assessments to understand where your students are at? Do you want some tools for considering whether your assessments are hitting the mark that you want? In this semester, we will work to establish a coherent framework for designing, enacting, and reflecting on data collected from classroom assessment (such as homework, exams, classroom discussions, and on-the-fly questions), and discuss how a variety of such assessments can best be used to answer your questions about student learning. You will develop assessments, get feedback on them, and use tools to think critically about your existing assessments.

Group members

1. **Rebecca Machen**, Student Academic Success Center.
2. **Harrison Stalvey**, Mathematics.
3. **Heidi Day**, Psychology and Neuroscience.
4. **Lizzy Trower**, Geological Sciences.
5. **David Budd,** Geological Sciences.

Other attendees

(Participated but not for the entire semester)

6. **Pam Harvey,** Molecular Cellular and Developmental Biology.
7. **Chris Aquinto,** Student Academic Success Center.
8. **Cheryl Pinzone**, Ecology and Evolutionary Biology.

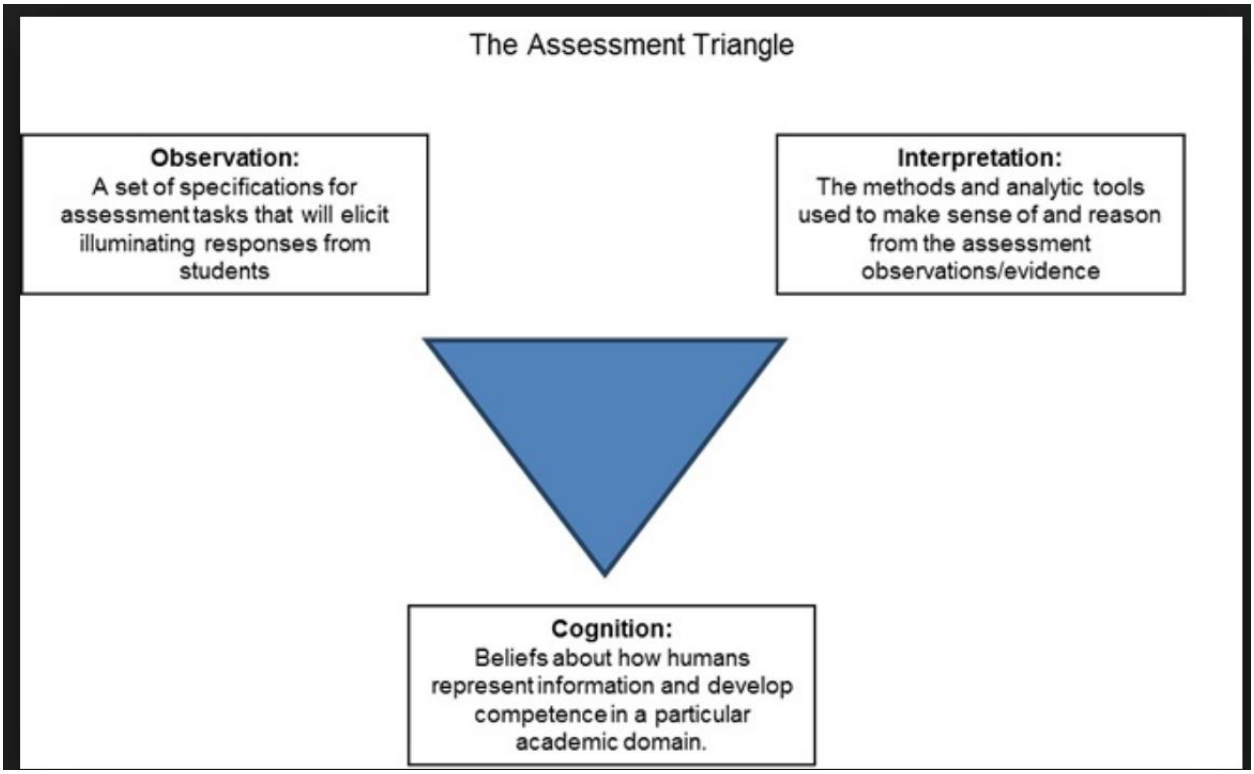
Meeting agendas

All meeting agendas and materials are in the shared Google Drive Folder. Access granted upon request.

1. Jan 22: **Introduction.** What are we doing together this semester and what are your needs?
2. Jan 29: **The Assessment triangle and learning goals**. What are we trying to do when we're assessing student learning?
3. Feb 12. **Techniques:** What types of assessments can we design, use, or adapt to align with these goals?
4. Feb 26. **Exploring alignment between assessments, course goals, and interpretive frameworks.** What can I discover by analyzing one of my own assessments?
5. Mar 19. **Grading and feedback.** How can we efficiently give feedback to students which they actually use to further their learning?
6. Apr 9. **Data party!** What can we learn about student thinking, and how can we inform our own instruction, through careful and collaborative analysis of student work?
7. Apr 16. **Thinking about assessment as participator**y. What are the participatory structures I'm going to build to support student learning?
8. Apr 30. **Wrap-up and next steps.**

Worksheets and frameworks used by the group

The assessment triangle



Assessment task feedback

1. What is your specific learning goal?
2. How does the task align with your refined learning goal/s?
3. In what ways could students misinterpret questions on the task, leading to situations where:

a. Students get the item right for the wrong reasons (e.g. test-wiseness)?
b. Students get the item wrong even though they have the correct understanding/skill?
c. Students don't have sufficient scaffolding to provide information about what they know/are able to do?

4. How will you use the task to draw out student skills/thinking during class?
5. What are possible student responses that you anticipate getting to the questions on the task?

Data Party Protocol

Data Party Protocol (20 minutes)

We are gathered today to take advantage of the multiple perspectives of each of us in the room for the purposes of providing insights and interpretations about a subsample of student work.

Our goal is to figure out what the student understands and what some next steps might be in helping the student learn and demonstrate his/her learning. To that end, we provide this protocol - which is based upon research about instructors looking at student work together - to structure our analysis of student work.

1. The presenter sets the context, describing goals, learning activity and assessment. (2-3 minutes).

2. The group describes what they see in the students' work, discussing each piece of student work in turn. Begin with observations about the student work before making inferences and interpretations. Don't be uncomfortable with silences. The presenter should keep track of the comments people make, but does not participate in the discussion except to respond to clarifying questions that arise in the course of examining the student work. (5-7 minutes)

3. The group discusses "next steps" for each student and suggests strategies for providing additional experiences and gathering additional information about the student's developing understanding. It may be useful to consider next steps for instruction on multiple timescales, as described below (5 minutes):
    - (Retrospectively) if you could have responded to the student within 5 seconds?
    - (Retrospectively) If you could go back and act in the next 5 minutes?
    - Tomorrow?
    - Next week?
    - When I move into the next instructional module this year?
    - When I teach this again next year?

4. The group reflects on the discussion. What insights, questions, issues did the discussion raise for participants? How can we improve the process? (5 minutes)

Participant reflections

David Budd

1. Cognition: What were my goals for participation in this group?

My goal was to be more thorough in formative assessments, particularly at the end of the term as students in the past expressed a lot of confusion with the material. By thorough, I mean designing and implementing formative assessments that will inform me of where students are as we work thorough content and do in-class activities. I wanted to develop data to better inform me as to student thinking so that I can revise the activities I use -- i.e., make them more effective in addressing the problem students have with the material.

2. Observation: What are the tasks that you engaged in, which can provide evidence as to whether your goals were achieved? Which of these were most useful tasks for you?

Main activity was develop a assessment of students ability visualize geometries and stacking patterns within sequence stratigraphic paradigm and to relate those spatial attributes to the drivers (rates and directions of change in accomodation space).

Some of the readings (especially on assessment triangle and *Question Design Patterns* to be particularly enlightening as I decided how to proceed. Obvious group discussions too.

3. Interpretation: In what ways were your goals achieved or not achieved? What tasks in the future will help you to further achieve your goals?

I designed and implemented 2 formative assessments (only shared out one of them) -- the first was after we had worked the material and it should be that 85% of the class had the concepts nailed. Great -- I take that to mean what we did between the lecture and assessment worked.

2nd (shared on the 30th) was far more involved and showed me that a large portion of the class was not able to string multiple concept related to the content together. Clearly I need to make changes for next year:

- I needed to be more aggressive in providing feedback on activities
- I probably need more scaffolding of activities
- Would be good to use an activity like the one I designed early (after intial introduction of the material), then again late in the the unit so as to measure gains and build student efficacy.

4. Reflection and Take-away: What was your biggest a-hah moment, or thing you would like to take with you from the group to inform your practice?

Have to close the loop -- design, assess, analyze data, PROVIDE FEEDBACK TO STUDENTs, and revise for next time. I was doing poorly on the feedback to students, and was iffy on formative assessments (too much focus on implementing activities without determining if they worked and what they revealed).

Harrison Stalvey

1. Cognition: What were my goals for participation in this group?

My original goal was to explore how active learning activities can be used as a formative assessment to track student learning.

2. Observation: What are the tasks that you engaged in, which can provide evidence as to whether your goals were achieved? Which of these were most useful tasks for you?

I developed a short formative assessment on inverse trigonometric functions with the intention of administering the assessment prior to students having any formal instruction on the topic. The reason behind giving the assessment prior to any formal instruction is to get students' authentic ways of thinking about prerequisite concepts and applying their knowledge to a concept they have not seen before. The assessment, which is multiple choice, might seem as though it would only tell me whether students get the right answer, but having the questions set up as tiered co-dependent multiple choice allows me to gain further insight into their reasoning behind their answers. Without the literature that we read in TRESTLE, I would have never thought of this type of tiered multiple choice format. Furthermore, the group discussions encouraged me to extend my assessment and add a free-response item ("tell me more"), as well as assign short reflections outside of class.

3. Interpretation: In what ways were your goals achieved or not achieved? What tasks in the future will help you to further achieve your goals?

When I wrote my original goal, I was curious about how my observations of students' group discussions can inform my teaching. I have learned now that my day-to-day observations in combination with real, recorded data can be more powerful than each of these tools alone.

4. Reflection and Take-away: What was your biggest a-hah moment, or thing you would like to take with you from the group to inform your practice?

My biggest a-hah moment was realizing that the practices of collecting and interpreting data in terms of a theory of cognition are not limited to research for publication. Instructors can use research practices to inform their teaching on a day-to-day basis.

5. Other: Any other public comments?

It was an honor to have had the opportunity to learn about innovative ways to assess students' learning. Thank you to everyone in the TRESTLE group for your support and valuable feedback.

Heidi Day

1. Cognition: What were my goals for participation in this group?

I originally wanted to develop a series of new assessments for NRSC 4132 (Neuropharmacology) that would be more reflective pieces of work, that would allow students to investigate neuropharmacological issues outside of the classroom, and away from the dense and sometimes difficult learning associated with the lectures/regular exams.

2. Observation: What are the tasks that you engaged in, which can provide evidence as to whether your goals were achieved? Which of these were most useful tasks for you?

a. I did not have learning goals for this part of the course initially (as this was not an assessment for the course the first time I taught it). So, the first step was to develop learning goals for the three reflective assignments. Within the TRESTLE group, I focused on one of these three assignments, and the goals posted are specific for this assignment.

b. The readings provided through the group were helpful in determining the specific assessment that I developed within the group setting. The inspiration for this assessment came from reading about authentic assessments.

c. The group discussions were sometimes very helpful, and sometimes less so, depending on the day/grouping. I personally found the whole group discussions more useful than discussing with just one or two people. The "data party" was surprisingly helpful.

3. Interpretation: In what ways were your goals achieved or not achieved? What tasks in the future will help you to further achieve your goals?

My goals were achieved for this semester, in that I did create learning goals and an assignment. However, like all teaching, this is an iterative process, and I learned a lot from student responses. Student writing was very variable in terms of quality, and I will probably update the learning goals to include a writing goal (in italics in the current learning goals), where students perhaps apply a "claim-data-warrant" style of critical reasoning, and must follow a specific citation style in their written responses.

I also asked for feedback from students at the end of the semester. Feedback from students showed that they appreciate choice. I will probably adapt this assessment to provide choice between drugs (say psilocybin versus tetrahydrocannabinol).

I may also develop a rubric for the assessment. This would help with grading, and would provide additional structure and guidance for students.

4. Reflection and Take-away: What was your biggest a-hah moment, or thing you would like to take with you from the group to inform your practice?

I'm not sure if it was an a-hah moment, are just further confirmation of something I've observed from other groups where faculty from different departments meet to improve their teaching. But it's incredible how useful it is to get people's point of view, particularly when they have a different

background. I was surprised how helpful the data parties were. I initially thought it would be less useful to have people with no background in the field look at data from other disciplines. But as a group, I think we were able to provide useful feedback, despite a lack of discipline knowledge, or maybe even because of the lack.

Lizzy Trower

1. Cognition: What were my goals for participation in this group?

Learning how to be more strategic and thoughtful about assessment design, particularly for assessments that can be used sustainably and effectively for large classes.

2. Observation: What are the tasks that you engaged in, which can provide evidence as to whether your goals were achieved? Which of these were most useful tasks for you?

I developed and refined a set of learning goals for the final unit of my class and developed and refined an assessment in the form of exam questions to implement. Although the timing of this exam was too late to analyze student responses, the readings and discussions about rubrics have been very helpful and I've worked on implementing those into evaluating other assignments in my course this semester. The whole exercise of applying concepts from readings and discussions to create real materials for my class has been helpful since I've had to work through all the challenges of implementation.

3. Interpretation: In what ways were your goals achieved or not achieved? What tasks in the future will help you to further achieve your goals?

I think my goal was achieved in that I now feel like I have a strategy to apply in the future. It has been illuminating to realize that the process of assessments can and should be iterative and that collecting and interpreting student responses is an important part of the process - i.e., that I may learn something about their learning that was unexpected. In the future, I think I will benefit from continuing to work on refining more specific learning goals for different components of my course and setting goals to iterate.

4. Reflection and Take-away: What was your biggest a-hah moment, or thing you would like to take with you from the group to inform your practice?

Although I wasn't able to implement it directly into the assessment I developed here, the materials and discussion on different types of rubrics were really helpful for me - in particular, the realization of the value in developing the right kind of rubric, the level of detail, etc. - that is both more valuable to the students in providing a means for individual feedback (without me having to write individual comments) and for me in terms of grading more efficiently and consistently and being able to better analyze student performance. Although I still have plenty of room for improvement, I started applying more detailed and thoughtful rubrics to other assignments in my course and I have definitely received fewer students questions/complaints and feel like I've been able to use them to review student work more efficiently.

Rebecca Machen

1. Cognition: What were my goals for participation in this group?

I wanted to participate in this group for two reasons: to improve my teaching through the creation of learning goals and assessments, and to get ideas I could share with my faculty so they would restructure their courses based on learning goals.

2. Observation: What are the tasks that you engaged in, which can provide evidence as to whether your goals were achieved? Which of these were most useful tasks for you?

I was asked to create learning objectives for my precalculus course, and I can use those moving forward. The learning objectives set a foundation for the assessments in my course, so I plan to create more assessments this summer to fit with what I want students to learn in the course. The most useful task was creating an assessment and then getting feedback from my peers, particularly the math folks. It gave me insight into where I might be making assumptions about what students know and how they interpret the language I use on assessments.

3. Interpretation: In what ways were your goals achieved or not achieved? What tasks in the future will help you to further achieve your goals?

I achieved one of my goals regarding my personal teaching. I am striving to achieve the second goal this summer. I had asked my faculty to write up learning objectives before leaving for the summer, and I will be going through their work and modifying it prior to the start of the fall semester.

4. Reflection and Take-away: What was your biggest a-hah moment, or thing you would like to take with you from the group to inform your practice?

I think the biggest a-ha moment was the assessment triangle. Now, when I am creating anything for my class, I can look back at the triangle and figure out if it is supporting my intended course goals.

5. Other: Any other public comments? (You will be given an anonymous feedback survey on the group later).

This group was energizing for me, and overall, it reinforced that good teaching is recursive. I have been teaching for more than 10 years, and I always learn something new when I am around other educators.

Participant Developed Assessments

David Budd: Formative in-class activity to assess ability to distinguish visual relationships in geology.

Harrison Stalvey: Pre-assessment activity to identify student ability to understand functions for precalculus.

Heidi Day: Authentic assessment take-home activity for assessing student critical thinking skills in neuropharmacology.

Lizzy Trower: Summative exam questions to assess student abilities to defend a claim in geology.

Rebecca Machen: Summative exam to assess student ability to evaluate and understand logarithmic and exponential functions in precalculus.

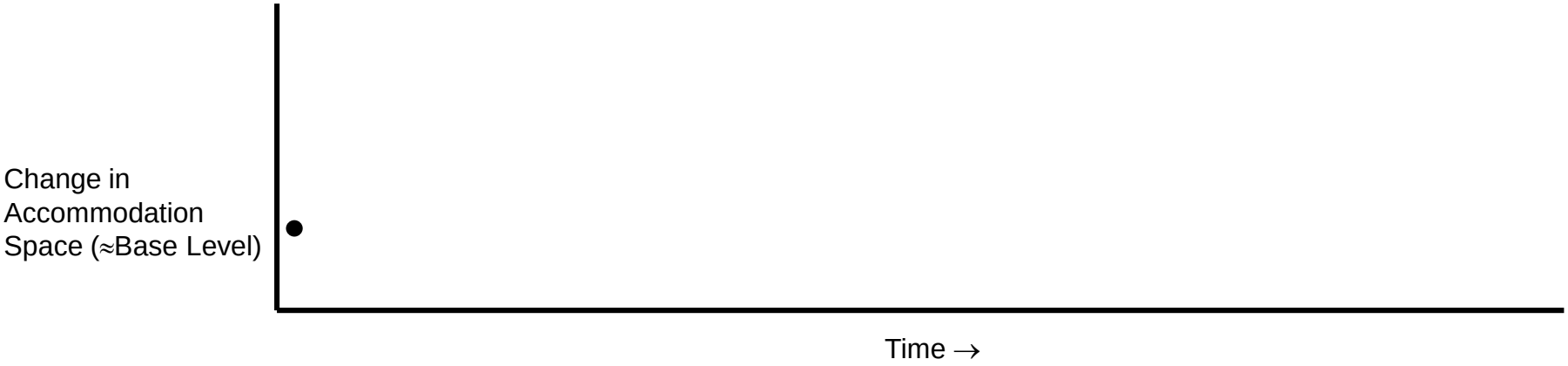
Assessments and learning goals follow in this order.

Learning goals to assess (formative via in-class activity – students working alone and without their notes

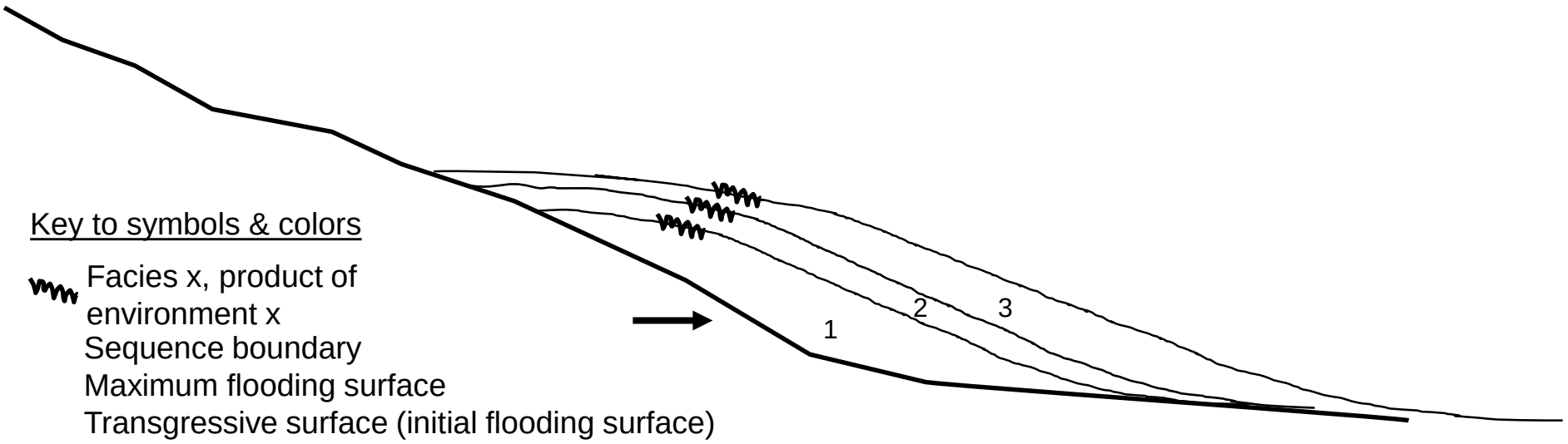
Learning Goals Assessed

Diagram depositional stacking patterns and their relation to changes in accommodation space & base level and development of the corresponding types of systems tracts.

Compare and contrast the attributes of low stand, transgressive, and high stand systems tracts (attributes to consider: lateral stratal geometries, parasequence stacking, relative grain size trends and differences, evidence of erosion, and condensation).



Worksheet



Key to symbols & colors

Facies x, product of environment x
Sequence boundary
Maximum flooding surface
Transgressive surface (initial flooding surface)

Draw the parasequence boundaries (time lines) associated with the following scenario. Answer the interspersed questions on the back of the worksheet.

1. Based on the initial givens (geometries, and position of facies xxx), the initial parasequences represent what systems tract?
2. Explain the evidence that lead you to that conclusion.

- Now draw in two parasequences that represent a forced regression (forced progradation).
- Add where you predict (project) the location of facies xxx atop each of your two new parasequences (if you want label them 4 and 5).

3. A rise in accommodation space follows. What type of systems tract will form next?

- Add that new systems tract to the figure. Show it by depicting the geometries of 3 successive parasequences (if you want, label them 6, 7, 8).
- Add where you predict (project) the location of facies xxx atop each of these 3 new parasequences.

4. What type of stacking pattern did you illustrate with your placement of those 3 new parasequences (#s 6, 7, 8) and the 3 occurrences of facies xxx?
5. If the rate of rise had been superfast, how might your depiction of parasequences 6, 7, 8 and their associated facies xxx have been different?

- At the top of the page, in the graph area, start at the dot and draw a line that depicts how accommodation space has changed through formation of parasequences 1 to 8. Label the position on the curve where each of the 8 parasequences formed, and put a tick mark at the boundaries between 3 and 4, and 5 and 6.

6. The rate of which accommodation space is formed then decreases (but some space is still forming). So what systems tract forms next?

- Draw in the location and geometries and location of facies xxx in 2 new parasequences (#9, 10) that represent this new systems tract.

- WOW – base level next falls dramatically to the level of the black arrow on the diagram. And it falls so rapidly, there is no deposition of sediments during the fall.

- Given that fall in base level and the reduction of accommodation space, draw a bold squiggly line where you predict erosion to occur on the top of parasequence 10.

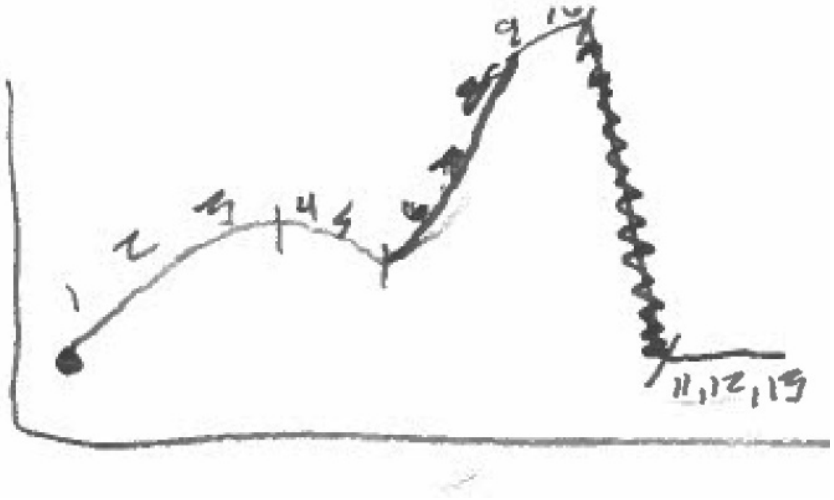
7. If there had been a period of time with a slow fall in accommodation before the rapid fall occurred, then additional parasequences probably would have formed. What systems tract would they have represented and what type of stacking pattern would you have depicted for it?

- And let's up date the graph at the top of the page. Extend the line that depicts accommodation space through time so that it includes the slow rate of accommodation formation that generated parasequences 9 and 10, plus the rapid fall in accommodation space that followed. Mark where 9 and 10 formed on the line, and where you predicted the erosion to have been forming.
- Then add a period of stable accommodation space (neither increasing or decreasing)
- Add three final parasequences (11, 12,13) and their associated facies xxx to the lower diagram. These three form during that period of stable accommodation space.

8. What type of stacking pattern did you illustrate with your placement of those 3 new parasequences (11, 12, 13) and their 3 occurrences of facies xxx?
9. What type of systems tract do these last 3 parasequences represent?

10. How many different parasequence sets do we now have on the diagram?

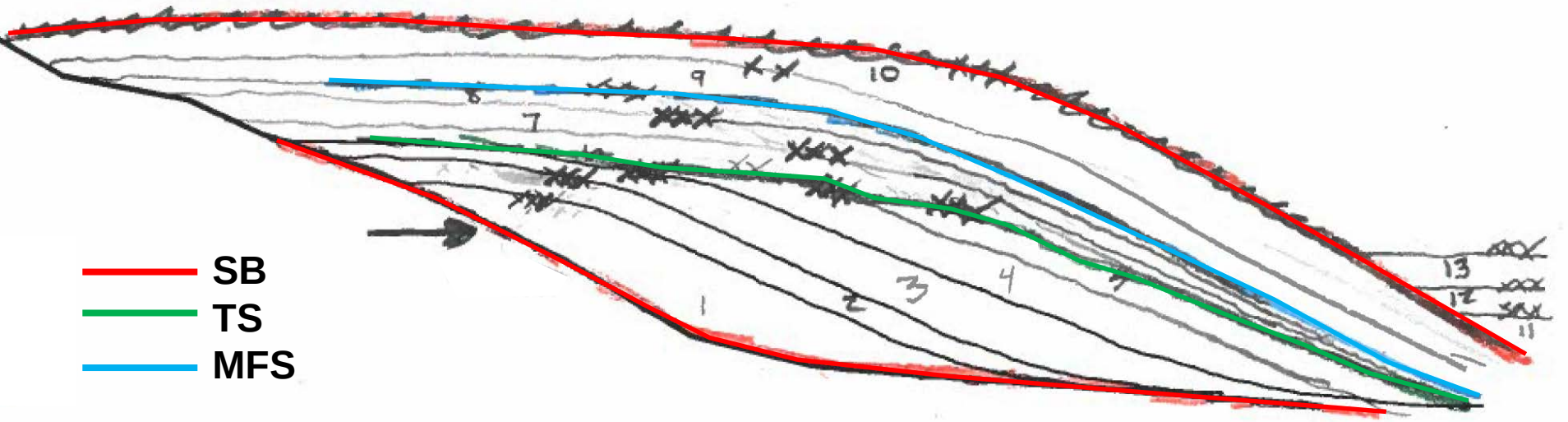
11. On the diagram, label the location of every sequence boundary in one color, maximum flooding surface in another color, and flooding surface (transgressive surface) in yet a 3rd color. Add to the "key to symbols & color" in the lower left what color goes with what type of surface.



1. Early HST
2. Both onlap & downlap + position of successive facies xxx shows up and out trend (normal progradation)
3. TST
4. Retrogradational (up and back)
5. A lot less up, a lot more back

6. Early HST
7. Late HST, forced progradation – out, or out and down.
8. aggradation
9. LST
10. 4

"Answer"



RUBRIC – highlighted are class averages (normal distribution, slight negative skewness, poor kutosis)

DRAWING

Stacking patterns

0 – none shown;	1 – patterns mostly incorrect	2 – patterns mixed in trend	3 – patterns nearly all correct	4 – correct with both back and out components

Geometries

0 – none shown;	1 – patterns mostly incorrect mounding; vertical stacking	2 – patterns mixed	3 – patterns nearly all correct (probably just no fall	4 – correct with onlaps downlaps & offsets

ACCOMODATION PLOT

Initial eHST rise (1-3), late HST fall (4-5), TST rise (6-8), eHST rise (9, 10), fast and deep fall, stable (11-13)

0 – none shown;	1 – trends/slopes mostly incorrect	2 – trends/slopes mixed	3 – trends/slopes nearly all correct	4 – trend/slope of all 6 components correct
0 – no labels	1 – PS placements mostly incorrect	2 – PS placements mixed	3 – PS placements nearly nearly all correct	4 – PS placements correct

Written responses

Identify the systems tract 1-3 (early HST), 6-8 (TST), 9-10 (early HST), late HST, LST (11-13) – Q1, 3, 6, 7, 9

0 – all 5 wrong	1 – 1 of 5	2 – 2 of 5 correct	3 – 3 of 5 correct	4 – 4 or 5 correct

Explain why givens are (Q1 answer) - Q2 - There is onlap, downlap, and normal progradation (up and out) - (score 0, 1, 2 –few listed laps)

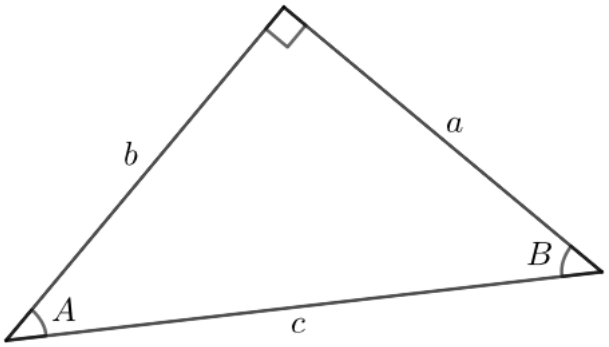
Explain alternative stacking (Q5) – more back and less up - (score 0, 1, 2) – landward common, but so was thicker

MATH 1151 – Precalculus Supplemental Lab
Inverse Trigonometric Functions Learning Goals

1. Distinguish between the types of measurable mathematical objects (angles versus ratios of lengths) whose values are the inputs and outputs of trigonometric functions and inverse trigonometric functions.
2. Compute the output of inverse trigonometric functions at particular input values using the notions of domain, range, reference angles, and coterminal angles, in combination with the unit circle.
3. Describe the various considerations that need to be made when computing the output of an inverse trigonometric function (e.g., domain, range, reference angles, coterminal angles, unit circle).
4. Describe how inverse trigonometric functions fit into the general description of function. In particular, use the words *input*, *output*, *domain*, and *range* to describe how inverse trigonometric functions transform an input into a unique output.

MATH 1151 – Precalculus Supplemental Lab
Inverse Trigonometric Functions Pre-Assessment – Part 1

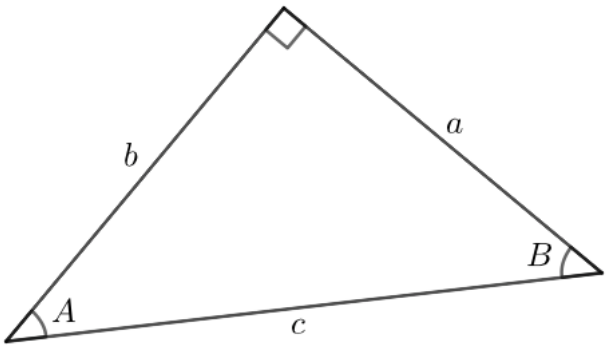
NAME: _____ **SECTION:** _____



1. Classify each of the following expressions (parts of which are referenced in the above figure) as an input, output, or neither for the sine function. Assume that no quantity in the figure is equal to 1.

I.	b	IV.	A	VII.	c
II.	B	V.	b/c	VIII.	a/b
III.	a/c	VI.	a	IX.	c/a

Inputs	Outputs	Neither



2. The arcsine function is the inverse of the sine function. That is, arcsine reverses the process of sine. Classify each of the following expressions (parts of which are referenced in the above figure, which is the same figure as in Question 1) as an input, output, or neither for the arcsine function. Assume that no quantity in the figure is less than or equal to 1.

I. b	IV. A	VII. c
II. B	V. b/c	VIII. a/b
III. a/c	VI. a	IX. c/a

Inputs	Outputs	Neither

3. Assume that the domain of arcsine is $[-1, 1]$ and the range of arcsine is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$. Compute $\arcsin\left(-\frac{1}{2}\right)$.

A. $\frac{11\pi}{6}$ B. $\frac{7\pi}{6}, \frac{11\pi}{6}$ C. $-\frac{\pi}{6}$ D. $\frac{7\pi}{6}$

Remember your choice. You will use it for Part 2 of this assessment.

MATH 1151 – Precalculus Supplemental Lab
Inverse Trigonometric Functions Pre-Assessment – Part 2

NAME: _____ **SECTION:** _____

4. Question 3 from Part 1 said that the domain of arcsine is $[-1, 1]$ and the range of arcsine is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$, and it asked you to compute $\arcsin\left(-\frac{1}{2}\right)$. Circle the answer that you previously chose.

   A. $\frac{11\pi}{6}$ B. $\frac{7\pi}{6}, \frac{11\pi}{6}$ C. $-\frac{\pi}{6}$ D. $\frac{7\pi}{6}$

   Which choice below best matches <u>all aspects</u> of your reasoning for your answer to Question 3 from Part 1? Read each choice carefully.

   A. $\arcsin(-1/2)$ must have reference angle $\pi/6$ and be on the unit circle where sine is $-1/2$, which happens in the third and fourth quadrants. The angle must be in the third quadrant because then it would be the smallest angle measured counterclockwise giving us the sine value $-1/2$.

   B. $\arcsin(-1/2)$ must have reference angle $\pi/6$ and be on the unit circle where sine is $-1/2$, which happens in the third and fourth quadrants. The range does not contain angles in the third quadrant. The range indicates that angles in the fourth quadrant are measured clockwise.

   C. $\arcsin(-1/2)$ must be the angles with reference angle $\pi/6$ and be on the unit circle where sine is $-1/2$, which happens in the third and fourth quadrants.

   D. $\arcsin(-1/2)$ must have reference angle $\pi/6$ and be on the unit circle where sine is $-1/2$, which happens in the third and fourth quadrants. The range does not contain angles in the third quadrant.

5. After reading the justifications above, would you like to change your answer to Question 3 from Part 1? If so, circle your new answer below. Do not change your answers to Question 4.

   A. $\frac{11\pi}{6}$ B. $\frac{7\pi}{6}, \frac{11\pi}{6}$ C. $-\frac{\pi}{6}$ D. $\frac{7\pi}{6}$

   Which justification corresponds to your new answer? Write the letter here: _____

6. On a scale from 1 to 5, rate how confident you are in your final answers (with 1 being not very confident and 5 being very confident): 1 2 3 4 5

7. Is there anything else you would like to say about how you chose your answer in Questions 3, 4, or 5? If so, please write it here.

HEIDI DAY - TRESTLE SCHOLARS – RELEVANT LEARNING GOALS FOR ASSESSMENT

Neuropharmacology in Society	**Appreciate the value of neuropharmacology in society** • Experience intellectual curiosity about neuropharmacology in society • Appraise the impacts of some aspect of neuropharmacology on enhancing vs diminishing human welfare
Critical Thinking	**Critically evaluate scientific claims and evidence** • Critically evaluate claims in the popular/mass media • Critically evaluate claims in scientific research articles • Either defend and justify an existing position, or propose & justify a new position, based on above evaluations
Writing	• *Possibly incorporate Toulmin's Claim-Data-Warrant model* • *Possibly incorporate citation/reference goal*

NRSC 4132 NEUROPHARMACOLOGY – REFLECTION 2

PART 1

SCENARIO

You are working as part of an advisory board to the DEA (Drug Enforcement Agency). The board has become aware of a number of ballot measures across the country that appear to be paving the way for legalization of psilocybin (the major psychoactive ingredient in "magic mushrooms"). These ballot measures may be fueled, in part, by pushback over the classification of psilocybin as a Schedule I drug.

TASK

You are tasked with writing a 1-page, 500-600 word memo to the board

1) Critically analyzing the strengths and/or limitations of classifying psilocybin as a schedule I drug, and
2) making a recommendation for classifying psilocybin as a schedule I, II, III, IV or V drug, or removing it from the controlled substance list entirely

You should provide supporting evidence for your arguments from the provided documents.

DOCUMENTS

1) DEA definition of controlled substance schedules
2) Denver Post Article (February 19, 2019) announcing a Denver ballot measure to mandate that police officers make enforcing the laws for buying, selling or possessing psilocybin mushroom their lowest priority.
3) Review – Classic psychedelics: an integrative review (Johnson et al 2019. Pharmacol Therap in press)
4) Review – Psychedelic drugs in biomedicine (Kyzar et al. 2017. Trends Pharmacol Sci 38:992-1005)
5) Review – The abuse potential of medical psilocybin according to the 8 factors of the controlled substances act (Johnson et al. 2018. Neuropharmacology 142:143-166)
6) Websites: https://thethirdwave.co/what-to-expect-on-a-magic-mushroom-trip/ and https://www.vice.com/en_us/article/43avgd/people-tell-us-about-their-mushroom-trip-horror-stories
7) You are welcome to include additional documents, but if you do, you must cite them.

PART 2

Do you support the following psilocybin ballot measure? Explain why or why not (250 words or less).

Shall the voters of the City and County of Denver adopt an ordinance to the Denver Revised Municipal Code that would make the personal use and personal possession of psilocybin mushrooms by persons twenty-one (21) years of age and older the city's lowest law-enforcement priority, prohibit the city from spending resources to impose criminal penalties for the personal use and personal possession of psilocybin mushrooms by persons twenty-one (21) years of age and older, and establish the psilocybin mushroom policy review panel to assess and report on the effects of the ordinance?

https://ballotpedia.org/Denver,_Colorado,_Psilocybin_Mushroom_Initiative_(May_2019)

Goal: Propose and defend a set of observations (qualitative or quantitative) you would use to identify life on the Archean Earth and/or another planet.

Assessment (exam questions):

The following 3 questions pertain to the following scenario:

Imagine a future astronaut on a mission to another planet outside of our Solar System; the primary goal of the mission is to determine whether or not there is life on the planet.

Part 1: Which **two** of the following characteristics make the best case for this planet being potentially habitable? (Assume that all the observations described are possible at the time of the astronaut's mission.)

a) the observation that the planet has an atmosphere
b) the observation that the planet has liquid oceans
c) the observation that the planet has active volcanoes
d) the observation that the planet has a moon

Part 2: One of the challenges the astronaut faces is that life might not look the same, morphologically or chemically, on this other planet as it does on Earth, so it might be difficult to recognize. In light of this, the astronaut has come prepared with some tools to potentially recognize alien life forms based on our broad definition of the characteristics of life. Which of the following statements is **not** part of how we broadly define life?

a) A life form has DNA and RNA.
b) A life form is self-contained.
c) A life form can reproduce and evolve.
d) A life form can perform chemical reactions for energy.

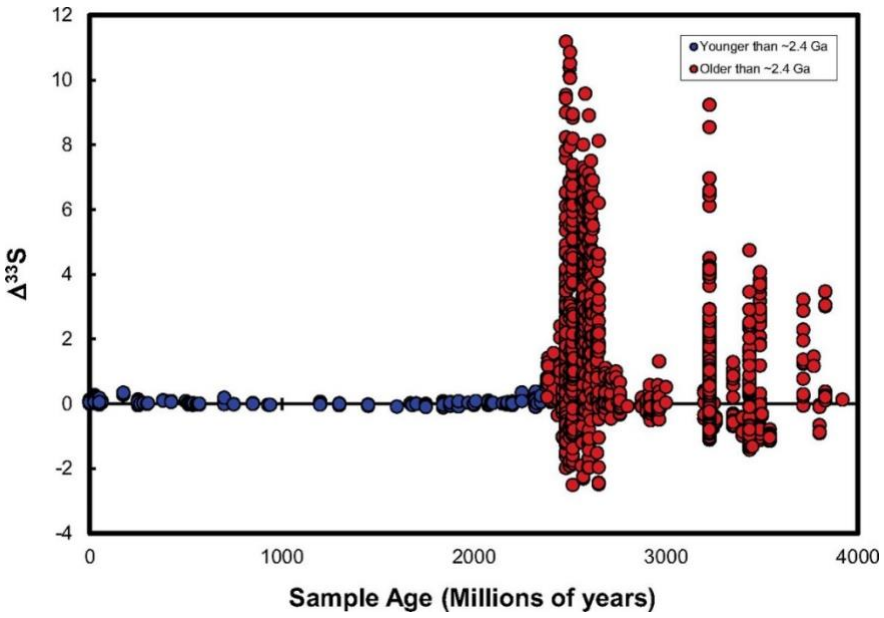
Part 3: Prior to setting off on the mission, the astronaut had the choice to focus on one of three methods to detect life: 1) microscopic imaging that can resolve organisms as small as a virus; 2) a mass spectrometer to measure stable isotope ratios of C, N, S, and O; or 3) culturing experiments to determine if organisms are growing by measuring the concentrations of key molecules required for possible metabolic reactions.

Which of the three methods would you choose? Explain the advantages and disadvantages of your choice. Which aspect(s) of the definition of life would your chosen method address and would it still be useful if it was instead applied to identifying life on early Earth (with the aid of a hypothetical time machine)?

Goal: Identify the observations and data that demonstrate the occurrence of the Rise of Oxygen and explain why each dataset supports this.

Assessment (exam question):

Complete the following statement describing this graph and the important phenomenon in Precambrian time that it illustrates:



This image shows a record of [blank1], which demonstrate that prior to ~2.4 billion years ago, [blank2] were being transformed by [blank3] reactions that occur only in [blank4].

Options for blank1:

a) mass independent fractionation of sulfur isotopes
b) mass dependent fractionation of sulfur isotopes
c) oxygen isotopes as a temperature proxy

Options for blank2:

a) sulfur gases
b) oxygen isotopes in water molecules
c) oxygen molecules

Options for blank3:

a) abiotic
b) microbial

Options for blank4:

a) an anoxic atmosphere
b) oxygenated shallow marine sediments
c) high temperature environments

The Learning Goals being assessed on this exam are as follows:

1. Evaluate input and outputs of logarithmic and exponential functions using multiple representations
2. Articulate in words the meaning of the inputs and outputs in logarithmic and exponential equations when given real-world scenarios
3. Recognize logarithmic and exponential functions by graphing points given by a table or through the evaluation of inputs and outputs from a given function
4. Determine if a solution to a logarithmic or exponential problem is logical, based on the given conditions
5. Identify the value that logarithms and exponential add to the ability to make common calculations in math and science
6. Solve exponential and logarithmic equations through algebraic manipulations and through the use of inverse relationships.
7. Identify the limitations of modeling real world data with logarithmic or exponential functions.

Precalculus Logarithmic and Exponential Exam
Self Assessment

Name:_____

Directions: Read all questions thoroughly before starting this exam. In the margin next to each, mark whether you think the problem is going to be easy, medium, or hard. There are no calculators allowed on this exam. Simplify your answers as far as you can without a calculator. Good luck!

1. (XX points) Let A(t) be an exponential function that describes the amount (mIU/mL) of human chorionic gonadotropin in a person's blood at time, t, in days after ovulation, during a pregnancy.

   (a) (XX points) What does A(21) = 1061 mean?

   (b) (XX points) What should A(0) be? Justify your claim.

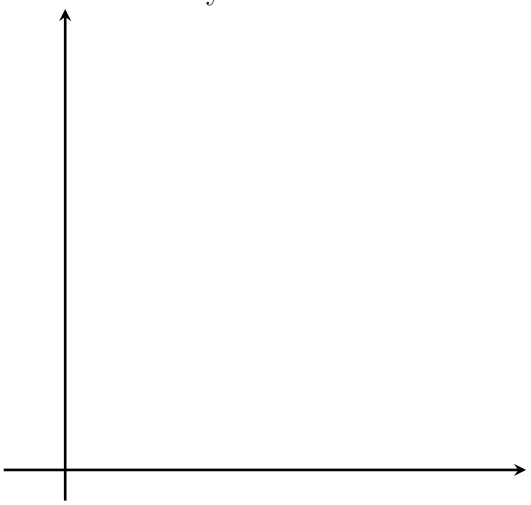
   (c) (XX points) What does $A^{-1}(2637)$ represent?

   (d) (XX points) What could it mean to say that [0,252] is a reasonable domain for A(t)?

2. The following table gives the number of users, in thousands, on Snapchat over a time period in months after the apps creation.

Users	96	200	16121
Months	11	13	33

(a) (XX points) Graph the data and smooth approximation curve in the space provided. Label your axes.



(b) (XX points) Determine if the function you've graphed is logarithmic or exponential. Justify your conclusion.

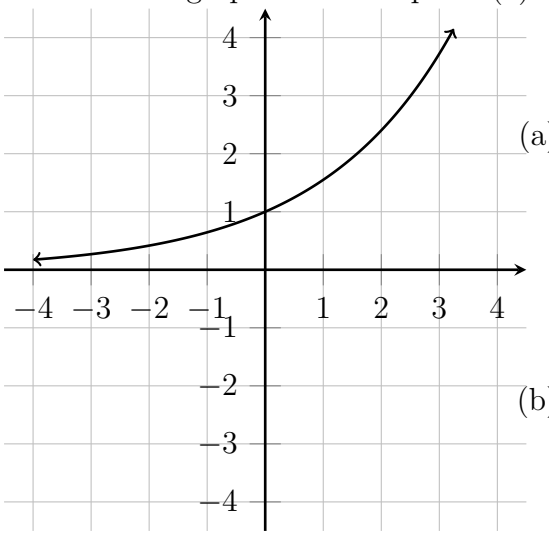
(c) (XX points) At 12 months the number of users is reported at 175 people. Is the function you've graphed an underestimate, overestimate, or accurate representation of users based on this new data? Justify your conclusion.

(d) (XX points) Determine an approximate y-intercept of the function.

(e) (XX points) How does the approximate y-intercept compare with the real-world understanding of the users of Snapchat at that time?

3. Evaluate the following functions.

Consider the graph below for parts (a) and (b).



(a) (XX points) Estimate $H(3)$.

(b) (XX points) Estimate x where $H(x) = -1$

Consider the table below for parts (c) and (d).

X	1	4	18	180
F(x)	4	18	180	3460

(c) (XX points) Evaluate $F(4)$.

(d) (XX points) Evaluate $F^{-1}(4)$.

(e) (XX points) $R(w) = \log_{\frac{1}{2}}(w) = 1$ at what value of w?

(f) (XX points) $A(x) = \ln(x) = 4$ at what value of x?

4. (XX points) Mark which of the following scenarios exhibit logarithmic or exponential behavior. Justify your choices.

   (a) The distance measured over time of a car traveling at a constant speed.

   (b) The amount of bacteria in a petri dish measured over a 24-hour period of time.

   (c) The amount of decibels measured in sound intensity.

5. (XX points) Solve each equation and check for extraneous solutions.

   (a) $\log_2\left(\log_5(m)\right) = 1$

   (b) $\log_3(x) + \log_3(x-2) = \log_3(x+10)$

   (c) $\left(\frac{1}{5}\right)^{x-1} = 25^x$

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4. Determine if a solution to a logarithmic or exponential problem is logical, based on the given conditions
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7. Identify the limitations of modeling real world data with logarithmic or exponential functions.

Reflection Questions:

1. Go back through each part of each question on this exam and assign it a learning objective.

2. With your assessment of the learning objectives, which objectives have you mastered? How do you know?

3. With your assessment of the learning objectives, which objectives do you need to improve on before the exam? How do you know?

4. Set two realistic and measurable goals that you can accomplish in the next two weeks to support your mastery of this material.