

PBL Rubrics

Cycle A: Individual Reflection Rubric

Goal: Identify what you currently understand (prior knowledge) and the reasons for why you have those understandings.

Background: The mind is a wonderful thing. As soon as you read or hear a question, your mind races to make associations, bring prior experiences to bear, and think of reasons about why things are the way they are. It is said that "nature abhors a vacuum" and the mind seems to be no different.

Piaget demonstrated that even five-year-olds have explanation about almost everything. When he asked Swiss five-year-olds, "Which came first--Lake Geneva or the city of Geneva?" they each had an explanation and reasons for their thinking. "The city came first, then they built the lake to swim in," some said. Or, "They liked the lake so they built a city around it."

Unless these personal understandings are revealed and examined, they often remain intact, in spite of countervailing evidence. Students learn quickly that "explanation giving" not the "theory building" that is required to be successful in most classes. Students tell teachers what others--the book, the experts, the teacher--think, not what they think, so their own explanations never come out.

What keeps people from revealing their own personal understandings? Often, no one asks about them. Or, when an understanding is expressed, it is critiqued, rather than explored. Some people do not want to be wrong. Others are used to examining their own thoughts or checking in on what they think they understand. These personal understandings are tenacious, particularly if they are never revealed. They hang on and interfere with developing deep and accurate understandings. Even with these private ideas out it in the open, it takes time to evolve them through discussion, and experience. This course is based on the idea that for learners to develop a deep and accurate understanding of complex ideas, such as Earth System Science, inquiry into what learners think they understand in light of what there is to know needs to be the standard way of teaching.

To get your personal understandings out, state what you think. Make that educated guess, search for what "makes sense" to you, and pull out the reasons for why you think so. By starting with your personal understandings, you will be more actively engaged in supporting, elaborating, or debunking them. The purpose of this assignment is for you to list what you already know and how you would explain things. You do not need to conduct any research about what anyone else thinks to do this assignment.

Personal Understanding: How do you explain this to yourself, "I think..."

<p>4 Rating: A coherent summary of your personal understanding and a list of questions you have or things you don't understand or can't explain.</p>	<p>3 Rating: A list of some ideas related to the topic and a list of questions you have or things you don't understand or can't explain.</p>	<p>2 Rating: A list of questions you have or things you don't understand or can't explain.</p>	<p>1 Rating: A list of some ideas related to the topic.</p>	<p>Rationale Explain your rating with specific references to your work as evidence:</p>
<p>Reasons: Supported by reasons, "Because..."</p>				
<p>4 Rating: You describe your reasoning including logical explanations (inductive or deductive) about how and why things happen in the Earth's System.</p>	<p>3 Rating: You support your understanding with logical reasons.</p>	<p>2 Rating: You describe why you believe your understanding to be accurate or not.</p>	<p>1 Rating: You say where you originally learned about this topic.</p>	<p>Rationale Explain your rating with specific references to your work as evidence:</p>
<p>Source: Uses what you currently know, "These reasons come from..."</p>				
<p>4 Rating: You support your explanations and reasons with multiple sources that can be verified and with examples from experience.</p>	<p>3 Rating: You cite sources or experience for your key ideas.</p>	<p>2 Rating: You support your explanations with examples.</p>	<p>1 Rating: You cite some sources for your understanding.</p>	<p>Rationale Explain your rating with specific references to your work as evidence:</p>

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Your individual work this cycles corresponds to PBL Steps 1, 2, and 3 and focuses on an Earth system science event. The rubric below assesses how well you do PBL Steps 2 and 3 in your effort to get your personal understanding out and well-elaborated.

Using the same rubric that your facilitator will use, rate your attempt to express your personal understanding. Remember you are developing your ability and willingness to make your thinking visible, so you can increase the sophistication and accuracy of your understanding. [Click here to read more about PBL Grading.](#)

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Cycle A: Team Knowledge-Building Rubric

Goal: Build ESS knowledge as a team about the event described in the scenario.

Background: While Piaget helps us to understand that we are not blank slates, but rather creatures with rich and complex understandings that we construct and reconstruct, a Russian psychologist, Lev Vygotsky, helps us to understand how learning together brings those personal understandings out in the open and helps us evolve them.

Since we have our own personal, unexamined understandings, we need opportunities to make them visible and to examine them. Vygotsky found that we evolve our understandings when we communicate them to others, and they respond with their own understandings, connections to what they know, and feedback about what they believe—a kind of mirroring. These interactions provide a safe and yet challenging environment, in which everyone is saying what they think they understand, and at the same time looking for evidence to support or refute that understanding. The goal is knowledge-building through considering different perspectives.

To begin knowledge-building you need to know what you know and what you want to know--your questions. Work with your team to create a list of questions.

In the typical "go find out about it" method, learners are familiar with a traditional, formal, linear classroom approach where they find answers to questions posed by the teacher. This knowledge acquisition is teacher-directed and limited to what the teacher asks. The knowledge-building in this course is based on your questions and is limited only by your curiosity. In working together to develop a shared understanding, teammates:

* value multiple perspectives * ask each other for evidence for their ideas* provide evidence* actively make connections among the ideas* share responsibility for regularly summarizing information* generate more questions from team discussions

These are the signs of a successful knowledge-building community at work.

The goal of knowledge-building in this course is not to find only the "right" answer, but rather answers that are most supportable with evidence. The evidence needs to support the answers and the answers need to explain the evidence.

Team knowledge-building results in more thoughtful answers, more powerful questions, and more confidence by individual members in their ideas.

Based on your questions, you and your team will determine "what you need to know" and will develop a problem statement to focus your thinking toward making your recommendations or solutions for the problem described in the scenario. Remember to post in your course discussion space any new resources that are worthy of sharing as you come across them. Your team assignment will be assessed according to the rubric below, so you may want to refer to it while you are doing your assignment.

Team knowledge-building results in more thoughtful answers, more powerful questions, and more confidence by individual members in their ideas. Your teamwork in this cycle corresponds to PBL Steps 4, 5, and 6. The rubric below assesses how well you do PBL Steps 4 and 5 in your effort to build knowledge as a team. PBL Step 6 is to develop a problem statement, which is a natural outcome of the work you do in Steps 4 and 5.

Use the criteria and indicators below to gauge your success. Click here to read more about [PBL Grading](#).

4 Rating: A rich list of questions (profound and trivial) with contributions from each participating team member.	3 Rating: Each participating member contributes a variety of questions to the list.	2 Rating: Question list contains a variety of questions.	1 Rating: Question list is 5-6 questions in one or two categories.	Rationale Explain your rating with specific references to your work as evidence:
Multiple perspectives on each question				
4 Rating: Multiple perspectives are weighed as members begin to answer questions.	3 Rating: Different perspectives emerge as most members begin to answer most team questions.	2 Rating: More than one perspective is apparent as some members begin to answer some team questions.	1 Rating: Individual perspectives remain separate since individual members answer only their own questions	Rationale Explain your rating with specific references to your work as evidence:
Evidence to support answers				
4 Rating: Answers are supported with sufficient evidence from experience, prior research and reading.	3 Rating: Answers are partially supported with evidence from experience, prior research and reading.	2 Rating: Answers are supportable.	1 Rating: Only answers are given, without reasons.	Rationale Explain your rating with specific references to your work as evidence:
List what needs to be done				
4 Rating: A thorough investigation is planned and explained with individual roles, resources and expected outcomes.	3 Rating: An investigation that builds on itself is planned and justified.	2 Rating: A list with roles is explained and expectations given.	1 Rating: The list of things to do is given and explained in terms of how it will address the team's questions.	Rationale Explain your rating with specific references to your work as evidence:
Creation of problem statement				
4 Rating: A problem statement is developed and elaborated to test its power and centrality.	3 Rating: A problem statement is developed and discussed in terms of its centrality to the questions and evidence.	2 Rating: A problem statement is suggested and analyzed before acceptance.	1 Rating: A problem statement is suggested and accepted without considering other options.	Rationale Explain your rating with specific references to your work as evidence:

Cycle B: Team Model Building Rubric

Goal: Use your team's original or revised problem statement, build an ESS model that includes the ESS relationship statements and evidence that support your conclusions (recommendations or solutions).

Background: Based on your collective knowledge and the answers to your questions in Cycle A, you have created an ESS model as a team. Discuss what you learned and what conclusions you can support with evidence from multiple sources including observation, expert opinion, analogy, or experimental results. "Does that make sense?" you ask. Negotiated meaning is at the heart of developing meaning. We can memorize on our own, but we need to talk or

write about our ideas to refine them.

So how does negotiated meaning work? Doesn't the loudest, oldest, or smartest voice usually dominate? Isn't there a right answer? Why should you entertain ideas you don't agree with? Consider these three reasons:

1. Some say truth has its own life - that we have only to discover it, so when the same idea emerges from different people's thinking for different reasons, it often points toward the truth. 2. Language gives life to thought and, in doing so, changes it. In a team, your job is to be sure that you are understood. Is what your teammates heard what you meant? Feedback from them about what they heard pushes you to be clearer in your communication and your thinking. 3. Seeing how ideas filter through other people's minds gives you a perspective you can only imagine on your own. What ideas do others find most compelling? Why? How do ideas fit together for them? What do they find to be problematic? What are they curious about? Tell them what you hear them saying and do your best to understand what they mean. If you can live inside their perspectives, they will expand your own.

Remember, a model satisfies a broader audience than your own mind. The evolution of private understandings into models is the social learning phenomenon that Vygotsky identified and is the outcome of Problem-Based Learning. Building a model takes reflection and dialectic. The trick is to stay curious rather than to become judgmental and critical of others' ideas. When you become judgmental and critical, you are probably hanging on to those private understandings a little too tenaciously.

Think like an investigator, trying to discover, rather than deciding what to think. Use your teammates to keep you honest about the quality of your ideas and to expand your sense of the possibilities.

Your teamwork this cycle corresponds to PBL Steps 7 and 8. The rubric below assesses how well you build a team model that supports your findings.

Use the criteria and indicators below to gauge your success. Click here to read more about [PBL Grading](#).

Support: Clarity and focus of supportable ideas and conclusions

<p>4 Rating: Develop a comprehensive summary of supportable ideas and conclusions that go beyond the facts to show insight into the systemic relationships.</p>	<p>3 Rating: Develop an accurate summary of supportable ideas and conclusions with insight beyond the facts.</p>	<p>2 Rating: List some supportable ideas and conclusions beyond the facts that summarize the overall causes and effects.</p>	<p>1 Rating: List ideas and conclusions, but does not summarize the overall causes and effects or fails to go beyond the facts.</p>	<p>Rationale Explain your rating with specific references to your work as evidence:</p>
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Relationship Statements: Number, accuracy, and thoroughness of relationship statements (assertions) in causal chains

<p>4 Rating: Reveal a thorough understanding of the Earth System Diagram through your analyses by asserting in full detail the impact of the event on the spheres, the interactions among spheres, and the return effect on the event itself in causal chains.</p>	<p>3 Rating: Reveal a satisfactory understanding of the Earth System Diagram through your analyses by detailing causal chains involving all the spheres (at least S>S>S).</p>	<p>2 Rating: Reveal some understanding of the Earth System Diagram through defining causal chains and supporting them.</p>	<p>1 Rating: Show some understanding of the Earth System Diagram through your analysis by describing causal relationships.</p>	<p>Rationale Explain your rating with specific references to your work as evidence:</p>
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Evidence: Scope, detail and accuracy of the evidence supporting the relationship statements

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4 Rating: Present comprehensive evidence or other corroborative data from multiple sources that are thoughtfully explained for each assertion.	3 Rating: Present evidence to support most, but not all of the relationship statements, or present less than complete evidence to support each assertion.	2 Rating: Present some evidence to support most assertions.	1 Rating: Make assertions without evidence.	Rationale Explain your rating with specific references to your work as evidence:
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Teamwork: Team members contribute insight used in the development of the model.

4 Rating: Each participating member of the team contributes insight beyond the facts for the development of the model.	3 Rating: Each participating member of the team contributes to the building of the model, most with insight beyond the facts.	2 Rating: Each participating member of the team contributes to the building of the model, some with insight beyond the facts.	1 Rating: Each participating member of the team contributes to the building of the model, but not beyond the facts.	Rationale Explain your rating with specific references to your work as evidence:
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Cycle C: PBL Individual Design Rubric (Cycle C)

Goal: Individually design a PBL lesson for your students and post it for feedback from your teammates who will act as "critical friends". Then, be a good critical friend by providing feedback on two teammates' PBL lessons.

Background: You have seen the value of examining your own understanding up front and then working between reflection and discussion to refine it. You have used rubrics to look objectively at how you are progressing. This cycle you created a PBL lesson for your students. Rate how the scenario engages students and how the lesson is restructured for reflection and rethinking by students, the quality of the resources, and the assessment criteria. Then reflect on your experience in using PBL and how that helped you refine your personal understanding.

Use the criteria and indicators below to gauge your success. Click here to read more about [PBL Grading](#).

Goal Focus: Setting expectations

4 Rating: Goals are clear and understandable and focused on a few pivotal concepts.	3 Rating: Goals are clear and understandable to your students.	2 Rating: Goals are understandable to your students.	1 Rating: Goals are clearly stated.	Rationale Explain your rating with specific references to your work as evidence:
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Rethinking: Scenario and instructional plan

4 Rating: The scenario and activities are powerful in drawing out students personal understandings about Earth Systems Science, causing them to rethink their ideas and to work together to build strong arguments for what they think they understand.	3 Rating: The scenario and activities are designed to draw out students' personal understandings about Earth Systems Science, cause them to rethink those ideas and to think out loud together.	2 Rating: The scenario and activities are designed to cause students to rethink what they think they know and ask questions about what they don't know about Earth Systems Science.	1 Rating: The scenario and activities are designed to make Earth System Science intriguing to students so they want to learn more.	Rationale Explain your rating with specific references to your work as evidence:
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Resources: For student use				
4 Rating: List of a variety of multiple resources (Books, Journals, CD ROMS, Internet, etc.) with interesting annotations.	3 Rating: List of multiple resources for student use from more than one source with a reason to use each.	2 Rating: List of resources for student use from one source (e.g. Internet URLs).	1 Rating: List of 3-4 resources for student use.	Rationale Explain your rating with specific references to your work as evidence:
Assessment: Criteria and indicators of success (for example, a rubric)				
4 Rating: Assessment is ongoing and standards-based involving students in seeing their own growth against clear criteria and indicators along a continuum of progress (Rubric).	3 Rating: Assessment is ongoing, authentic and standards-based.	2 Rating: Assessment is ongoing and standards-based.	1 Rating: Assessment is a test and an evaluation of the final presentation.	Rationale Explain your rating with specific references to your work as evidence:
Personal Reflection: What you have learned				
4 Rating: A detailed comparison of your initial understanding with your current understanding and an explanation of how your thinking changed through the PBL process.	3 Rating: An explanation of why you think your current understanding is more supportable than your original understanding based on your problem solving.	2 Rating: A comparison of your initial understanding (from Cycle A) with your current understanding.	1 Rating: A description of how you developed your current understanding.	Rationale Explain your rating with specific references to your work as evidence:

PBL Final Project Rubric

You will end this course by completing a Final Project. The Final Project is an ESS analysis performed individually, so remember that you will not be able to consult your classmates.

Rate your final ESS analysis on how well you: Provide a list of the E > S, S > E, and S > S interactions with reasoning and support. Provide a list of chains of interactions between the event and 3 or more spheres.

You should write as many E > S, S > E, and S > S interactions as you can that include accuracy, depth of reasoning, and quality of support. Use the rubric below to evaluate and improve your analysis.

Using your E > S, S > E, and S > S interactions, create and document causal chains. Your work will be graded based on the rubric being applied to each causal chain that you list. Each causal chain that earns a 3 or 4 rating will be worth one point toward the maximum 10 points you can earn for this assignment.

Be sure to explain your reasons for each rating with specific references to the assignment. The "rationale" is a direct message from you to your instructor about the quality of your work.

Use the criteria and indicators below to gauge your success. Click here to read more about [Group Investigation Assessment](#).

Accuracy

4 Rating:

3 Rating:

2 Rating:

1 Rating:

Rationale

Presents precise and meticulous scientific understanding.	Uses currently accepted scientific understanding in explaining effects.	Uses currently accepted scientific understanding in explaining interactions.	Attempts to explain interactions, but strays from accepted scientific understanding.	Explain your rating with specific references to your work as evidence:
Depth of Reasoning				
4 Rating: Uses arguments from at least two perspectives for most of the effects and interactions.	3 Rating: Uses scientific reasoning, concepts, and processes to explain each effect and interaction.	2 Rating: Includes science concepts and processes in the reasons provided for each effect and interaction.	1 Rating: Explains at least two reasons for each effect and interaction.	Rationale Explain your rating with specific references to your work as evidence:
Quality of Support				
4 Rating: Cites data and respected authorities, as well as logic, explanations and examples to support statements about the interactions and effects.	3 Rating: Cites data and respected authorities to support statements about the interactions and effects.	2 Rating: Cites data from multiple sources to support statements about the interactions and effects.	1 Rating: Cites respected authorities to support statements about the interactions and effects.	Rationale Explain your rating with specific references to your work as evidence:
Number of Causal Chains				
4 Rating: More than eight causal chains.	3 Rating: Six to eight causal chains.	2 Rating: Three to five causal chains.	1 Rating: One or two causal chains.	Rationale Explain your rating with specific references to your work as evidence:
Personal Reflection on What You Have Learned				
4 Rating: A detailed comparison of your initial understanding with your current understanding, with an explanation of what caused the evolution of your thinking.	3 Rating: A general comparison of your initial understanding and your current understanding with evidence to support your current understanding.	2 Rating: A basic explanation of why you think your current understanding is more supportable than your original understanding.	1 Rating: A basic description of the ideas that support your current understanding.	Rationale Explain your rating with specific references to your work as evidence: