

Analysis of Student Understanding of Evidence-based Explanations



Dimension	Level 1	Level 2	Level 3
1. Degree to which the student makes comparisons among pieces of evidence.	<ul style="list-style-type: none"> Student uses only one form of evidence. For example: discussion of data in a simple experiment, or discussion of an amino acid sequence in a textbook example. 	<ul style="list-style-type: none"> Student <i>reports</i> multiple forms of evidence. For example: <i>reports</i> data from a complex controlled experiment, or <i>reports</i> about human, chimp, and gorilla amino acid sequences from a textbook example. 	<ul style="list-style-type: none"> Student <i>compares</i> multiple forms of evidence (data from one investigation or multiple investigations) in a sophisticated way and/or considers counterevidence. For example: <i>compares</i> findings from complex experiment(s), or <i>compares</i> amino acids sequences from humans, chimps, and gorillas from a textbook example.
2. Degree of depth in student's explanation.	Level 1.1 – Nominal Description*	Level 2.1 – Nominal*	Level 3.1 – Nominal Explanation*
	Level 1.2 – Full Narrative Description**	Level 2.2 – Full Narrative**	Level 3.2 – Full Narrative Explanation**
	Explanations with Theoretical Components <ul style="list-style-type: none"> Student describes <i>what</i> happened. Student describes, summarizes, or restates a pattern or trend in data without making a connection to any unobservable/ theoretical components. 	<ul style="list-style-type: none"> Student describes <i>how</i> or partial <i>why</i> something happened. Student addresses unobservable/ theoretical components tangentially. 	<ul style="list-style-type: none"> Student explains <i>why</i> something happened. Student can trace a full causal story for why a phenomenon occurred.
	Explanations with Mathematical Components <ul style="list-style-type: none"> Student describes <i>what</i> happened. Student describes, summarizes, or restates a pattern or trend in data. 	<ul style="list-style-type: none"> Student describes <i>how</i> something happened. Student links observations to mathematical concepts in isolation. For example: correlates the number of strings supporting a load in a pulley system with the effort to lift the load. 	<ul style="list-style-type: none"> Student explains <i>why</i> a mathematical model accounts for a phenomenon. Student links observations to statistical or other mathematical models. Student explains the links between observations and statistical or other mathematical expressions.
3. Degree to which evidence and explanations are integrated in written products	<ul style="list-style-type: none"> Student reports of data are sandwiched in between descriptions of what happened 	<ul style="list-style-type: none"> Student begins to describe how their data are about a larger idea Connections between evidence and explanations are implied but not fully described 	<ul style="list-style-type: none"> Student writes about how observable/ measurable components are cases of unobservable/theoretical ideas Students can identify how the specific component from the investigation(s) relates to the general case from theory or a complex mathematical relationship Student explanation contains a claim that justifies the link between observable data and unobservable/ theoretical components.

* **Nominal** means that aspects of the student's response indicate that the student does not fully understand the topic or concept at hand (i.e., making nominal use of a science term without communicating understanding of that term).

** **Full narrative** means that the student's response is communicating, with rich detail, the topic or concept as fully as possible within the constraints of the assignment.