Scientific Inquiry through Evidence Based Reasoning

Science is fundamentally about explaining phenomena by determining how or why they occur as well as the conditions and consequences of these phenomena. A **scientific phenomenon** is an event that begs a logical and rational explanation. For example, ecologists may try to explain why species diversity is decreasing in an ecosystem, or astronomers may try to explain the phases of the Moon based on the relative positions of the Sun, Earth, and Moon. When scientists explain phenomena and construct new claims, they provide evidence and reasons to justify them or to convince other scientists of the validity of the claims.

To be a scientifically literate citizen, you need to engage in similar inquiry. You need to understand and evaluate explanations that appear in newspapers, in magazines, on the news, and especially on the Internet to determine their credibility and validity. For example, an article may claim that stem cell research is important for human health and for treating diseases. You need to be able to critically read that article by evaluating the evidence and reasoning presented in it. This capability allows you to make informed decisions.

In science classes, when we do a lab activity, we commonly encounter such scientific phenomena. To reach this goal of being a critical scientific thinker, it is necessary for you to construct your own "***Statement of Understanding***". Besides stating the phenomenon you want to focus on, you must list any detailed and relevant evidences. Finally, you should support your own written claims with appropriate (logical and rational) justification.

The "Statement of Understanding" framework includes four components: a phenomenon, a claim, evidence, and reasoning:

Scientific Phenomenon: As explained above, a "***scientific phenomenon"*** is an event that implores a logical and rational explanation. Sometimes an experiment or an event has many different scientific aspects. It is **extremely important to narrow down one aspect** as you frame the rest of the statement.

Claim: The ***"claim"*** makes an assertion or conclusion that addresses the original question or problem about a phenomenon.

Evidence: The ***"evidence"*** supports your claim using scientific data. This data can come from an investigation that you complete or from another source, such as observations, reading material, or archived data, and needs to be both **appropriate** and **sufficient** to support the claim. By **appropriate**, it means data that are ***relevant*** to the problem and help determine and support the claim. **Sufficient** refers to providing ***enough data*** to convince another individual of the claim. Often providing sufficient evidence requires using multiple pieces of data.

Reasoning: The ***"reasoning"*** links the claim and evidence and shows why the data count as evidence to support the claim. Often in order to make this link, you must **apply appropriate scientific principles**. When laying out your reasoning, it is important to consider your audience. In this class, we will *assume our audience does not have much scientific knowledge and do not understand most scientific terms we have learned*. Hence, it is vital that you define and explain concepts step by step so it is easy to follow. What we do **not** want is a superficial explanation and assumes your audience can follow your "leap of logic"! Because scientific principles can be confusing at times, it is encouraged that you draw or illustrate them. Whenever drawings are employed, they must be labeled clearly with appropriate captions.

Statement of Understanding Rubric

Components	Level			
	0	1	2	3
Phenomenon – a scientific event that appeals for a logical and rational explanation.	No phenomenon stated.	A phenomenon is stated but it lacks focus, or it is not well framed.	A specific aspect of the scientific event is clearly stated.	
Evidence – Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide any evidence.	Provides very little evidence or inappropriate evidence (evidence that does not support the claim).	Provides appropriate evidence but insufficient amount to support the claim. There might be a small amount of inappropriate evidence.	Provides appropriate and sufficient evidence to support the claim.
Reasoning – A justification that links the claim and evidence. It shows why the data count as evidence by using appropriate and sufficient scientific principles.	There is no reasoning provided. Students went from evidence directly to claim.	Provides illogical and irrational reasoning. The reasoning stated does not link evidence to claim. The reasoning does not consider the audience and often makes use of "leap of logic".	Provides reasoning that links the claim and evidence. Repeats the evidence and/or includes some – but not sufficient scientific principles. Some details of stepwise reasoning are missing. If diagrams are used, they are not labeled clearly.	Provides reasoning that links evidence to claim. This includes appropriate and sufficient scientific principles. The reasoning considers a non-scientific audience and the reasoning are laid out in a detailed step-by-step manner. If diagrams are used, they are labeled clearly.
Claim – A conclusion that answers the original question posed by the phenomenon.	There is no claim present anywhere in the paragraph, or the claim has nothing to do with the original stated phenomenon	Makes an accurate but incomplete claim to did not address the specific phenomenon outlined earlier.	Makes an accurate and complete claim to answer the specific phenomenon outlined at the beginning of the statement.	