Sections of the Long-term Science Investigation

urban advantage
science initiative

Poster and Rubric

Title

The title should state both the independent variable and the dependent variable.

Sample format: "The effect of (the independent variable) on (the dependent variable)."

Question

The question describes the focus of the investigation. The question should ask how the independent variable will affect the dependent variable. The question should be written so that someone else can easily understand it.

Sample format: "How will (the independent variable) affect (the dependent variable)?"

Hypothesis

A hypothesis predicts the effect that a change purposely made in the independent variable will have on the dependent variable. The hypothesis should make a statement about what the student thinks will happen. The hypothesis should state why the student thinks this will happen ("because…").

Sample format: I think (independent variable) will affect (dependent variable) and I expect (predicted result) because (describe the scientific reasons of why you expect this relationship between the variables. Include scientific concepts that relate to this prediction).

Sample format: If (summarize investigation or action being planned, i.e., changing the independent variable) then (predict result, i.e., effect on dependent variable) because (describe the scientific reasons of why you expect this relationship between the variables. Include scientific concepts that relate to this prediction).

Background information (Background information should be found within the hypothesis section as well as the discussion / conclusion section)

Students should be researching scientific concepts and knowledge related to their question both before and after they perform their investigation. Students should provide relevant, well-chosen facts and scientific concepts, definitions, concrete details, quotations or other information and examples related to the relationship between the IV and the DV.

This background information provides the basis of the prediction. Students should consider the question: "What did I read that makes me predict this outcome?"

Background information should also be used to support the scientific reasoning within the Discussion/ Conclusion. See the Discussion/Conclusion description for more information.

Often students will provide basic facts about things related to their investigation. However, information that is not clearly related to the hypothesis or to scientific reasoning within the discussion / conclusion should not be included.

Investigation Design (the ID diagram used in UA PD may be included as a graphic organizer here)

Using the five components below, describe the design of the investigation:

1. **Independent variable**: the variable that the student changes on purpose. (In a field study we describe the independent variable as the category(ies) that the student chooses. In a secondary research project, we describe the independent variable as the variable that the student lets change and does not keep constant.)
2. **Dependent variable:** the variable the student measures that is affected (changes) as a result of changes purposely made in the independent variable.
3. **Constants (**also called constant variables**)**: the variable(s) in an investigation that are kept the same and not allowed to change or vary.
4. **Levels of the independent variable**: the values of the independent variable at which data is gathered. For example, when studying effect of the time of day on sea lion behavior, the levels might be: 8:30am, 12:30pm, 4:30pm, etc. as this is when the student is observing the sea lion. When studying the effect of the mass of a ball on the distance it pushes something, the levels might be: 1g, 5g, 10g.
5. **Number of repeated trials:** the number of times that a level of the independent variable is tested in an investigation, or the number of objects or organisms tested at each level of the independent variable. Typically, at least three trials are conducted at each level in a middle school investigation.

Procedure

The procedure is a detailed, step-by-step description of the way in which the investigation was performed. The procedure should be written so that another student can replicate the investigation and should use precise language and scientific vocabulary. All materials and equipment used should be included in the appropriate portion of the procedure. In addition to being replicable, it is important that the procedure be appropriate for the investigation. The procedure should be one that will allow the student to answer the question posed and should be consistent with the investigation design.

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Data/Results (Table and Graphs, and Data Analysis)

Students use the data reported in this section to determine whether or not their hypothesis was supported and to make a claim answering or addressing the original question. Data reported in this section must be directly related to the question and the hypothesis.

Students make their own observations for the following types of projects: controlled experiments, field studies and design projects. Students use observations or data reported by other investigators when they do secondary research.

Data should be shown in tables, charts, and/or graphs as appropriate. All data tables and graphs should be accurate and include titles, axis labels, units of measure, etc. Overall trends and patterns in the data should be discussed (with numeric or other data being provided to demonstrate any trend or pattern).

Discussion/Conclusion

This is one section that is scored based on two different items: "the scientific explanation" and "reflections."

The overall Discussion/Conclusion portion should follow a format similar to the one below:

"In this investigation, the hypothesis (was/was not) supported." Students should then make their claim and provide evidence and reasoning for that claim (the scientific explanation - see below). Students should then discuss sources of error and possible future investigations.

Discussion/Conclusion: Scientific Explanation

The scientific explanation begins with a claim that addresses or answers the original question asked. This claim should then be supported by relevant, accurate data from the students' investigation. Relevant science concepts and knowledge should be used to explain this data and relate it to the claim. Students should use words, phrases and clauses that connect and clarify the relationships between the claim, evidence (data) and reasoning in a formal style.

Discussion/Conclusion: Reflections

Students should state whether or not the hypothesis was supported by the data. This statement usually comes at the beginning of the discussion section. At the end of the discussion section, students should explain any possible causes of error as well as how they might prevent these possible errors in the future. Students should also explain how they might use the data or ideas from this investigation in future investigations.

Literature Cited

The project should include a list of sources used. Sources should be varied (books, articles, websites…), clearly related to the topic, and at the appropriate level. Citations should include title, author, publisher, year, and URL (if website) in a format that aligns with school expectations and ELA standards by grade level. These sources should be cited in the text of the hypothesis, background research, conclusion and other sections as appropriate.

Long-term Science Investigation Project Evaluation Rubric:

Please adapt the rubric to your own needs and your students' needs. The scoring table (below the rubric) should also be modified to match your needs.

A. Title

3	The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.
2	The title correctly states the independent variable and the dependent variable but is worded as a question.
1	The title is present but does NOT correctly state the independent variable or the dependent variable.
0	Not attempted.

Comments:

B. Question

3	The question states the independent variable and the dependent variable, and is testable.
2	The question does not make the independent variable and the dependent variable clear, but is testable.
1	The question is present but is NOT testable.
0	Not attempted.

Comments:

C. Hypothesis

3	The hypothesis ● predicts the effect that changing the independent variable will have on the dependent variable, AND ● explains the reason for the prediction using scientific concepts ("because…")
2	The hypothesis ● predicts the effect that changing the independent variable will have on the dependent variable AND ● explains the reasoning for the prediction using scientific concepts ("because...") but is incomplete or weak.
1	The hypothesis ● is a prediction that does not frame a relationship between the variables OR ● DOES NOT explain the reasoning for the prediction using scientific concepts ("because...").
0	Not attempted

Comments:

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D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)

3   Background research is accurate and complete, containing MANY relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that
  ● provide information on the IV & DV; defining them and explaining the relationship between them AND
  ● support the 'because' portion of the hypothesis AND
  ● support the 'scientific reasoning' of the discussion/conclusion.

2   Background research is accurate, containing SOME relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that
  ● provide information on the IV & DV AND
  ● attempts to support the 'because' portion of the hypothesis OR
  ● attempts to support the 'scientific reasoning' of the discussion/conclusion.

1   Background research contains inaccurate or FEW relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that
  ● provide information on the IV & DV OR
  ● attempts to support the 'because' portion of the hypothesis OR
  ● attempts to support the 'scientific reasoning' of the discussion/conclusion.

0   Not attempted.

Comments:

E. Investigation Design (ID)

3   All 5 components of the investigation's design (or ID) are stated correctly and explicitly, AND only one independent variable (or IV) is allowed to change at a time, AND there are multiple trials

2   Four of the 5 components of the ID are stated correctly, OR more than one IV is changing at a time or there are not multiple trials.

1   Two or more of the components of the ID are not reported, and/or two or more components have issues as described above.

0   Not attempted.

Comments:

F. Procedure

3   The procedure
  ● is a step-by-step description of how the investigation was done AND
  ● uses precise language and scientific vocabulary to describe both the sequence of actions taken and materials used AND
  ● is sufficiently detailed to enable the reader to replicate the investigation AND
  ● is consistent with the Investigation Design Diagram (IDD) and is an appropriate test of the hypothesis.

2   The Procedure accurately and completely satisfies two or three of the above.

1   The Procedure accurately and completely satisfies one of the above.

0   Not attempted.

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Comments:

G. Data/Results (Tables and Graphs, and Data Analysis)

3 Data table(s) and graph(s)
- are accurate and include labels (titles, axes with units of measure) AND
- address the hypothesis and have been chosen to clearly address the original question AND
- data analysis identifies and accurately summarizes trends or patterns in the data.

2 Most parts of the data graphs and tables are present, complete and accurate. Data analysis is attempted but may not be accurate

1 Few parts of the Data/Results section are complete and accurate or data analysis is not attempted.

0 Not attempted.

Comments:

H a. Discussion/Conclusion: Scientific Explanation

3 A scientific explanation consisting of a statement that
- makes an overall claim addressing the original investigation question AND
- supports the claim with evidence and relevant, accurate data from the investigation AND
- contains relevant scientific concepts AND
- uses words, phrases and clauses that clarify and connect the relationships between claim, evidence and science concepts AND
- demonstrates an understanding of the topic.

2 Three or four parts of the Scientific Explanation are complete and accurate.

1 One or two parts of the Scientific Explanation are complete and accurate.

0 Not attempted.

Comments:

Hb. Discussion/Conclusion: Reflections

3 Conclusion contains thoughtful, relevant, and reasonable reflections including
- states whether the hypothesis was or was not supported AND
- a description of possible sources of error AND
- suggested solutions to these sources of error AND
- "Next Steps" determined as a result of this investigation.

2 Two or Three parts of the Reflections are complete and accurate.

1 One part of the Reflection is complete and accurate.

0 Not attempted.

Comments:

I. Literature Cited (applies throughout the project)
(align citation format with school's expectations and ELA standards by grade level)

3 A sufficient number of credible sources
- are listed in the bibliography in an appropriate format that allows the reader to locate the resource AND
- are cited in the text of the hypothesis, background research, conclusion, and other sections as appropriate AND
- include books, articles, scholarly websites, or personal communication with knowledgeable experts/scientists.

2 Most parts of the Literature Cited are complete and accurate. Bibliography is present but references are not cited in the text of the investigation.

1 Few parts of the Literature Cited are complete and accurate.

0 Not attempted.

Comments:

Please adapt the scoring section to your needs and your students' needs.

Project Section	Score (0-3)	Weight	Weighted Score
A. Title		x 1	=
B. Question		x 1	=
C. Hypothesis		x 2	=
D. Background Research		x 2	=
E. Investigation Design (ID)		x 2	=
F. Procedure		x 2	=
G. Data/Results		x 3	=
Ha.Discussion/Conclusion: Scientific Explanation		x 2	=
Hb. Discussion/Conclusion: Reflections		x1	=
I. Literature cited		x 2	=
		Total weighted score	= **(54 max)**
	Final Score (%) =	**Total weighted score/54 x 100**	= **%**

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