Completed Rubric for Exit Project Titled

"The effect of F-2 algae food on the biofuel emission of algal (nannochloropsis) growth"

This project was evaluated using the point scale of 0-1-2-3. The project was evaluated based on the visible information in the project photograph; some more information may have been on the additional sheets.

Summary:

A. Title
Title: The effect of F-2 algae food on the biofuel emission of agal (nannochloropsis) growth
Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*
Comments: The title states both the IV and the DV and isn't a question.

B. Question
Question: Which amount of F-2 algae food drops will produce the greatest amount of biofuel that is produced by algae (nannochloropsis)?
Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*
Comments: None

C. Hypothesis
Hypothesis: If the amount of algae food added affects how much bio fuel will be produced, then we hypothesize that 6 drops of algae food (F-2) will produce the most or largest amount of biofuel, since it will provide the most nitrogen, sodium nitrate, and manganese according to http://en.wikipedia.org/wiki/Nannochloropsis_and_biofuels; http://oilprice.com/Alternative-Energy/Biofuels/Why-Algal-Biofuels-May-Never-Hold-the-Key-to-the-Future.html; http://www.forbes.com/sites/kensilverstein/2012/05/20/will-algae-biofuels-hit-the-highway/
Score: 3 – *The hypothesis (1) predicts the effect that changing the independent variable will have on the dependent variable, AND (2) explains the reason for the prediction using scientific concepts ("because…")*
Score: 2 – *The hypothesis (1) predicts the effect that changing the independent variable will have on the dependent variable AND (2) explains the reasoning for the prediction using scientific concepts ("because") but is incomplete or weak.*
Comments: 2.5 - The hypothesis ties in IV and DV and gives some scientific explanation, but rather than starting a single level of the IV it should have been phrased as an increase in chemical amounts. The hypothesis does not explain how adding nitrogen, sodium nitrate, and manganese increases biofuel concentration, nor does it explain how it increases algae amounts. The student did not state that the 6 drops of "algae food" is the largest amount of food given, which is necessary based on the student's explanation that the most nutrients/chemicals will be provided.

D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)
Score: 1 – *Background Research contains inaccurate or FEW relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that (1) provide information on the IV & DV OR (2) attempts to support the "because" portion of the hypothesis OR (3) attempts to support the "scientific reasoning" of the discussion/conclusion.*
Comments: This section is missing an explanation of what is in the purchased algae food, aka the chemicals in the hypothesis. The student should include information on how the amount of algae food does or does not affect biofuel production. The student did not define biofuel production, although one might presume it is oil production.

The student did not seem to understand the difference between amount of algae and amount of biofuel produced—the reasoning chain here is that nutrients are good for algae's growth so adding nutrients will increase the percent by weight of the biofuel the algae produced. There is no evidence for this claim in the background research. The student's argument would have been stronger had he/she simply stated that more algae would be produced—not that more oil would come from the algae.

E. Investigation Design (ID)
Score: 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.*
Comments: While the constants are not mentioned here, they are mentioned in the procedure.

F. Procedure
Score: 1 – *The Procedure accurately and completely satisfies one of the above.*
Comments: The procedure is not replicable as is. More precise information on exactly what occurred each day is necessary, as is precise information on the materials used. There are additional areas that lack clarity such as how/why the student obtained 6800mL of algae in each jar. Furthermore, the procedure is not an appropriate test of the hypothesis as the control likely should have been 0 drops of algae food. More importantly, there is no information regarding the procedure for biofuel extraction.

G. Data/Results
Score: 3 – *Data table(s) and graphs(s) (1) are accurate and include labels (titles, axes with units of means) AND (2) address the hypothesis and have been chosen to clearly address the original question AND (3) data analysis identifies and accurately summarizes trends or patterns in the data.*
Comments: The question introduced in the analysis section clearly defines each variable. If this were the experimental question, it would be far clearer than the question the student poses earlier on. In this section, the student is confusing levels with trials and use the terms to mean different things at different points. Each amount of "food" added is a level, and each jar is a trial. The student summarizes trends appropriately at the end of the section.

Ha. Discussion/Conclusion: Scientific Explanation
Score: 2 – *Three or four parts of the Scientific Explanation are complete and accurate.*
Score: 1 – *One or two parts of the Scientific Explanation are complete and accurate.*
Comments: 1.5 –The student includes a claim as well as evidence from the data analysis section. The student should have summarized the evidence to state that as amount of food provided was increased, the amount of gasoline (or oil) produced increased. The scientific reasoning portion was weak, if present. The student needed to link the ingredients in the algal food to algal growth and explain how algae produce "biofuels".

Hb. Discussion/Conclusion: Reflection
Score: 1 – *One part of the Reflection are complete and accurate.*
Comments: No solutions offered to the potential sources of error and no next steps suggested.

I. Literature Cited
Score: 3 – *A sufficient number of credible sources (1) are listed in the bibliography in an appropriate format that allows the reader to locate the resources AND (2) are cited in the text of the hypothesis, background research, conclusion, and other sections as appropriate AND (3) include books, articles, scholarly websites, or personal communication with knowledgeable experts/scientists.*
Score: 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.*
Comments: 2.5 – The only spot where references are cited outside the bibliography is in the hypothesis; one of the resources mentioned in the hypothesis isn't included in the bibliography.

Project Section	Score (0-3)	Weight	Weighted Score
A. Title	**3**	x 1	**= 3**
B. Question	**3**	x 1	**= 3**
C. Hypothesis	**2.5**	x 2	**= 5**
D. Background Research	**1**	x 2	**= 2**
E. Investigation Design (ID)	**3**	x 2	**= 6**
F. Procedure	**1**	x 2	**= 2**
G. Data/Results	**3**	x 3	**= 9**
Ha. Discussion/Conclusion: Scientific Explanation	**1.5**	x 2	**= 3**
Hb. Discussion/Conclusion: Reflections	**1**	x 1	**= 1**
I. Literature Cited	**2.5**	x 2	**= 5**
		Total weighted score	**= 39 (54 max)**
	Final Score (%) =	**=Total weighted score/54 x 100**	**= 72 %**