Completed Rubric for Exit Project Titled

"The effect of the distance from trails on the presence of Japanese Knotweed."

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: This project uses a field investigation to determine if the distance from a managed trail in Central Park has an effect on the presence of Japanese Knotweed, a non-native and invasive species in the park. Students were able to clearly link background research to their question, hypothesis, and investigation design. The project would have been strengthened if visuals had been used to clarify how the quadrant study was set up to make it replicable. Additionally, students could have utilized background resources throughout their project to support their conclusion and reflection.

A. Title
Title: The effect of the distance from trails on presence of Japanese Knotweed
Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*
Comments: This title states both an independent variable (distance from trails) and the dependent variable (presence of Japanese Knotweed).

B. Question
Question: What is the effect of the distance from trails on presence of Japanese Knotweed?
Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*
Comments: This question correctly states the independent and dependent variable, and how the IV affects the DV. In addition, the dependent variable is testable.

C. Hypothesis
Hypothesis: If the amount of knotweed that is present in terms of distance from the trails is measured, then one would find that there are more knotweed plants closer to trails than there are further into the woods because according to specialists such as Maria Hernandez, knotweed seeds travel on birds, people, dogs, cars, and other modes of transportation and animals. When people or animals go to places infested with knotweed (such as Staten Island, as Clay Wollney reports), the seeds cling to their bodies, car tires, clothes, feather or fur, etc. When people and pets come by Central Park, they generally keep to the trails and if they carry knotweed seeds, the seeds fall of their host and land on the soil nearby the trails they travelled. The seeds then thrive in this soil and grow, making more seeds to be spread by more hosts.
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…").*
Comments: The hypothesis predicts that there will be more knotweed plants growing closer to trails because knotweed seeds attach themselves to people and animals as well as other types of transportation including cars. The students' hypothesis is that people and animals traveling on trails will deposit seeds they are carrying, which will land on soil closest to the trail and grow there.

Students do refer to an expert specialist names Maria Hernandez in the "because" portion of the hypothesis as the source for how knotweed seeds travel and their introduction to Central Park. However, there is no citation provided in the hypothesis to show where the expert's information was derived. This will be addressed in the "Literature Cited" portion of this rubric.

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

Score: 2 – *Background research is accurate, containing SOME relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that (1) provide information on the IV & DV AND (2) attempts to support the "because" portion of the hypothesis OR (3) attempts to support the "scientific reasoning" of the discussion/conclusion.*
Comments: The background research thoroughly discussed why it is important to assess non-native and invasive species in a given ecosystem with a focus on Japanese Knotweed.

Information was paraphrased and quoted from six sources and clearly cited (footnotes) in the Background Research portion of the project. All of them were websites; half of them were ".org" including the NYC Parks Department, the Botanical Society of Britain and Ireland, and the Invasive Species Specialist Group. The other sites are ".com". If possible, its best to verify information cited on .com sites using either websites that are .org, .edu, and/or .gov or an alternative information source such as text.

In this case, the information on culinary uses of knotweed and the value of knotweed to beekeepers was sources on .com sites; this information was interesting, but not essential to supporting the hypothesis, so it's okay that it wasn't supported by multiple sources. Another .com was a newspaper source; newspapers are usually .com sites, but we presume that reporters have researched their information and verified it before publishing it.

The information essential to supporting the hypothesis was obtained from .org sites. However, the hypothesis did not specifically describe or cite a reference as to how Japanese Knotweed spreads (by seed or by rhizome growth) though reference was made to how the seeds travel, and its spread from seeds was referenced in other sections of the project. In addition, there was a relevant description of knotweed's growth given by a blogger named Ellen Zachos for which no citation was provided.

E. Investigation Design (ID)
Score: 3 – *All 5 components of the investigation's design (or ID) are stated correctly, AND only one IV is changing at a time AND there are not multiple trials.*
Comments: In a field study, investigators cannot change or control anything about the environment. In this case, the students chose to sample areas of plant growth next to a trail in central Park and at four additional locations that were varying distances from the trail. The levels of their IV are the distances from the trail. The students were very specific about the constant which were mainly focuses on how they did the sampling at each distance from the trail and next to the trail. This section would have been strengthened if the students clarified that they were measuring the DV by counting total number of stalks within a defined quadrant zone.

F. Procedure
Score: 2 – *The Procedure accurately and completely satisfies two or three of the above. (The procedure is (1) a step-by-step description of how the investigation was done AND (2) uses precise language and scientific vocabulary to describe both the sequence of actions taken and materials used AND (3) is sufficiently detailed to enable the reader to replicate the investigation AND (4) is consistent with the Investigation Design Diagram (IDD) and is an appropriate test of the hypothesis.)*
Comments: The procedure was thorough. Phots were included along with a step by step procedure; the photos helped illustrate how areas at each level of distance were sampled. The students used a hula hoop, thrown within a sampling area at random, to isolate a portion of plant growth that was examined for the presence of knotweed plants. This is a method used by professional field botanists, though they usually use a wooden square frame instead of a hula hoop! Students recorded additional environmental data including temperature readings, another practice of seasoned field ecologists and botanists.

The procedure received a reduced score for a few reasons. It did not provide the reader with enough detail to sufficiently replicate the data collection. It was slightly unclear where students stood when using the hula hoop to randomly select an area to count the DV. A map or other visual representation of the site would have been useful here. It also would have strengthened this section is students clarified that they counted the total number of stalks of Japanese Knotweed to quantify the DV.

G. Data/Results

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

Comments: The students did include accurately labeled data tables and a graph. They performed and included an additional level of analysis: measures of center. In the measures of center, it was evident that data collected at two levels/locations – 0 meters and 7 meters from the trail—had a broad range as compared with data collected at 3.5 meters, 10.5 meters, and 14 meters from the trail. In their data analysis statement, the students acknowledged these variations. Their graph includes a trend line, and though they do state that the number of plants observed at the 7 meter level/distance is an "outlier" with reference to the trend line, they focus on the trend line to make the claim about their data and to state that their hypothesis was supported. The score would have been higher if the students had explicitly stated some skepticism as to whether the trend line along could reliably represent an existing phenomenon if the data collected for the "outlier" level had such a varied range.

It was inferred from the photos provided that the location of level 4 is on a rock outcrop where no plants are visible, where plants would not be able to grow easily. As the data recorded at this location contributes to the explanation and conclusion in a significant way, the students should have anticipated a question from reviewers about why they chose to include a sampling area where plants could probably not grow because of the rock outcrop without mentioning or acknowledging it in data analysis. In their analysis students could have identified that data collected at distances farther from the trail were low because plants are unlikely to grow on rock vs. soil.

Ha. Discussion/Conclusion: Scientific Explanation

Score: 2 – *Three or four parts of the scientific explanation are complete and accurate ((1) makes an overall claim addressing the original investigation question AND (2) supports the claim with evidence and relevant, accurate data from the investigation AND (3) contains relevant scientific concepts AND (4) uses words, phrases, and clauses that clarify and connect the relationship between the claim, evidence and science concepts AND (5) demonstrates an understanding of the topic.)*

Comments: All 3 parts of the explanation were included, however, each had an issue that lead to reduced score in this section. The students make the claim, "The distance from trails has an effect on the presence of Japanese Knotweed plants, and there will be more knotweed in areas closer to the nearest trail." The claim addresses the original investigation question and references both the IV and the DV. However, the claim is stated as a prediction: students wrote "….there will be more knotweed in areas closer to trails…" rather than as a statement of what was observed: for example, "The distance from trails had an effect on the presence of Japanese knotweed plants; more knotweed was observed in areas closer to the nearest trail." This section would have been improved if students had grappled with how data collected on rocky areas may have impacted their claim.

The evidence portion of the explanation includes relevant, accurate, numerical data that was visible elsewhere in the project in the forms of tables and graphs. Their evidence portion would have been stronger if students had addressed their outlier level and been more skeptical of the trend line. Their measures of center included in the data analysis, which increased the rigor of their data analysis and is commendable, showed how variable trials were in the outlier level.

The reasoning portion refers to experts from the "Conservancy of Horticulture" but does not cite the source of the information which is partially paraphrased and partially quoted.

Hb. Discussion/Conclusion: Reflection

Score: 3 – *Conclusion contains thoughtful, relevant, and reasonable reflections including: 1) states whether the hypothesis was or was not supported AND 2) a description of possible sources of error AND 3) suggested solutions to these sources of error AND "Next Steps" determined as a result of this investigation.*

Comments: This section was thorough and highly detailed, which demonstrated that this student team really reflected on the challenges they faced in collecting the data although their investigation design accounted for as much as they could possibly think of in terms of how to collect samples

randomly using the methods of professional field botanists. Among the limitations and challenges they noted are the fact that the larger area of study was in fact surrounded by a trail, which put in question whether the levels furthest from "the trail" were truly at a distance from any trail. They speculate that repeating the investigation in other areas on Central Park to see if a similar pattern of plant presence with respect to distance from trails emerges would enable them to make a stronger claim about the relationship of location with respect to a trail and plant density—the number of plants present.

I. Literature Cited

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: The literature cited would be improved if personal communication with scientist/park manager was included in the bibliography. A standard format for citing these sources should also be used (MLA or APA). Background resources should also be cited within the text of the project beyond the background research section. There were no citations for references that were paraphrased and quoted in the hypothesis and scientific explanation sections.

Project Section	Score (0-3)	Weight	Weighted Score
A. Title	**3**	x 1	**= 3**
B. Question	**3**	x 1	**= 3**
C. Hypothesis	**3**	x 2	**= 6**
D. Background Research	**2**	x 2	**= 4**
E. Investigation Design (ID)	**3**	x 2	**= 6**
F. Procedure	**2**	x 2	**= 4**
G. Data/Results	**2**	x 3	**= 6**
Ha. Discussion/Conclusion: Scientific Explanation	**2**	x 2	**= 4**
Hb. Discussion/Conclusion: Reflections	**3**	x 1	**= 3**
I. Literature Cited	**2**	x 2	**= 4**
		Total weighted score	**= 43 (54 max)**
	Final Score (%) =	**=Total weighted score/54 x 100**	**= 80%**