10th Natural Selection
Summative Assessment Teacher Rubrics
Grade 10, Unit I – Nature of Science and Evolution

1. What do the data in ***Figure 1*** indicate about the range of variation in beak depth in the finch population in 1976? *(Note: Use numerical data in your response.)*

This item measures the student's ability to analyze graphic information.

Criterion for a Correct Response:

1. Student responds with a statement that includes a numerical description of the range in beak depth.

Samples of Complete Student Responses:

a. The finch beak depth variation ranged from 5.8-mm to 13.8-mm.
b. Most of the finches had beak depths that ranged from about 8-mm to 11-mm.

Code	Response
	Complete Response
20	Uses correct numerical values (5.8-mm to 13.8-mm) to describe the range in beak depth in the finch population. May include mean beak depth in response.
21	Uses correct numerical values (about 8-mm to 11-mm) to describe the range of beak depth for most of the finch population. May include mean beak depth in response.
29	Any other correct response.
	Partially Correct Response
10	Uses correct numerical values for the range but response includes data on factors other than range.
11	Gives the correct mean beak depth (9.2-mm) but does not include range.
12	Uses correct numerical values (half the population has beak depths that range between 5.8-mm and 9.2-mm) that give an incomplete description of the range of beak depth.
13	Correct numerical values listed but not described.
19	Any other partially correct response.
	Incorrect Response
70	Indicates no variation in range.
71	Gives a correct non-numerical description of range, i.e., beak depth varies from small to large.
72	Uses incorrect numerical values.
73	Misinterpretation of graph axes.
76	Repeats the questions or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

2. How does mean beak depth before the drought (***Figure 1***) compare with mean beak depth after the drought (***Figure 2***)? *(Note: Use numerical data in your response.)*

This item measures the student's ability to analyze graphic information.

Criterion for Correct Response:

1. Student responds by comparing the numerical values for mean beak depth before and after the drought.

Samples of Complete Student Responses:

a. Mean beak depth increased from 9.2-mm to 10.0-mm.
b. Mean beak depth increased 0.8-mm between 1976 and 1978.

Code	Response
	Complete Response
20	Uses correct numerical values (9.2-mm and 10.0-mm) to compare means.
21	Indicates increase in beak depth using correct numerical value (0.8-mm).
29	Any other correct response.
	Partially Correct Response
10	Uses one correct and one incorrect numerical value in comparing means.
11	Uses approximate numerical values (about 9-mm to 10-mm) in comparing means.
12	Uses approximate numerical value (about 1-mm) to describe increase in mean.
13	Correct numerical values listed but not described.
19	Any other partially correct answer.
	Incorrect Response
70	Uses incorrect numbers to compare means or describe increase in mean.
71	Indicates that beak depth did not change or that it decreased.
72	Indicates beak depth mean increased but uses no numerical data.
73	Responds by describing population change, not mean beak depth change.
76	Repeats the question or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

3. Compare the size of the finch population in 1976 with the population in 1978 using information in ***Figure 3***. *(Note: Use numerical data in your response.)*

This item measures the student's ability to analyze graphic information.

Criterion for Correct Response:

1. Student responds using numerical data that show a decrease in the finch population between 1976 and 1978. Response may include a description of the finch population in 1977.

Samples of Complete Student Responses:

a. The finch population decreased from about 1,400 in 1976 to about 200 in 1978.
b. The population in 1976 averaged about 1,300. In 1978 the population averaged about 300.
c. At the end of 1976, the finch population was about 800 while at the beginning of 1978 it was about 200.

Code	Response
	Complete Response
20	Uses correct numerical values (approximately 1,400 in 1976 and approximately 200 in 1978) to compare populations. May include finch population range in 1977 of about 800 to about 200.
21	Uses correct numerical values to describe the finch population at the end of 1976 (about 800) with the finch population at the beginning of 1978 (about 200).
29	Any other complete response.
	Partially Correct Response
10	Uses one correct and one incorrect numerical value to compare populations.
11	Uses numerical values which lack precision, i.e., 1,000 in 1976.
12	Correct numerical values listed but not described.
19	Any other partially correct response.
	Incorrect Response
70	Population size decreased but uses no numerical data.
71	Population size remained the same but uses no numerical data.
72	Population size increased but uses no numerical data.
73	Uses incorrect numerical data in explanation.
76	Repeats the questions or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

4. What do the data in *Figure 4* show about seed abundance before the drought compared with seed abundance after the drought? *(Note: Use numerical data in your response.)*

This item measures the student's ability to analyze graphic information.

Criteria for a Complete Response:

1. Student responds using numerical data that show a decrease in seed abundance between 1976 and 1978.
2. Student may mention that the decrease is related to drought.

Samples of Complete Student Responses:

a. Seed abundance decreased from about 10-g/m^2 in 1976 to about 3-g/m^2 in 1978.
b. The seed abundance at the end of 1976 was about 8- g/m^2 while at the beginning of 1978 it was about 2-g/m^2.

Code	Response
	Complete Response
20	Uses correct numerical data (a high of about 10-g/m^2 in 1976 to a low of about 3-g/m^2 in 1978) to compare seed abundance.
21	Seed abundance before the drought ranged from about 8 g/m^2 to about 11 g/m^2. After the drought, seed abundance ranged from about 2 g/m^2 to about 4g /m^2.
29	Any other correct response.
	Partially Correct Response
10	Uses correct numerical data to describe seed abundance in one year but incorrect values in the other year.
11	Uses numerical values which lack precision, i.e., 6-g/m^2 in 1978.
12	Correct numerical values listed but not described.
19	Any other partially correct response.
	Incorrect Response
70	Seed abundance increased.
71	Seed abundance remained the same.
72	Seed abundance decreased but no numerical values given.
76	Repeats the stem of the question or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

5. Describe the relationship between the abundance of seeds (***Figure 4***) and the size of the finch population (***Figure 3***).

This item is intended to measure students' ability to identify relationships based on graphic evidence.

Criteria for a Complete Response:

1. The student responds by indicating the direct relationship between seed abundance and finch population size. Numerical values may be used but are not required.

Samples of Complete Student Responses:

a. As seed abundance decreased, so did the finch population.
b. Seed abundance and the finch population seem to be directly related. As seed abundance went down, the finch population also went down.
c. When seed abundance was high at about 10-g/m^2 in 1976, the finch population was also high at about 1,400. On the other hand, when seed abundance was low at about 3-g/m^2 in 1978, the finch population was also low.

Code	Response
	Complete Response
20	As one factor increases/decreases, the other also increases/decreases.
21	Direct relationship described using numerical data.
29	Any other correct answer.
	Partially Complete Response
10	Indicates relationship but is nonspecific, i.e., "they are related" or "look the same."
11	Correct numerical values listed but not described.
19	Any other partially correct response.
	Incorrect Response
70	As one goes up/increases, the other goes down/decreases.
71	No relationship.
76	Repeats the stem of the question or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

6. Propose an explanation that accounts for the change in the mean depth of the finches' beaks between 1976 and 1978 using your knowledge of natural selection, and the information in the ***Introduction*** and ***Figures 1-4.***

This item is intended to measure students' ability to propose an explanation or hypothesis to account for data from observations.

Criteria for a Complete Response:

1. The student responds by including the following criteria in an explanation or hypothesis that accounts for the change in finch mean beak depth:
   a. *Variation:* Genetic variation is present among members of a population.
   b. *Struggle for survival:* The survival of an individual organism depends on its ability to compete successfully for food and other resources and to avoid predation and disease.
   c. *Differential survival and reproduction:* Individuals with the most successful adaptations to their environment are most likely to survive and reproduce. Over generations the character of a population changes as the frequency of a trait increases or decreases.

   Note: In their responses students may, but are not required, to include *overproduction of offspring*: Populations have the reproductive potential to exceed available resources.

Samples of Complete Student Responses:

a. The mean depth of finch beaks changed because of natural selection acting on the finch population. Beak depth is a genetic variation in finches related to their ability to eat seeds of different sizes. Finches with traits best adapted to their environment survive the best and pass their traits to offspring. On Daphne Major the drought, in causing a decrease in the abundance of seeds, favored the survival of finches with large beaks which were better adapted for eating large, tough seeds. Large beaked survivors passed the trait for larger beaks to their offspring which resulted in an increase in mean beak depth in future generations.

Code	Response
	Complete Response
30	Includes all 3 criteria (a, b, and c) in an explanation that properly integrates data on beak depth in the finch population.
39	Any other complete response.
	Partially Complete Response
20	Includes criteria a and b but not c in explanation.
21	Includes criteria a and c but not b in explanation.
22	Includes criteria b and c but not a in explanation.
10	Includes only criterion a in explanation.
11	Includes only criterion b in explanation.
12	Includes only criterion c in explanation.
13	Any other partially correct response.
	Incorrect Response
70	No mention of any of the 3 criteria.
71	Explanation reflects Lamarckian theory, i.e., use and disuse and the inheritance of acquired characteristics.
73	Lists one or more of the criteria without explanation.
76	Repeats the stem of the question or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

7. Little rain fell on Daphne Major from 1979 through 1982. At the beginning of 1983, unusually heavy rainfall occurred on the island. Plants that produced small seeds flourished while big-seed plant populations crashed. With plenty of food available, the size of the finch population increased dramatically over the next several years.
   a. Predict how the rainy weather of 1983 affected mean (average) beak depth over the next several generations using your knowledge of natural selection. Make your prediction by circling one of the following choices:
      A. Mean (average) beak depth increased.
      B. Mean (average) beak depth decreased.
      C. Mean (average) beak depth remained the same.

This item measures the student's ability to apply an understanding of natural selection to making a prediction about how a change in the environment might affect a trait.

Criteria for a Complete Response:

1. Student selects choice "B. Mean beak depth decreased."

Samples of Complete Student Responses:

a. Mean beak depth decreased.

Code	Response
	Complete Response
10	Mean beak depth decreased.
	Incorrect Response
70	Mean beak depth increased.
71	Mean beak depth remained the same.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

7. Little rain fell on Daphne Major from 1979 through 1982. At the beginning of 1983, unusually heavy rainfall occurred on the island. Plants that produced small seeds flourished while big-seed plant populations crashed. With plenty of food available, the size of the finch population increased dramatically over the next several years.
   b. Explain your prediction.

This item measures students' understanding of the concept natural selection and ability to apply it.

Criteria for a Complete Response:

1. Because this question measures students' ability to apply their understanding of natural selection to an extension of the scenario in question 6, students need not include all 3 of the criteria specified for a complete response to question 6. Therefore, to avoid what may seem like redundancy to students, a response will be considered complete if it includes the following criteria:
   a. In the new environment, the trait for small beak depth enables finches to compete and survive more successfully than finches with large beaks.
   b. Over generations, differential survival and reproduction of individual finches with the variation for small beak depth results in a decrease in mean beak depth.
   Students may, but are not required to, state that in the new environment finches with small beaks and bodies require less food for metabolism than is required by large finches. This lower energy input requirement gives small finches a selective advantage.

Samples of Complete Student Responses:

a. Because the rainy weather resulted in an abundance of small, soft seeds and few tough, large seeds, finches with the trait for small beaks can compete more successfully than finches with large beaks. Small-beaked birds would survive to have more offspring than birds with large beaks. This would result in mean beak depth decreasing over generations.

Code	Response
	Complete Response
20	Includes both criteria (a and b) in an explanation that properly integrates the criteria in predicting a decrease in mean beak depth.
29	Any other complete response.
	Partially Complete Response
10	Includes only criterion "a" in explanation.
11	Includes only criterion "b" in explanation.
12	Any other partially correct response.
	Incorrect Response
70	No inclusion of either criteria in explanation.
71	Explanation reflects Lamarckian theory.
72	Explanation supports an increase in mean beak depth.
73	Explanation supports no change in mean beak depth.
74	Criteria (such as struggle for survival and differential survival and reproduction) are merely listed with no explanation given.
76	Repeats the stem of the question or some other response already given.
79	Any other incorrect response.
	Non-Response
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.