Achieve

SCIENCE TASK ANNOTATION

ANNOTATION KEY

EQUITY
Supporting a wide range of diverse students.

SCENARIOS
Information provided to elicit performances.

SEPs
Opportunities to demonstrate science and engineering practices.

DCIs
Opportunities to demonstrate understanding of disciplinary core ideas.

CCCs
Opportunities to demonstrate understanding of crosscutting concepts.

SENSE-MAKING
Opportunities for reasoning about phenomena and problems.

ASSESSMENT PURPOSE
Highlights how the task features connect to intended assessment use.

TWO SPECIES OR ONE?

Scientists are helping a group of people on Norfolk Island in the South Pacific Ocean protect a population of birds currently known as Pacific Robins. Scientists collected data on genetic and physical characteristics to decide if the population:

1) should continue to be classified as Pacific Robins

2) is more closely related to other nearby robin species (Scarlet Robins or Red-Capped Robins), or

3) is its own species of Norfolk Island Robins.

The birds on Norfolk Island are currently declining in number because of predation from rats, and because humans are clearing the forest habitats where they prefer to live.

If the scientists decide this population of birds is its own species, then the group will take steps to protect them. However, if the scientists decide they are more closely related to other bird species, the Norfolk Islands robins will not be protected.

The scientists compared four populations of robins with respect to their genetic similarity and physical characteristics.

Scientists agree that the following are separate species:

- Scarlet Robins
- Red-Capped Robins
- Pacific Robins

The question is whether the Norfolk Island Robins are a different species from the other three, based on both genetic and physical data.

This scenario is grounded in a real-world, specific phenomenon-based problem and question. The scenario is written with simple language but is text-heavy without any additional supports for engagement or understanding, which might impede some students' ability to connect and comprehend the full scope of the scenario.

SCENARIOS EQUITY

This clearly helps students understand why this task is worth undertaking by describing why a stakeholder group is invested in the outcome.

SCENARIOS

This would be a helpful opportunity to include images or other visual information.

SCENARIOS

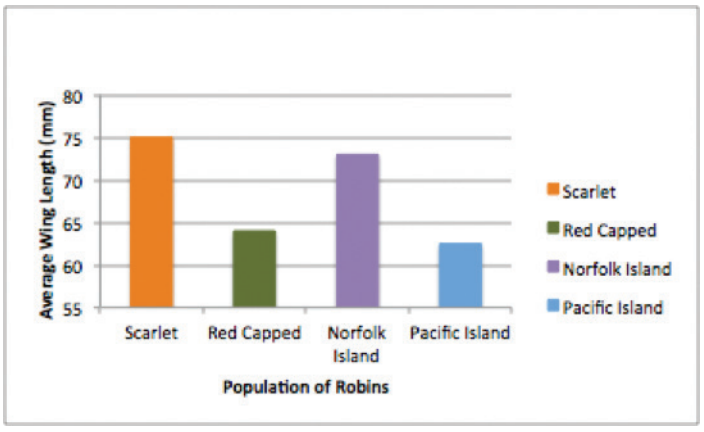
TWO SPECIES OR ONE? (CONTINUED)

Data on Genetic Similarity

The scientists decided to compare genetic similarities of Norfolk Island (NI) robins (for the alleles of ND2 gene) to each of these populations of robins.

- Red-capped Robin (different species): 98.2% similar to the NI robins
- Pacific Robins (population we want to know about): 96.7% similar to the NI robins
- Scarlet Robins (different species): 88.7% similar to the NI robins

The chart below shows the average wing length of the different populations of robins:



This is a confusing leap, and some students may not understand why they are comparing genetic similarities for this single gene. The confusion introduced here might prevent some students from fully engaging with the task, by providing unintentionally distracting informantion.

SCENARIOS EQUITY

TWO SPECIES OR ONE? (CONTINUED)

Question 1. On the basis of these data, which group of robins most likely shares a most recent common ancestor with the Norfolk Island robins?

Question 2. Which data best support your claim? Why are these data important to scientists in determining common ancestry?

Answering **Q1 and Q2** requires students to 1) read and make sense of the information provided above regarding genetic similarities for alleles of a particular gene and phenotypic observations of wing length differences, 2) connect this as evidence with reasoning based in an understanding that the organisms with the most genetic and trait similarities most likely shared a common ancestor (when they had identical DNA) most recently, and 3) distinguish among data that supports different ideas and determine which claim is supported most strongly.

This requires students to make sense of the provided information using two dimensions: DCIs and SEPs. This question elicits part of the HS LS4.A element "genetic information…provides evidence of evolution….ongoing branching that produces multiple lines of descent can be inferred by comparing [genetic information] of different organisms", but can likely answered using:

- the MS LS4.A element "anatomical similarities and differences between various organisms…enable the…inference of evolutionary lines of descent."
- Students also had to analyze and interpret simple data (part of a 3-5 SEP element) and use provided information as evidence to support a claim (part of the 6-8 element "[support] an argument with empirical evidence and scientific reasoning to support [a claim]." Because the claim is supported by a single piece of evidence provided, this use of the SEP is closer to MS-level understanding than HS.

It should be noted that a below-grade-band use of targeted dimensions might be entirely appropriate, if this is appropriate in instruction for any number of reasons. However, the scoring guidance should make this clear so that students and educators are making the right inferences about student progress.

SEPs DCIs SENSE-MAKING

Question 3. What patterns in the data are relevant to deciding whether the species are the same or different, but do not support your claims? Why are these sources of data in general important to scientists in determining common ancestry?

Answering this question requires students to engage similar ideas to questions 1 and 2. In all three questions, students have to identify a very simple pattern, but across the three questions, students are scaffolded toward recognizing that patterns at one scale may be inconsistent with patterns/information from a different scale is revealed (HS patterns element). While students did not need to know that in order to answer these questions, the task could be used to develop that understanding, providing an instructional purpose while also meeting assessment needs.

CCCs

TWO SPECIES OR ONE? (CONTINUED)

Question 4. If you were a scientist, what would you conclude: Should the Norfolk Island robins be considered a unique species? What evidence supports your conclusion? What is your reasoning: in other words, why is that good evidence to support your conclusion?

Questions 1-3 provide support for students to lay their thinking out in order to construct the argument asked for in questions 4 and 5. Responding to question 4 requires students to synthesize their thinking from prior questions and connect it to a claim supported by evidence and reasoning about speciation. This elicits further evidence of the SEPs and DCIs identified above, along with more robust information about students' facility with the SEP engaging in argument from evidence. Because students are provided with such limited evidence to work with, this is an example of a 3-5 or MS level practice engagement.

SEPs DCIs SENSE-MAKING

Question 5. What is one additional piece of evidence that would help convince you that the Norfolk Island robins are the same or different from other island bird species? Say what the evidence would have to show to support your claim.

This question can elicit a much more sophisticated understanding of 1) what separates species, and 2) what evidence would be needed to demonstrate those features (e.g., gene flow, heritable traits, embryological development, etc). This question requires deeper sense-making of the information provided because it asks students to consider what's missing, and connect this with reasoning to scientific ideas. While the question is open-ended enough to elicit a wide range of student thinking, it has the potential to elicit parts of grade-appropriate DCIs, SEPs and CCCs (e.g., that different patterns at different scales can provide evidence...for phenomena).

Importantly, this question requires careful scoring guidance to help teachers and students understand how student responses connect to expected performance across all three dimensions.

SENSE-MAKING EQUITY

CONNECTION TO ASSESSMENT PURPOSE

TWO SPECIES OR ONE? (CONTINUED)

Question 6. The Pacific Robin and Red-Capped Robin do not interbreed because they cannot reach each other in flight (their short wings are not useful for flying long distances). Additionally, over time their habitats may start to vary. The Pacific Robin's habitat will likely be the same because people decided to protect the environment and limit any future development. The Red-Capped Robin's habitat is at risk of being destroyed by human activity (such as building hotels for tourists). Over multiple generations, what could happen to these two populations? (Circle two plausible answers)

1. The two populations' wing lengths would stay about as similar to one another as they are today.
2. The two populations' wing lengths would become more different from one another as the Red-Capped robins adapted to different conditions.
3. The Red-Capped Robin population would go extinct.

Explain your reasoning for each answer you select.

Students have to evaluate three possible claims based on the provided information in the task and select and support two claims—on the surface, this requires relatively deep reasoning, but only one claim is implausible—that the wing lengths would stay about as similar to one another as they are today. While this does still require sense-making to connect their understanding of how populations change over time in response to environmental changes to the provided information, this is relatively superficial and more appropriate to middle school (especially MS.LS.4C).

Here students have to use evidence and scientific principles to make sense of the merits of different claims, providing evidence of the HS SEP element "Evaluate claims, evidence…to determine the merits of arguments."

SEPs SENSE-MAKING DCIs