Do all kinds of organisms have a lot of genetic diversity?

Grade Band: High School • Discipline: LS • Time: Two 50-minute class periods

Lesson Level Performance Expectation

• Compare, integrate and evaluate genetic diversity data as well as scientific research to gather empirical evidence in order to identify patterns in population size related to changes in the physical environment (whether naturally occurring or human induced), contributing to the decline of species diversity potentially leading to the extinction of some species. (HS-LS4-5; HS-LS4-6; SEP: 8.2; DCI:LS4.C.4; CCC: 1.5)

• Use a model based on evidence to predict the cause and effect relationship between genetic diversity, population size, and environmental change by examining what is known about variation in the genetic information between organisms leading to variation in the expression of that genetic information, which is required for populations to remain extant in a changing environment and evolve by natural selection. (SEP: 2.3; DCI: LS4.B.1; LS4.C.5; CCC: 2.2)

What Students Will Figure Out

• All populations have the possibility of genetic variation through mutation, but asexual reproduction and certain events can lead to low genetic diversity in a population.

• Students figure out that genetic diversity is an advantage because if there is a lot of diversity in the population when the environment changes, it is more likely there will be individuals within the population that will survive.

• Events that lead to low genetic diversity (bottle necks, founder effect, etc.) put populations at risk when the environment changes.
Lesson Snapshot

High school students as scientists investigate genetics, natural selection, and evolution to answer the following driving question: Do all kinds of organisms have a lot of genetic diversity? Students analyze a dataset to see that genetic diversity varies in different populations, but all populations do have some degree of genetic diversity. After analyzing genetic diversity across different species worldwide, students wonder why some populations have higher levels of genetic diversity than others and if this difference is significant. Next, students analyze a dataset to look for patterns in genetic diversity between different populations of different species. They find no clear pattern between any specific type of organisms and amount of genetic diversity. Students read about organisms with varying degrees of genetic diversity and find patterns in causes that led to low diversity. They return to the dataset and choose some of the organisms with low diversity to find they too suffered similar environmental issues. Students consider how genetic diversity in human populations is similar or different from the populations they’ve looked at. Finally, students return to their initial Driving Question Board to determine which of the questions they had can now be answered. They then use what they have learned throughout this unit to explain how genetic diversity is maintained in populations and why genetic diversity is important, and they think about how they want to use this information to learn more and to help educate others.

Phenomenon

Species that seem to have a lot of trait variation don’t necessarily have high genetic diversity.

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<td>Obtaining, Evaluating, and Communicating Information</td>
<td>LS4.B: Natural Selection</td>
<td>Patterns</td>
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<td>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.</td>
<td>• Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information - that is, trait variation - that leads to differences in performance among individuals.</td>
<td>• Empirical evidence is needed to identify patterns.</td>
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<td>Developing and Using Models</td>
<td>LS4.C Adaption</td>
<td>Cause and Effect</td>
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<td>• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.</td>
<td>• Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. (HS-LS4-5), (HS-LS4-6)</td>
<td>• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</td>
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<td>• Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ evolution is lost. (HS-LS4-5)</td>
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Do all kinds of organisms have a lot of genetic diversity?

This lesson could be one in a series of lessons building toward the following Performance Expectation(s):

**HS-LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges or seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

**HS-LS-4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

**HS-LS-4-6:** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

### Materials

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<td><strong>7.1 Transcript for Dogs vs Cats: The Diversity Paradox</strong></td>
<td><strong>Minute Earth:</strong> Dogs vs Cats: The Diversity Paradox</td>
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<td><strong>7.2 Genetic Diversity Data</strong></td>
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<td><strong>7.3 Connect-Extend-Question tool</strong></td>
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<td><strong>7.4 How is genetic diversity maintained in populations, and why is it important?</strong></td>
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Per Student (one of the following resources depending on interest and reading level)

- Nature: Genetic Drift: Bottleneck Effect and the Case of the Bearded Vulture
- University of Oxford: Chimps show much greater genetic diversity than humans
- Australian Geographic: The extraordinary survival story of the black robin
  — Video associated with the text The Man Who Saved the Black Robin
- American Association for the Advancement of Science (AAAS): Inbreeding Causes Isle Royale Wolf Population Crash
- Phys.org Not all is rosy for the pink pigeon
- AoB Plants High levels of genetic diversity and population structure in an endemic and rare species: implications for conservation
- Annals of Botany Population-level genetic variation and climate change in a biodiversity hotspot
Lesson Preparation

- Check the slides to ensure the links to the videos are ready to play.
- Create links to share the handouts, readings, and dataset with students using your school classroom management system, or have printed copies of the handouts and readings ready for students.
- Have chart paper or a large whiteboard and markers ready to create small group and classroom artifacts.
- Consider making grade-level versions of the articles using a lexile modification tool.

Diversity Data

Test the link to the diversity dataset to ensure it forces students to make their own copy of the Google Sheet. You may want to practice sorting the sheet in different ways to see if there are any patterns you discover and to be ready for any questions students have while looking for patterns in this very large dataset. If your school does not use the Google Suite, you may choose to download the sheet as an Excel spreadsheet and provide that file to students.

Experience the Phenomenon

What Students Are Doing

Students analyze a dataset to see that genetic diversity varies in different populations, but all populations do have some degree of genetic diversity. After analyzing genetic diversity across different species worldwide, students wonder why some populations have higher levels of genetic diversity than others, and if this difference is significant.

Teacher Guidance

1. Navigation: Looking back

Facilitate a discussion to surface what we figured out about the amount of diversity present in human populations. The goal of this instructional move is to have students recall and summarize what they figured out as a class. Since we have put all of the pieces together with our human example, we have figured out how to explain the anchoring phenomenon. For the unit project, we need to broaden out so students are able to have as much choice as possible when deciding what they are interested in explaining. In this step we problematize by challenging students to think about whether this high genetic diversity is unique to humans, or if this is important in other organisms as well.

Show SLIDE 3 and ask students to turn and talk with a partner to discuss the prompts found on the slide. Bring the class together to share ideas. Students should mention the following ideas that were figured out about adaptations to living at high altitude in humans:

- There are similarities and differences genetically and physiologically between the different populations (Andean, Ethiopian, and Tibetan) that live in low oxygen environments.
- Multiple alleles across many genes and traits play a part in surviving in low oxygen environments.
- Some alleles play a larger role than others in affecting the ability to survive in low oxygen environments.
- Natural selection is complex and typically acts on the cumulation of an individual’s total trait for surviving in low oxygen environments.
- Although these populations live in very different areas around the world, they experienced the same selective pressure of a low oxygen environment.
- The selective pressure has caused a decrease in genetic diversity in these areas compared to their low altitude counter populations.
- There is a LOT of diversity between different human populations!
After students surface these key ideas, Celebrate how much they’ve figured out, then ask if they think they can use what they’ve learned to explain how populations of other organisms might change over time. Facilitate a discussion to problematize the idea of the importance of genetic diversity in species other than humans.

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<td>We saw that genetic diversity for this trait is high in human populations, and we’ve seen some diversity in other organisms we’ve studied along the way. Do you think populations of other organisms have as much genetic diversity as we see in human populations?</td>
<td>Humans all look so different from each other, but when I look at squirrels or fish, or plants they all pretty much look the same to me so I think they don’t have as much diversity. But environments they live in have changed over time, so these populations must have changed too, There must have been diversity at some point.</td>
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Agree that we seem to have some competing ideas about the amount of genetic diversity in nonhuman populations so it seems like we need to investigate this further. Ask students to share ideas about what they might do to determine whether other organisms have more or less genetic variation than humans. Students should suggest they look at variation found within populations of the same species.

Push students to think about what data they would need to examine to determine how diverse different populations were. Students will likely mention trait variation, and some may mention they may need to find information about the genotypes of individuals. Agree that each of those types of datasets would give information if there is variation in the population, and it is much easier to note visible traits rather than finding genetic information for many different populations, so we should start there. You may ask students to list species they can think of (besides humans) that have a lot of diversity.

2. **Give students an opportunity to make predictions about which organisms might have the most genetic diversity based on phenotypic variation.**

Show **SLIDE 4** and explain that we are looking at images of domestic cats and domestic dogs. All of the different dogs shown are members of the same species, *Canis lupus familiaris*, and we can think of the breeds as different populations. The same is true for the domestic cat. Each cat pictured is a member of the same species, *Felis silvestris catus*, and the associated cat breeds listed.

Ask which of these two species seem to have the greatest trait variation. Students will identify the most trait variation in the dog species. Agree that we need to check then if dogs also have the most genetic variation.

Mention to students that you found a video that investigated this exact phenomenon for us. Give students time to create a Notice and Wonder chart and then show **SLIDE 5** and play **Dogs vs Cats: The Diversity Paradox** from 0 to 3:30 minutes.

After watching the video, pass out **Transcript for Dogs vs Cats: The Diversity Paradox**, give students time to add any observations or questions to their chart from the transcript, and then ask students to share ideas from the video. Some key ideas students may notice are:

- **Dogs have more phenotypic diversity, but they are not more diverse genetically than cats.**
- **Only a tiny fraction of dogs’ DNA differs from each other (.1%).**
- **Cats don’t look as different phenotypically, but their genetic diversity is much greater (.4%).**
- **Within a breed of dogs, they look similar to each other, but different from other groups (even though there isn’t much total variation).**
Do all kinds of organisms have a lot of genetic diversity?

- Cats within a breed don’t look as similar to each other, and cats of different breeds do look more similar (even though there is more total variation).
- We thought humans have a lot of variation because we all look so different, but really we don’t have much variation (only .1%).

Ask students if we can rely on visible trait variation to determine the total genetic variation in a population. After they agree that they cannot, facilitate a discussion to surface the idea that we need to compare genetic variation between other living things and ask them what kind of data would help us do this. Use talk moves to get students to voice that the video measured genetic diversity with a number (dogs and humans had 0.1% while cats have 0.4%) and ask if we can look up the value for other organisms too.

Investigate the Phenomenon

What Students Are Doing

In this section, students analyze a dataset to look for patterns in genetic diversity between different populations of the same species and between different species. They find it difficult to see any distinct patterns between any specific type of organisms and amount of genetic diversity given the information on the sheet. Students read about organisms with either high or low diversity and present their findings. They use this new information to make and test predictions about the cause of low diversity reported for some organisms on the diversity dataset.

Teacher Guidance

3. Introduce students to a dataset showing genetic diversity in many different plant and animal species.

   Give students a link that forces them to make a copy of Genetic Diversity Data. (This version of the link will force students to make their own copy.) This dataset is adapted from De Kort, Hanne; Prunier, Jérôme G.; Ducatez, Simon; Honnay, Olivier; Baguette, Michel; Stevens, Virginie M.; et al. (2020): Data and scripts GENETIC DIVERSITY. figshare. Dataset. doi.org/10.6084/m9.figshare.13373363.v1.

   Show SLIDE 6 as you are passing out the dataset and explain what “GDp” and “GDp normal” represents. Give students a few minutes to scan the data and then ask them to work with a partner to list any questions they have about the dataset.

   After a few minutes come back together to address any other questions they may have. Then show SLIDE 7 and facilitate a brief discussion to surface the important features of the dataset (species name, specific population of the species studied, classification of each population by kingdom and phylum, and finally the GDp normal value they will use to compare diversity).

   Students will also notice latitude and longitude is available. If they copy and paste those cells directly into a browser, it will take them to a map, but doing that for all of the organisms will take a lot of time. Encourage students to try to find patterns without accounting for geography now, and reassure them there will be an opportunity to look at this dataset in more depth again later.

   Ask students what else they might want to know to be able to determine if they see any patterns in the data. Facilitate the discussion using talk moves to get students to surface the following ideas:

   - What do these organisms look like?
   - Where/how do they live (habitat)?
Students will likely ask what is meant by position, as well as log longevity and log fecundity. Have a quick discussion, allow students to offer up definitions for longevity and fecundity, then either confirm the student definitions or provide these definitions for them. Longevity refers to the lifespan of an individual, and fecundity refers to how many offspring an individual has. You can leave it at that, or if the students are interested in learning more about how these are determined, you can tell them the researchers used the maximum documented lifespan of an individual in the wild (because that information was most widely available, and for fecundity they estimated the lifetime number of offspring for an individual by taking maximum life span minus age at reproductive maturity (in days) and multiplying by the clutch rate (per day) and clutch size (number of offspring). They transformed the values using a log scale to make them more comparable across species. Students may notice these values are only measured for animals, and that some of the categories are only applicable for plants (i.e., mating, pollination, seed dispersal, and lifeform). SLIDE 8 gives some parameters of what each of the position categories refer to.

4. Organize students into small groups to analyze the dataset to look for patterns

Give students time to work in the “alone zone” and to use the sort functions to see if they can find any patterns in the data. Show SLIDE 9 to help students see where to find the sorting tools in Google Slides. Give them time to experiment with different sorts and be sure to remind them to record any patterns they notice as they are sorting in different ways to share with their small group.

When students have had enough time sorting the data and looking for patterns, organize them into small groups of 3 to 4 and give time to share those patterns and anything else they noticed about their dataset. As they share what they noticed, the group should record their ideas on a whiteboard or chart paper.

Once small groups have finished compiling their findings, organize a gallery walk. Students should record similarities and differences between their own lists and the lists that other groups created.

Once students have compared all of the charts, the class comes together for a consensus discussion to report the findings.

Facilitate a discussion to surface the key ideas. Students may have found some patterns as well. Honor all student ideas by recording them. If the pattern seems dubious, you may poll the class to see if anyone else has seen the same pattern, and if not add a “?” to the listing so we can go back and check for that pattern later.

- Almost all of the populations had some diversity in the loci that were studied—but some had none!
- Some populations had a lot more diversity than others—even if they were the same species.
- Some organisms had high genetic diversity, but some had very low diversity.
- We wonder if there are patterns related to where they live or maybe other characteristics, but the dataset was too large to be able to analyze that very well (even though we had location data we didn’t have time to look up every organism on the list).

Dig deeper into the idea of so many populations having low diversity. Problematize this idea by asking students if they think diversity is even important then, or is it just random that some species have a lot of diversity and some don’t, but it doesn’t really matter. Students will have competing ideas for whether or not the diversity matters. Use that to motivate the next part of the investigation.

Pose the question about investigating the importance of genetic diversity: If we are trying to understand whether it matters if a population has high or low genetic diversity, what data or information would help us answer this question?

Facilitate a discussion to give students the opportunity to say they would like to learn more about populations with low levels of genetic diversity and about populations with high levels of genetic diversity.
**Additional Guidance**

Depending on students’ comfort level with spreadsheets, you may choose to walk students through how to sort data by the different columns. Be sure to click the top left corner cell (left of “A” and above “1”) so the entire sheet is highlighted before sorting. Remind students that the sort function is at the top of the “Data” pull down menu. They should choose “sort range” and “advanced range sorting options” to be able to choose which column to sort by. Encourage students to add additional columns to their sort range as well.

If students find the entire dataset overwhelming, you may choose to assign each group only one phylum or give half the groups the animal kingdom and the other half the plant kingdom to investigate. If students are struggling with where to start, ask them if they have sorted the set by level of diversity yet and then use talk moves to help them decide what other factors they would like to sort by.

5. **Assign each group a reading to learn more about the population and natural history of a specific species.**

Assign each student one reading from the list below:

- Genetic Drift: Bottleneck Effect and the Case of the Bearded Vulture | Learn Science at Scitable
- Chimps show much greater genetic diversity than humans | University of Oxford
- The extraordinary survival story of the black robin (associated video with this reading: The Man Who Saved the Black Robin)
- Inbreeding Causes Isle Royale Wolf Population Crash | American Association for the Advancement of Science (AAAS)
- Not all is rosy for the pink pigeon
- High levels of genetic diversity and population structure in an endemic and rare species: implications for conservation - PMC
- Population-level genetic variation and climate change in a biodiversity hotspot | Annals of Botany | Oxford Academic

Show SLIDE 10 and ask students to work in the “alone zone” as they interact with their reading, using the Connect-Extend-Question tool to organize their thinking as they read about their assigned populations with the purpose of answering the questions “What causes populations to have very high diversity or very low diversity?” and “Is it important to have genetic diversity?”

Students assigned the same reading combine in a group and discuss what they learned, and create a small group consensus chart answering what they learned that could help answer the two questions “What causes populations to have very high diversity or very low diversity?” and “Is it important to have genetic diversity?”

Once small groups have finished compiling their findings, organize a gallery walk. Students record similarities and differences between their own lists and the list that other groups have created. As they are doing this, encourage them to also jot down any new ideas or connections they are making or questions they might have.

Once students have compared all of the charts, bring the class together for a consensus discussion to report the findings. Facilitate a discussion to surface the key ideas. Ask students if they found any patterns among the species or populations that had very high diversity or those that had very low diversity. As students are sharing these ideas, record them on a whiteboard or chart paper in a place all students can access.
Do all kinds of organisms have a lot of genetic diversity?

High School • Discipline: LS

- Genetic diversity can be lost when populations get very small
  - Bottleneck (population was once very small then got big from those few individuals, which can result in high load of detrimental mutations)
  - Drift (alleles randomly disappearing from small populations because they were not passed on during mating)
  - Inbreeding (in small related populations there is a high likelihood of offspring receiving two recessive alleles for a detrimental or harmful trait)
- The larger a population, and the more population genetic diversity, the likelihood of a population surviving a changing environment also increases.
- Genetic diversity is being used in conservation plans for different species.
- Rapidly changing environments due to climate change, habitat loss, etc., create a dire need for diversity.
- For plants, dispersal ability, generation time, reproductive ability, degree of habitat specialization, and plant–insect interactions, as well existing genetic diversity determine how well they do in the face of rapidly changing environments.
- Low genetic diversity in rapidly changing environments puts species at high risk of extinction.

Once students have shared what they have learned, ask them what they would expect to see if they did some research on some of the organisms from the dataset with very low diversity. Students should say that the organisms may be threatened or endangered and have a very small population, or the population has made a comeback, but it was once endangered, or due to selective breeding much of the variation in the population has been lost. Give students time to do a quick search to test their predictions. Show slide 11 and tell students to re-open the dataset and sort it (from low to high) by GDp normal (row F). They should choose an organism they are interested in on the first or second page to search for more information about, using the scientific name.

Ask them read about the organism to see if they can find any information to support their predictions for why their diversity is so low and to return to their small groups to share their findings.

Optional Extension

Students may be interested in going back to the dataset and sorting with more purpose now that they have some background information. If you have time to do this, students will find it valuable to be able to see patterns related to position, which may also help them think about the research they would like to do for the next lesson.

Reading Support

There are articles at several reading levels available. Each article has also been modified to be a level below the original reading level. Look over the resources to determine ahead of time which article (and which version of that article) will be most appropriate for each of your students.

Extension Opportunity

The lesson only asks students to make predictions about species with low genetic diversity. If students are interested in looking to make predictions about why some of the organisms have high diversity, support them to think beyond just population size. After all, humans have a large population size but very low diversity. Guide them to also think about how populations are distributed and whether those populations are genetically distinct from each other. Considering geographic range (wide or narrow), habitat specificity (broad or restricted), and local abundance (somewhere large or everywhere small) is important when looking at reasons for high and low diversity.
Explain the Phenomenon

What Students are Doing

In this section, students return to their initial Driving Question Board to determine which questions they had can now be answered. They then use what they have learned throughout this unit to explain how genetic diversity is maintained in populations and why genetic diversity is important and think about how they want to use this information to learn more and to help educate others.

Teacher Guidance

6. **Support students to create a Gotta-Have-It checklist of components and to describe the interactions between components.**

   Give each student a copy of L7 Exit Ticket - How is genetic diversity maintained in populations and why it is important? Give students time to work in the “alone zone” using what they’ve learned so far in this unit to create a Gotta-Have-It checklist of components and an initial description of the interactions that must be included in their explanation.

   Ask students to work in small groups to compare their lists of components and interactions, and give individual students time to update their own lists and descriptions of interactions based on what the small group shares.

7. **Facilitate a discussion to build a class consensus Gotta-Have-It checklist.**

   Bring all students back together as a large group. Allow each group to share one of the components from their list (that has not already been shared), and as they share, list the components publicly on chart paper for the whole class. Continue allowing each group to share a component until all groups have shared everything. Use the same procedure to chart the interactions between components that will be important to describe in the interaction as well.

   As students are sharing, use talk moves to clarify student thinking as the components and interactions are shared to ensure that complete and clear ideas are present on the whole class chart.

**Components students may list:**

- population size
- alleles for different trait variation
- reproduction/breeding
- inbreeding
- random loss of alleles in small populations (drift)
- bottleneck or founder’s effect (random frequency of alleles due to small population size)
- changing environment
- migration/gene flow

**Interactions students may describe:**

- If there is a lot of diversity in the population when the environment changes, it is more likely there will be individuals within the population that will survive.
- Events that lead to low population size often also result in low genetic diversity (bottle necks, founder effect, etc.).
- Low genetic diversity puts populations at risk when the environment changes because alleles that could have conferred trait variation that would be advantageous in new environment are less likely to be present.
**Additional Guidance**

While exit tickets are certainly an opportunity for assessment, students should not feel like they are being tested. Rather, they should feel like this is an opportunity for them to demonstrate what they know. Giving all students the tools and support to show what they know is not lowering the bar. Students differ in their ability to recall specific terms (memorize stuff), and that differing ability sometimes makes it tricky from a teacher’s perspective to distinguish what students understand and what they are simply reciting back. By giving time and support to build the pieces that would normally be memorized by some students, we are giving all students the same opportunity to then SHOW us what they know in their explanations so we can assess what ideas they have ownership of, and where there may still be some gaps in understanding.

8. **Give students time in the “alone zone” to write a final explanation to answer “How is genetic diversity maintained in populations and why is it important”?**

Ask students to flip their exit ticket over and to use the Gotta-Have-It checklist of components and interactions to explain how genetic diversity is maintained in populations and why it is important. Provide time for students to finish this explanation in class and collect the exit ticket to assess and provide feedback.

9. **Revisit the Driving Question Board to give students the opportunity to reflect on what they figured out.**

Celebrate what we’ve figured out over the course of the unit. Instruct students to use the models and explanations, along with any artifacts they’ve created as a class, to identify questions from the Driving Question Board on which they’ve made progress.

Facilitate this by reading the questions from the board, asking students if they’ve made progress, and if so whether or not they’ve completely answered their question, or if they still have lingering questions. Organize the questions into groups that are “answered,” “partially answered,” and “we didn’t really address.” Of the questions they feel we haven’t really addressed, they may now realize that some of the questions weren’t related, others were tangentially related, and some may have been too specific to answer directly in this unit.

10. **Navigate to the next lesson**

Once students finish organizing the Driving Question Board, motivate the next lesson by saying something like “We’ve been looking at a lot of examples in this lesson and throughout the unit. As we were learning, many of you were probably thinking about traits of organisms that you are interested in learning more about or learning to explain. Maybe there is an organism on the diversity data list you became interested in studying, or maybe you really want to figure out one of the unanswered questions on the Driving Questions Board.” Ask students to work in their small groups to create a list of interesting populations of organisms, or trait variation in populations of humans or other organisms they would be interested in trying to explain, or unanswered questions they have (that they may now be able to answer using what they’ve figured out over the course of this unit). Say, We will use these lists and any other ideas you might think of to kick off our next lesson.