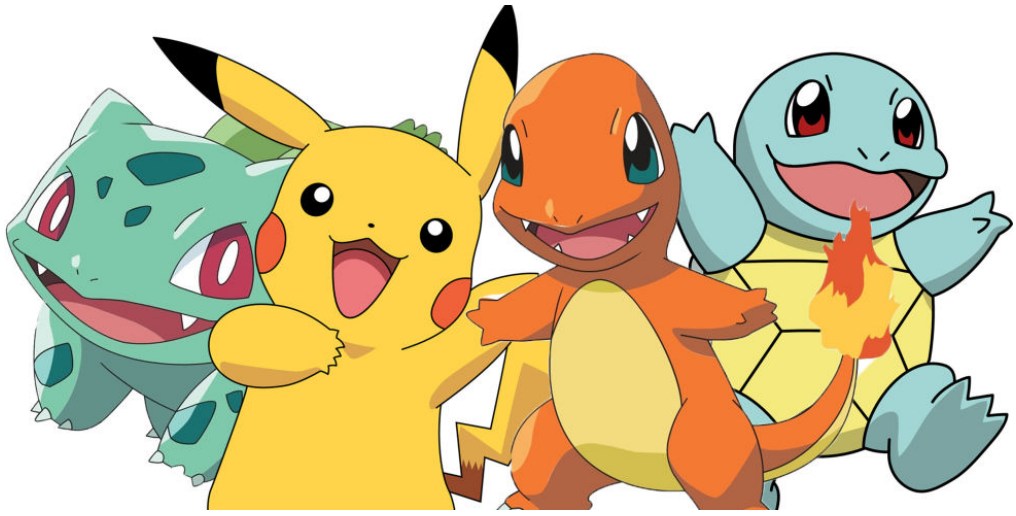
Pokémon… Go!

Meghan Antol

Grades 3-5

July 20, 2017



Introduction

Rationale:

Through this unit, students will examine different patterns of evolution and trait resiliency in order to draw their own conclusions about evolution's influence on survival. They will use a variety of lenses to study several different species, existing in both the past and present. Ultimately, the goal is for students to analyze different traits for their effect on species' resiliency, applying this newfound knowledge to create the most resilient Pokémon creature design possible.

This unit aligns directly with the North Carolina Standard Course of Study Life Science standards for 4th and 5th graders, which examines the effects of adaptations and behaviors on animal survival. Studying these skills gives students precursory science knowledge of ideas such as "survival," "resiliency," and "traits" that move more toward the tenets of natural selection and genetics in middle and high school standards. The way in which this unit incorporates informational texts, writing, and math concepts as well ties directly to the Common Core State Standards, helping students to build other essential critical thinking skills. As they examine informational texts and actively discuss them with peers, students are using analytical skills to evaluate, formulate, and defend their own opinions on the multiple perspectives being examined. In math, students will be asked to examine data sets and create their own graphs in order to present their findings on resiliency. Ultimately, the variety of content and skills presented throughout this unit will help to build critical thinking skills that can be widely applied to many disciplines. Through the lenses of evolution and adaptation, students ultimately examine the concept of survival, which is omnipresent in many spheres and disciplines.

Teaching this universal content is also essential because its examination builds lifelong problem solving skills. For example, a key emphasis in standards such as 4.L1 ("Understand the effects of environmental changes, adaptations and behaviors that enable animals (including humans to survive in changing habitats") demonstrates that students are expected to apply what they have learned about adaptation to the human element as well.[1] Through this unit, students will build knowledge through, many lenses, including that of the animal kingdom. However, as students progress beyond this unit and continue their study of these standards, they can apply their knowledge to many situations, such as the human situation, ultimately drawing conclusions and brainstorming solutions about the longevity of human survival, a problem essential to our very existence.

Moreover, this unit is unique in the way that it extends content knowledge into independent design. Rather than just being asked to regurgitate facts about species' resiliency at a knowledge level, students are challenged to apply their knowledge, creating a brand new Pokémon and then

[1] http://www.dpi.state.nc.us/docs/curriculum/science/scos/support-tools/new-standards/science/3-5.pdf

working to justify why their creation is the most resilient. By looking at these concepts through the lens of Pokémon, the content is made highly relevant and interesting to students, but also fosters skills such as creativity, art, and presentation that are highly applicable across curriculum and essential in formulating creative thinkers and lifelong learners.

Differentiation for Gifted Learners:

Though it is sometimes hard to generalize gifted learners due to their diverse needs and interests, this unit does fit the needs of many of these learners through elements such as depth, complexity, and advanced content. This unit is a week long, in-depth study of one concept. As such, students are given the time to make connections about one concept through different lenses, which in turn facilitates patterns of thinking that fit gifted learners' abilities to process quickly and more deeply.

The content of this unit is uniquely adapted to gifted learners in many ways. The articles, readings, and texts used in each lesson contain advanced vocabulary and concepts that are particularly suited to gifted learners. Many of the texts are complex scientific texts, which surpass grade level content and will challenge the analytical skills of the gifted. Moreover, the variety of sources pushes gifted students' critical thinking skills through the examination and evaluation of multiple perspectives. Including third grade students in the suggested cohort does allow for some aspects of grade level acceleration, as evolution and survival are not part of the third grade science course of study.

Much of this unit's process is geared toward independent inquiry, research, and discussion with other gifted peers. In addition, questioning in this unit is differentiated specifically towards gifted students, focusing on higher levels of questioning that add complexity and depth to the content. Students are challenged to answer and also create their own open-ended responses throughout the unit, which again advances the complexity of both the content and their thinking. Moreover, students will be introduced to several different models through this unit that are research based and geared directly towards gifted learners, such as a Socratic Seminar, Simulation, and a lesson based on Bruner's Structure of the Discipline. These types of lessons allow for collaborative work and student-initiated exploration, which again fits the need of gifted students for challenge and creative, open-ended problem solving.

The way in which students are challenged to apply their learning in a final creation of their own species requires high levels of critical thinking and processing that are geared towards gifted abilities. Rather than simply comprehending or restating the facts learned, students must successfully apply what they have learned and be able to justify why their creation is highly resilient, based on facts and research. The independence with which they can research and design allows for creativity, individualized pacing, self-direction, and choice, all characteristics that often appeal to learners with high abilities.

It is suggested that this unit is taught to a small group or class of clustered gifted students. This learning environment provides unique opportunities for discussion of big ideas with students of like ability, which will further push student thinking and provide additional challenge. Opportunities for collaboration in design and research within this learning environment will also foster a setting of challenge and push the complexity of student work.

Intended Population of Gifted Students:

This unit was designed for gifted third through fifth graders. Students who have gained at least a basic knowledge of the Pokémon games, either through playing the video or card games, may benefit more from this unit because they will most likely be deeply invested in the content. I have found that this unit is highly applicable across all socio-economic groups. Though children from higher socio-economic groups might have increased access to video games and more background knowledge from experience, children from all backgrounds have access to both the games and cards and seem to hold an equal interest in exploring concepts around this topic.

Moreover, background knowledge of the game is not a necessity. Students who are interested in design, art, science, or animals might also be attracted to the content of the unit. In fact, through teaching this unit, I found that some students who held an almost singular interest in the Pokémon game itself were a bit frustrated by the exploration of other content areas and the amount of focus on real world animals and adaptation.

Students should also have a basic working knowledge of reading and analyzing informational texts. A past exposure in how to conduct independent research is also helpful as students begin to design their own Pokémon creatures.

This unit appeals in particular to students who are highly creative and enjoy making connections that go beyond the literal. Highly literal students may be frustrated by the imaginary premise of being evaluated by "game developers," as well as activities such as the Bruner lesson, which ask them to imagine and invent scenarios. Artistic students may enjoy this unit because of the openness to show their creations through a variety of mediums, including drawing and clay, though the flexibility in the Summative Assessment also allows less artistic students to do just as well. It will appeal to students who enjoy self-directed pacing and a high amount of independence. In creating their final product, students may decide what direction their research takes and are given complete freedom in how they can present their creature in order to make it appeal to the "game developers" during a final gallery walk. In addition, the way in which this unit incorporates group work and high levels of discussion will appeal to students who enjoy debating or considering big ideas with peers.

Though this unit does not spend a lot of time building background or base level knowledge, it will fit a wide range of gifted abilities. Those students with less background knowledge can meet their needs through differentiations in independent research. In general, student needs may include ample opportunities to share their background knowledge of Pokémon or design

progress, as many students who self-select this unit will most likely have an intensified interest in the game and its various creature's traits. Students may also need additional support with how to conduct successful research as well as continued open-ended questioning that pushes their designs past the surface level, to relate more deeply to the concept of survival. Despite high-level abilities and potential, some participating students might be lacking background opportunities that have previously pushed them to think at these different levels.

Goals and Outcomes

Content Goals and Outcomes
GOAL 1: To develop an understanding of how and why different species change over time, as related to factors such as environment.

Students will be able to...

1. Describe ways in which animals of the same species subgroup are similar or different from previous generations.
2. Describe ways in which animal adaptation can be influenced by environmental factors.
3. Examine sources on species' evolution and justify why traits have developed.
4. Recognize that evolutionary traits can be both behavioral and physical in nature and draw conclusions about the causes and effects of both on species' resiliency.

Process Goals and Outcomes
GOAL 2: To develop analytical skills, with application to science.

Students will be able to...

1. Analyze information to find trends and create generalizations.
2. Create inferences based on observational, text, and discussion data.
3. Analyze multiple perspectives on a given issue.
4. Draw conclusions about the effects of trait evolution on survival.
5. Justify opinions based on information gained from a variety of sources.
6. Apply scientific methods to observation and critical thinking practices.

Concept Goals and Outcomes
GOAL 3: To understand that evolution influences survival in many ways.

Students will be able to...

1. Apply inferences about evolution and survival to a newly encountered species or situation.
2. Formulate open-ended questions that further explore how evolution influences survival.
3. Predict the impact of various traits on future survival.
4. Work both a group and as an individual to designate factors that will influence survival (and justify why using clear examples).
5. Express opinions through a clear presentation of their argument, whether verbal or visual.
6. Create an independent design that demonstrates and justifies how evolution influences survival.

Assessment Plan

Lesson 1
Formative Assessments

- Teacher's informal observation of the warm up activities. Teacher is observing and listening to initial responses to gain information on students' background knowledge and interest on the topic.
- Teacher observation of the "bird" interaction. Students will be given verbal feedback based on their participation in the mini-simulation. Teacher also informally observes anecdotal notes to gain evidence of student connections and background knowledge. Teacher is looking for detail and increasing knowledge of the ways in which traits influence survival.
- Writing prompt at the end of the lesson: "how does evolution influence survival?" Teacher is looking for responses that point to specific traits or examples that justify ideas.

Lesson 2
Formative Assessments

- Teacher's informal observation of student discussion surrounding video game designers.
- Teacher's observation of the Bruner process, including student discussion as well as written "lab notes" and sketches in response to the scenarios. Teacher is looking for student abilities to compare and contrast information and make inferences that relate to the concept of survival.
- Teacher observation of student letters written to the development team at the end of the lesson. Teacher is looking for responses that add depth to yesterday's exit ticket as well as the discussion of the discipline at the beginning of class (i.e. a response which contains vocabulary related to design or multiple examples of how traits can influence survival).

Lesson 3
Formative Assessments

- Teacher observation and anecdotal notes during Socratic Seminar. Teacher is looking for student synthesis of ideas, ability to analyze multiple perspectives, and ability to justify opinions based on text (and build off of other students' opinions).
- Teacher observation of student recording sheets for Socratic Seminar. Analysis of the last questions on the sheet will especially be important to look at student contribution in a non-verbal way (see checklist attached to Lesson 3).
- Peer Analysis of design progress (see checklist attached to Lesson 3).

Lesson 4
Summative Assessment

- Evaluation of Performance Task using Rubric (see below)

Daily student discussion and writings will be the biggest indicators of content and process goal mastery as students examine the concept through multiple lenses and educational exposures. All three areas (content, process, and product) will be seen through work on the final performance task. Though each student is responsible for creating their own unique Pokémon, the process and product of this task is left very open-ended, providing for creativity and fluid thinking about

the concept. In addition, a rubric is provided to guide the teacher towards evaluating student mastery in all three areas. However, the teacher could also choose to have the students create their own rubric as a class with which to evaluate the Summative Assessment. This change would allow students to further analyze both the concept and what the final product is asking them to do (and why).

Final Performance Assessment

The Pokémon game designers are hard at work creating their newest Pokémon game! They are seeking a unique character to make their new game even more interesting and have hired you as a character developer to help with this job. Your task is to design a creature whose evolutionary traits will help it to "outlast them all!"

You will work with your team of fellow developers to research and evaluate different evolutionary traits that have helped species to outlast competition throughout history. Based on your conclusions, you will create a prototype, showing an entirely new Pokémon that would evolve to be a strong candidate in the new game. Your prototype will show the creature in its most advanced evolutionary stage, pointing out traits that add to its resiliency. Your model will also be accompanied by a self-narrative that will help explain, from the Pokémon's own perspective, the evolutionary path of your species and insights into experiences or challenges that show the species' survival along the way.

Your species will ultimately be showcased through a gallery walk that shares your prototype, its evolution, and its story with the game designers. Your gallery walk presentation should be professional, but remember: creativity is key! You need to catch the designers' attention and effectively convince them that your creature is the best candidate for their game. Be sure to include evidence from your research or team experiences and your Pokémon's own narrative so the developers understand why your creature's evolutionary process and resulting traits truly make it more of a survivor than the competition.

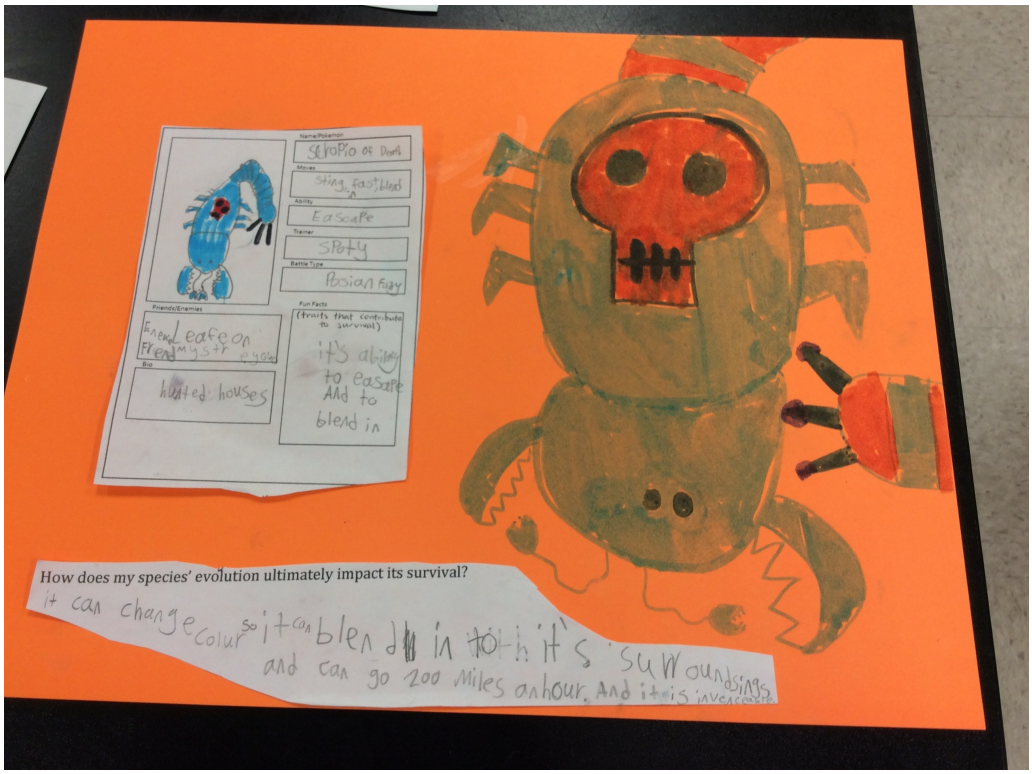
Evaluation of Performance Task Rubric

Student name: _____

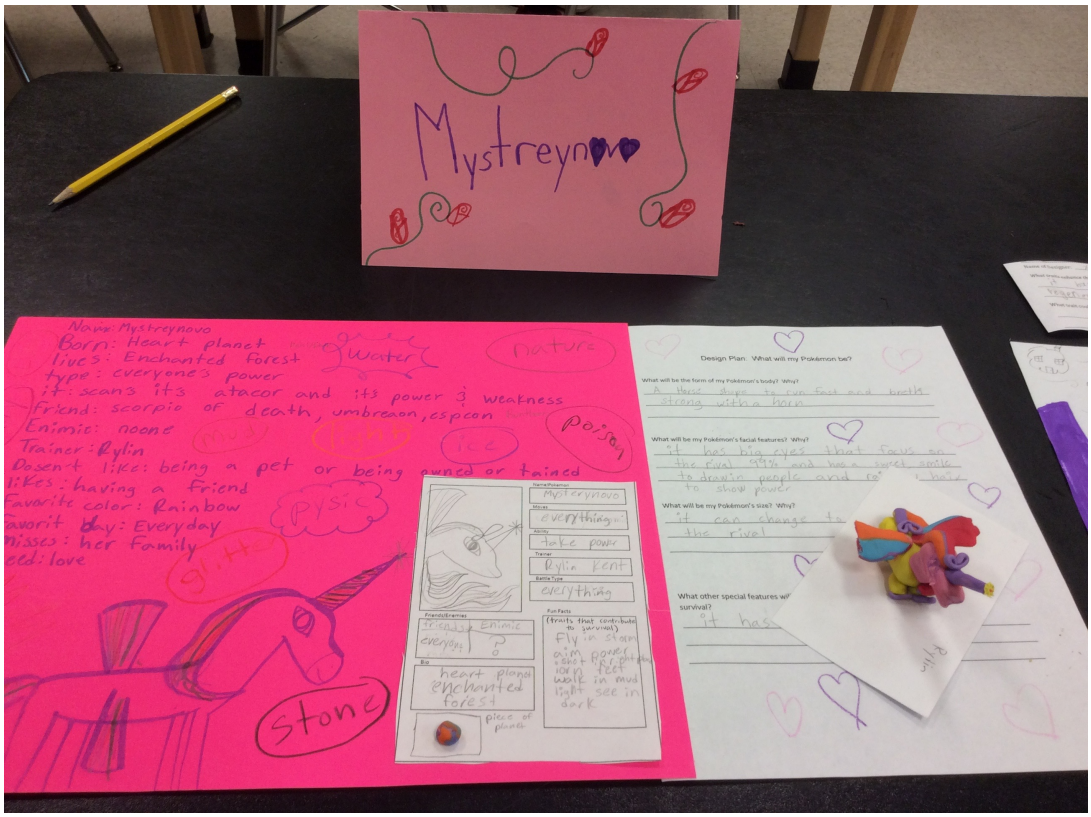
	1	2	3
Depth of Content Knowledge Displayed	Student responses and presentation do not mention either evolution or survival. Design does not connect how species' evolution influences survival at all. Student is unable to verbalize how their design relates to survival when prompted.	Student responses and presentation mention evolution and survival. However, connection is not clearly verbalized. Justification includes less than 2 ideas from texts or outside research. Student can somewhat justify reasoning behind design and how it relates to survival. Prompting may be needed to make stronger connections to concept.	Student responses and presentation clearly show how species' evolution influences survival and is supported with at least 3-4 ideas from texts or outside research. Student can clearly justify reasoning behind design and how it relates to survival. Prompting is not needed; it is clear that the concept of survival was essential to the design.
Prototype	Student did not create a prototype and/or drawing to present to game developers.	Students' prototype and/or drawing are somewhat unclear or sloppy. Prompting may be needed to make stronger connections between traits displayed and concept goals.	Student prototype or drawing is clear, neat, and precise. Student can clearly justify prototype without prompting; concept of survival is clear in design.
Presentation	Presentation is not as unique, creative, or professional as desired. The focus audience of game developers is not at all clear.	Presentation is somewhat unique, creative, and professional. The audience of game developers may not be clearly defined.	Presentation is highly unique, creative, and professional. The audience of game developers is clear.

Additional Notes:

Examples of Student Assessments:



How does my species' evolution ultimately impact its survival? *It can change color so it can blend into its surroundings and can go 200 miles per hour.* As was explained through his presentation, the design was originally all red, but the student had it evolve to blue in order to adapt to an ice age. He was worried that it would mostly need defense mechanisms to survive, based on its small size. Therefore, he believed blending would be a primary trait it could develop to help it hide from enemies it did not see approaching, and a light blue would be best to blend with ice. However, the red skull would remain to still warn predators of its potential danger (stinging abilities). For bigger predators that could not be scared by the skull appearance, he gave the creature high speed running abilities in yet another evolution, which was especially applicable to help it outrun another environmental change: more frequent and heavy rains resulting in mud (creature could run fast over the mud as well).



How does my species' evolution ultimately impact its survival? As seen in her written explanation, the student created a species with a beautiful appearance, so that the creatures could draw in and attract enemies for the purpose of defeat. She chose to have the creature evolve when an ice age hit to develop a trait that promoted longer hair "so that her species' could more effectively stay warm in cold temperatures." She based these ideas off of Socratic Discussion and research on the Woolly Mammoth. Though this students' explanations deepened her thoughts about evolution's influence on survival, I would rate this student a "2" on my designed rubric. Given more time, I would have questioned her to research and justify her relation with the Wooly Mammoth more fully (the Wooly Mammoth is now extinct, how does this effect your views on survival?). I also would have pushed her presentation to keep in mind more fully the audience and once again justify more aspects of evolution and survival.

TEACHER NAME			Lesson #
Meghan Antol			1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Questioning	**Science**	**3rd-5th**	

CONCEPTUAL LENS	LESSON TOPIC
Evolution	Animal Adaptations

LEARNING OBJECTIVES *(from State/Local Curriculum)*

Science Standard Course of Study:
4.L.1.4 Explain how differences among animals of the same population sometimes give individuals an advantage in surviving and reproducing in changing habitats.
5.L.3.1 Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

English/Language Arts Standards:
RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
RI.3.6 Distinguish their own point of view from that of the author of a text.
RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g. in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
W.4.4, W.5.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience
SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Math Standards:
3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets.
3.MD.B.4 Show data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.
4.NBT.B.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Evolution influences survival	***How does evolution influence survival?***

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
-Students will know that an organism's characteristics can be similar or different from previous generations. -Students will know that animal adaptation can be influenced by environmental factors (i.e. available food sources, predators living in surrounding environment). -Students will know that adaptations often take place based on an organism's desire to increase chances of survival. -Students will know that possessing certain traits can give	Students will be able to… • Students will recognize ways in which animals of the same species subgroup are similar or different. • Organize and classify details in order to draw deeper conclusions • Compare and contrast information to form opinions on desirable species traits • Draw conclusions about the effects of trait evolution on survival • Analyze text to identify big ideas about evolution and

some organisms an advantage over others.	survival • Work collaboratively with a group to present a project that represents deeper understandings about advantageous traits and survival • Analyze data to determine trends. • Craft and pose open-ended questions that require high levels of thinking and processing.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
-What is a "trait?" -What does it mean to "survive?" -What are the elements that make up "evolution"? -What are some species that have changed and adapted? - What causes species to evolve over time? -What determines whether or not an organism evolves? - What happens to species that choose not to evolve? -Why do organisms evolve in different ways?	-When you picture a bird's "evolution," what do you see? -How is a Pokémon like a bird? -How do factors in the environment shape evolution? -Which factor plays the greatest role in causing an organism to evolve? What makes you say that? -What conclusions or connections can you draw from the graph you created? -How does the evolution of birds relate to other species in nature? -If you could adapt, or evolve, another part of the bird's body to make food collection easier, what would it be and why? How would you justify what choices would be best for your species, in consideration of its survival? -How do the charts or pictures in the text inform your opinions on evolution? -In what ways can you challenge these texts? (Which of the author's points do you question and why?) -Which overall trait's evolution has the most net impact for the species' survival? What evidence did you use to support your choice? -What are other ways a Pokémon or animal could survive, if they do not evolve? How do you predict these ways would impact survival, in comparison to an evolutionary path?	-What factors influence whether an animal adapts or remains the same? -How can we determine which traits are most advantageous for survival? -How can evolution be positive? How can evolution be negative? -What is the impact of behavioral vs. structural evolution in species? If a species could only choose one of these ways to evolve, which one should they choose? How would you justify your answer with ideas from the text? -If you could create an evolved species that was highly geared towards survival, what traits would it have? What evidence supports your choices? -What generalizations can we make about the evolution of birds? How does our work with birds today relate to the evolution and survival of Pokémon? -How would this experience have been different if we had looked at another animal species? What do you predict this animal's evolution would have looked like? -In what ways is this animal like a Pokémon? -How does evolution influence survival?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment

The readings used in the lesson contain above grade level text and advanced vocabulary that is geared toward gifted learners.	During reading, students will be grouped according to both readiness and preference. Some students will be reading in partners, while other students will be reading independently. They will answer questions about the text based on their groupings. Students will also be asked questions that require higher levels of critical thinking.	Students will use a variety of materials to create an original creature “to outlast them all” (a creature including a combination of evolutionary traits that will most positively impact their survival). The student-driven nature of this work and the high levels of critical thinking involved in the creation process are geared towards gifted learners.	

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Icebreaker: *Welcome to SPARK camp! I am excited to meet each and every one of you. You are each here because your outstanding knowledge identified you as someone who would be a great character developer for the Pokémon game designers. They are looking for someone who will come up with the winning concept, someone who can help to invent the next Pokémon "to outlast them all!" We'll learn more what that means soon. But first I want to learn more about you, and I know you probably want to meet the other potential character developers in this room!*

Place students in a circle. *Let's take a second to introduce ourselves. When I pass the Pokeball around the circle and it comes to you, go ahead and tell everyone your name and what school you go to. Then tell us a little about your favorite Pokémon. Why do you think this Pokémon has survived over time?* (Students have a chance to tell their names and introduce themselves).

Now that we know each others' names, we will play a quick game to get to know your other character developers a bit. (Have students sit in a row, so that they cannot see what's taped to their backs).

I will tape the name of a Pokémon on each one of your backs. It is very important that you do not look at the name on your back, as that will give the puzzle of our game away! And remember, the bosses at Pokémon are already looking for really hard-working employees who try their best and use their intelligence to solve different puzzles. So make sure you show them your best (and very honest!) work!

You will be paired with a partner. One partner will be the "guesser," the other will be the "helper." The helper must first look at their friends back to see what the clue word is. Make sure not to tell, keep it to yourself, because your partner has to try and guess what is taped to their back (you don't want to give them the answer.)
Questions to ask: What are three adjectives that describe my Pokémon?
What is a characteristic that makes my Pokémon unique?
What is something my Pokémon is similar to?
What is something my Pokémon is very different from?

As your partner gives answers to your question, you try to guess the name of your Pokémon. If you get it correct, you get to switch roles! Now you get to give answers to your partner's questions. If you both finish, you can walk to find another partner and can play again!

Teacher starts by pairing each student with a partner, and then students circulate freely to play the game. Teacher circulates to assist as needed.

After a few rounds, the teacher calls the students back to the meeting space to discuss the task for today.

Before we act as character developers, the Pokémon design team needs us to consider information and conduct some research on what traits would be most beneficial to create the Pokémon "to outlast them all."

Teacher asks the Pre-Lesson questions (listed above). Students are encouraged to formulate their own questions after responding to the teacher's questions.

Today we will study birds in different ways to see first-hand how this species' evolution, the way it has changed over time, has influenced its survival.

When you picture a bird's "evolution," what do you see? How is a Pokemon like a bird?

Teacher sets the scene for students and "transforms" students into birds by handing out feather necklaces (or a similar prop) to designate them as birds: *You are now all birds. While many birds collect food throughout the entire winter, some birds such as crows and jays often work to store some food ahead of wintertime. It is just about time for winter, and as crows and jays we have a job to do today: collect as much food as possible so that we can be prepared for the winter and do not go hungry*. (Points out colored papers, balls of various sizes, small marbles, slinkies that are the "worms," and objects scattered around the room) *These objects represent the food that is scattered throughout the forest habitat of a bird, such as berries, worms, or nuts.*

Each bird in our group has a "nest" (an envelope or basket with the student's name on it). Students store their nest in a safe place, off of the ground.

Teacher selects a few student volunteers. Our first group of birds all has the same kinds of beaks. They can only pick up food with their elbows like this (demonstrate). *Ask: What might be some effects of gathering food using this trait?*

Remind students that they must walk into the "forest." Stress to students that birds glide gently to their food, they do not hunt or run their food down. When students find a piece of food, they should pick it up (one at a time) and return it to their "nest" before collecting another.

Come back as a group to discuss the results. Ask: *How does the birds' performance influence their survival? How could we improve this bird's survival?*

As time went on and years passed, some birds found that they could not collect enough food to survive. They could not compete and get ahead of the other birds. Therefore, some birds evolved to help them gather more food in a shorter amount of time. Some birds in our group have adapted to develop a sharper beak than the other birds (hand some students a sharp pencil that allows them to "stab" at objects with their "beak"). Some birds in our group have evolved to develop a flat beak (give them a plastic scoop shovel to use as a "beak"). Other birds evolved to have a very long beak (give a long sock to wear over both arms).

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Student volunteers act out their assigned roles as an evolved bird, while other students act as observers and record observations. Students will be asked to reflect on what they observed in regards to the bird's evolution and to record initial thoughts about changes observed and views of survival.

When all food is collected, students will be given a blank piece of poster board (one side blank, one side "ghost gridded" with light graph paper outline) and work with a partner to tally results (how much food collected for each species) in a graph of their choice.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Students come back as a whole group to discuss the learning experience and the data in their graphs.
- *What conclusions or connections can you draw from the graph you created?*
-Which of these evolutionary traits is most advantageous for the birds' survival? What evidence supports your choice?
-If you could adapt another part of the bird's body to make food collection easier, what would it be and why? In what ways would you adapt that body part to best ensure survival for your species?

Students are divided into two groups according to preference and abilities to explore the topic through text. One group will be independent reading, the other group will be partner reading. Students will be given two texts: "The Evolution of the Kiwi" and "City Birds," along with informational tables, which show different traits of birds and how they have adapted to fit various purposes. The tables are found at this website:
https://www.cpet.ufl.edu/wp-content/uploads/2013/03/'Adaptation-Artistry'-Activity-Exploring-the-Importance-of-Adaptation-to-Birds.pdf
(Articles are attached to the end of this lesson)

Students are encouraged to formulate their own questions as they are reading the text.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Students answer the "During Lesson Questions" at this time (listed above). Each student or partner pair is given a question to answer in writing. Answers to all questions are then discussed with the whole group.

The teacher introduces the End of Unit Pokémon Design Project:
As many of you know, Pokémon are unique creatures that actively evolve and find unique ways to survive. As a part of this class, we will be thinking about evolution to design a creature that can outlast them all. The Pokémon game makers have heard that you are great designers and scientists, and we will eventually have to convince them that your Pokémon character is the best for the game.

To get us thinking about how to design the best Pokémon, we will first use what we learned today about birds. You will be working with your team to design an imaginary bird that contains traits that will help it to survive.

Tell the students their group will each have a chance to design their own original bird – one well adapted to its habitat. Each student/group should decide:

1. Where the bird will live
2. What it will eat
3. Its type of mobility
4. Its defenses

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Students work with their group to brainstorm and list their traits that they want to use. They will work to create a model of the creature out

of clay, construction paper, or using writing and paper and pencil.

Students will work with their group to justify why the traits they chose make the animal one that has a high chance of survival. Discussion is student-driven, with teacher floating to help discussion flow as needed (i.e. what can you tell the group about your animal? What ideas were you considering as you created your design? What potential difficulties might your animal face with the traits you chose? What potential strengths could your animal possess? Why? If you could change one thing about a group member's design, what would it be? Why?).

Explain to students: Before we wrap up today, you will have a chance to display your creation in a display. This display is showing possible prototypes and early ideas for new Pokémon creations to help inspire potential designers.

Since your creature cannot speak on its own, you will get to be its voice today. You just worked to discuss your traits and defend your creature's ability to survive to your group. Now, you will write a short narrative from your creatures' perspective to introduce your creature to the guests that come to see him or her in the display. Make sure to tell what life might be like for your creature (from his point of view) and different triumphs or struggles he or she might experience as a result of the traits he possesses. We will display your creature's story next to the creature so the visitors can read his story and learn more as they see him or her in the display.

After independent work time, the teacher calls the class back to do a gallery walk of all the creations. She asks the class the Post Questions (listed above) and students volunteer answers.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Today we studied the different ways that birds evolve, or adapt, in order to compete and survive. What generalizations can we make about the evolution of birds? How does our work with birds today relate to the evolution and survival of Pokémon?

How would this experience have been different if we had looked at another animal species? In what ways is this animal like a Pokémon?

The teacher asks students to reflect on what they learned today and the question: How does evolution influence survival?

Students work independently to write a response to the question.

Icebreaker Cards (to be taped on students backs for game)

Squirtle	Pikachu
Eevee	Ditto
Bulbasaur	Raichu
Mewtwo	Lapras
Sylveon	Magikarp
Slowpoke	Blastoise
Psyduck	Dratini

Cubone	Gastly
Jigglypuff	Marowak
Abra	Haunter
Grimer	Steelix

City Birds

Take a look at all the birds in your backyard sometime. Chances are you'll see several different types of birds, each with different beaks, coloration, body shapes and bills.

These birds live in the same basic habitat – the city. So why are they so different?

If all birds ate exactly the same food, lived in exactly the same place, and tried to raise their young in exactly the same habitat, they would all be competing for the same types of food, water, shelter, and space.

Fortunately, different birds fill different **niches** (areas within the habitat). Over time, they've developed special ways to adapt to their unique place in the environment so that they have a better chance of surviving.

Some of these adaptations or changes are physical, like the shape of the bill. Some adaptations are behavioral, like singing a special song.

Usually, the physical and behavioral characteristics that get passed along through the generations are the traits that help the bird survive the best.

One of the cool ways to see how a bird has adapted to its environment is to take a close look at its bill and feet. Bird beaks and feet come in all shapes and sizes. Each is equipment especially suited to help that bird find food and raise young.

Birds have also developed special wings and body coloration to help them survive. For example, the short, rounded wings of pheasants and quail help them make quick take-offs to escape predators. Some birds of the prairie have developed special coloration that helps them blend into the tall grass and wildflowers, so predators can't find them.

A Kiwi is a bird that lives in the country of New Zealand. A Kiwi's body has evolved over time in ways that maximize survival in its environment. Traits such as nostrils and a larger body help to maximize its' survival in unique ways.

Evolution is when an organism adapts to become increasingly well suited to living in a particular habitat. These are changes that occur over many, many generations. It is definitely not a quick process!

Organisms that have features better suited to their habitat will survive over successive generations, while those that are not well suited to the environment will not survive.

Adaptations are many and varied. In an isolated country called New Zealand, birds are one species that have evolved to possess unique characteristics. For example, flight was not required to escape predators, so birds such as the kiwi adapted to these conditions by developing a large body size and loss of flight.

Evolution can be structural changes to the physical features of the organism. These include things you can see, like its shape or body covering. These can occur in populations over many generations.

Here are a few of the ways New Zealand birds have adapted their physical features to suit a particular habitat:

- The kiwi is the only bird in the world to have nostrils at the end of its beak. This enables it to search for food by probing its long beak into the earth in search of worms.

- Kiwi birds have fine whiskers at the base of their beak. This helps them to navigate obstacles in the dark since they have poor eyesight.

- The Kiwi has wings, but over the years they have evolved to become smaller. After many years of not requiring the use of flight, they evolved a larger body size and lost the ability to fly.

- Kiwi's feathers blend in with forest undergrowth to allow them protection from predators through camouflage.

Evolution can also be behavioral adaptations that are learned to help organisms survive. These can occur in populations within one or a few generations.

The kiwi is a nocturnal bird. This behavior helps to protect it from predators who are usually awake during the day. It also allows it to find more food; finding food at night means it doesn't have to compete with other birds that usually gather food during the day.

My Species' Narrative

Habitat: _____

Primary Food Sources: _____

Type of Mobility: _____

Defenses: _____

TEACHER NAME		Lesson #
Meghan Antol		2
MODEL	**CONTENT AREA**	**GRADE LEVEL**
Bruner	Science	3rd-5th grade

CONCEPTUAL LENS	LESSON TOPIC
Evolution	Animal Adaptations

LEARNING OBJECTIVES *(from State/Local Curriculum)*

Science Standard Course of Study:
4.L.1.4 Explain how differences among animals of the same population sometimes give individuals an advantage in surviving and reproducing in changing habitats.
5.L.3.1 Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

English/Language Arts Standards:
RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g. in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
W.4.4, W.5.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience
SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Evolution Influences Survival	*How does evolution influence survival?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	**PROCESS SKILLS** (What will students be able to do as a result of this lesson?)
-Students will know ways in which animals of the same species subgroup are similar or different. -Students will know that an organism's characteristics can be similar or different from previous generations. -Students will know that animal adaptation can be influenced by environmental factors (i.e. available food sources, predators living in surrounding environment). -Students will know that adaptations often take place based on an organism's desire to increase chances of survival. -Students will know that tenets of the scientific process relate to the process for creating and refining a design	Students will be able to… • Analyze observational data to create generalizations. • Students will analyze information to find trends. • Create inferences based on observational data. • Apply scientific methods to observation and critical thinking practices. • Compare and contrast information to form opinions on desirable species traits. • Draw conclusions about the effects of trait evolution on survival.

	• Justify why some traits are more advantageous for a target species than others, based on information found in various texts. • Connect the tenets of the scientific process to their own work in species study and design. • Justify their opinions on advantageous traits, based on information in a variety of texts. • Work both with a group and individually to provide recommendations for species improvement.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
-What do video game developers do? -Where do game developers work? -What tools might game developers use? -What do game developers think about? -What characteristics make game developers successful? -How do we learn more about evolution and species traits? - Why do organisms evolve in different ways? -What causes species to evolve over time? -What methods do developers use to gather information? -How can thinking like a developer help us to learn more about the evolution of species?	-What are some of the traits that helped these species survive and become stronger over time? -What are some traits that limited species strength? Why? -What factors in the environment help shape evolution? -If more years passed and we went back again to observe these species, what would you expect to find? What makes you say that? -What traits would you ideally like to see on these creatures to make them even stronger? What makes you say that? -If you could choose only one trait to benefit this species' evolution, what would it be and why? Justify your answer with support from your observations. -Which of these species ultimately had the strongest chance of survival? Justify your answer with support from your observations.	-What methods did you use during your observation? -How did you make inferences about your observations? -How would this experience have been different if we observed from another perspective (i.e. as a student or a tourist?)? -How did what you learned about being a developer impact your work in designing your species? -How does thinking like a developer help us learn more about evolution and survival? -How does evolution influence survival?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Reading texts used in this lesson contain vocabulary and advanced content ideas that are geared toward gifted learners.	**Students will work to create inferences and generalizations through open-ended problem solving.**		

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Teacher welcomes students and reminds them of the task at hand. On the table is an elaborate, oversized envelope with little information, only pictures of Pokémon on the outside. The table is decorated with a special tablecloth and placed in a central location, so students' eyes are drawn to it. They are allowed to come up and examine it more closely and make predictions about what it might be, but are not allowed to open it, building suspense.

The Pokémon game designers were very pleased with the research and prototypes you began yesterday. It seems that they are ready for you to start the design process of your Pokémon today. They have sent us more information and a letter, which we will look at in just a bit. But first, we will have to complete some introductory research tasks for them and think a little bit more deeply about your role as a part of the video game development team.

Teacher asks students to create a list*: What do video game developers do?*

After initial brainstorming, students will share their thoughts out loud. The teacher will generate a list of ideas on the board and follow up with more specific questions to help guide the discussion:

-*What do video game developers do?*
-*Where do game developers work?*
-*What tools might game developers use?*
-*What do game developers think about?*
-*What characteristics make game developers successful?*

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Teacher projects an image of a video development team working together:
https://cdn.lynda.com/course/182890/182890-635600357589711966-16x9.jpg

Students then read a news article about how game developers begin designing their characters (article is attached to the end of the lesson plan).

Students are asked to refer to their list. *Teacher asks: after reading the article and examining the picture, can we add additional observations about video game developers to our list?*

Set background for students: *Show students a "letter" sent from the Pokémon game developers. The Pokémon game developers want us to research and evaluate some already existing creatures that could inspire ideas for new characters. As we saw, there are many ways to go about designing game characters. Sometimes, you have to study and do research in order to expand your knowledge about what would be best for our game. They are sending us to study three unique species that have been found in the rainforests of Brazil so that we can learn more about species evolution and hopefully apply some of our findings to the new game. As these species have just been discovered, relatively little is known about their characteristics and ability to adapt and survive in their environment* (letter is attached to end of lesson plan).

Students are divided into groups to observe as "game developers" doing research. Each group observes a different "species," set up in a shoebox (so that students cannot see species as they begin to change and are able to observe them without previewing, after being given the new scenario and context): one is a fork, one is a spoon, and one is a straight piece of paper. Each species has a varying amount of beads around it. The spoon has a good amount of beads in the top part, the fork has a few beads around its straight ends, and the straight piece of paper has no beads at all.

Students are asked to record their observations and conclude what their observations mean for the survival of their species. Students travel to each species and make observations in silence, then record their generalizations in their lab notebooks.

After observation, students come back together to discuss and share their findings with their group.

The teacher sets the stage for the next round of observations: *Many years have passed, and over the years humans have moved into the area. They have begun to develop the rainforests, causing widespread pollution. As such, food sources have become scarce, and our species has had to adapt to become even stronger in their environment. The government has asked us to go back to make more observations so that they can learn more about these species and their potential adaptability over time.*

Students go back to observe the new scenario: The piece of paper is now taped to a clothespin. The beads are scarcer, and now there are also square beads with tinier holes.

Students record observations in silence, then come back to share and draw conclusions with their groups.

Teacher asks "During Lesson" Questions (see above).

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

The teacher allows time for each group to report their observations and findings to the entire class. Students are encouraged to draw from other groups to build on their findings and refine their observations.

Teacher asks post questions (see above).

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Teacher asks students to reflect on the following question: *how can what we did to research as game developers today help us to improve upon our Pokémon designs? Students take part in a class discussion to reflect on how this process relates to their own work as designers of Pokémon.*

Yesterday, we began to look at evolution and designed a unique creature based off of what we learned about evolutionary traits and birds. Now that we are fully in our role as game designers, let's revisit our creations and see what improvements can be made.

Students use their conclusions to follow a process of scientific observation with their Pokémon creations. In small groups, students do a gallery walk of each other's work, writing observations about the creations they observe.

Students come back together as a class. Teacher questions: *What did you notice? How do you assess this creature's strength of survival based on your observations? Justify what makes you draw that conclusion.*

What suggestions could you make for improving this creature's survival? What makes you say that?

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students are given time to reflect on their observations and learning as game developers. They will then work independently to evaluate their own species (they may begin with the one created yesterday or begin with a new species of their choice) and think about what the next stage in its evolutionary process would be. Students will work independently to provide an adaptation that could make their species stronger.

Students will update their design. From the perspective of a game designer, they will write their own letters back to the Pokémon development team. Their letters will contain language showing their understanding and perspective of the discipline. Students will also be told that they need to clearly explain to the development team what they learned about evolution and survival from their research experience today. They will conclude their letters by articulating how their

species' evolution will influence its survival, as well as some wonderings (or hypotheses) they are still considering to make their design stronger.

(As part of this work, students will be provided with an article that gives more information on the Galapagos Islands and different interesting animal adaptations there: http://www.nathab.com/articles/galapagos-islands/animal-adaptations/ and attached in separate attachment as well).

(They will also be encouraged to do independent research online and in books, using sources such as:
http://kids.nationalgeographic.com/animals/ to learn more about animal adaptations and traits that promote survival).

What Do Game Developers Do?

(writing prompt/brainstorming page for students)

Dear Potential Character Developers,

We were extremely impressed with your research skills and the conclusions you made yesterday pertaining to evolution! You are ready for the next step in working with our video game design team.

As you may already know, we are looking for a new Pokémon character to "outlast them all." We have a lot of different ways of coming up with unique character ideas, but we need some truly different ideas that will realistically fit into our existing game.

Before you start designing, we need you to do some authentic research as video game designers, on location in the rainforests of Brazil. Here you will find species that have just been discovered. As such, relatively little is known about their characteristics.

We are asking that you study them in detail. Just as some of our game designers used ideas found in the Galapagos Islands, we feel that these species might provide valuable insights on evolution that we can apply to our new game.

We look forward to hearing more about your discoveries and how we can use this information in our character development!

Sincerely,
The Game Developers of the Pokémon Series

(Image specified in the lesson, to be projected after initial Bruner questions)

Video Game Designer Recording Sheet (To record observations in Lab Notebook.)

Draw a picture showing what you observed:

What I observed…	**What I infer…**

Want to know how The Pokémon Company designs Pokémon?

If you've ever wondered how the heck The Pokémon Company and developers design Pokémon, then you're about to find out.

As we approach the launch of *Pokémon Sun and Moon* we've already got over 700 Pokémon in existence - and that's not even including the Pokémon already confirmed for the next game.

So how then do the designers and other developers even start creating a new game?

"When we start designing the game, we come up with loads and loads of ideas," game developer Shigeru Ohmori explained. "They're all over the place and even if they're really difficult ideas that won't really be possible, we throw them out there."

"As we proceed along and focus everything on making our final game, we whittle those ideas down to what would be a really interesting idea to implement and focus on that side of things to really simplify our ideas so that they can really work as a Pokémon and make it into the game itself. Because this is the 20th year we've been going, it is really hard to come up with ideas," admitted Ohmori. "But there's not just one specific way in which we come up with and design Pokémon. There are lots of different ways the designers set about the task."

"One way [to design Pokémon] is that you think of a real-world animal, start your design based on that and then work from there." That's very evident from a great number of the Pokémon we've already seen, whether it's Sandslash and the amazing pangolin, Charmander, who was based off the characteristics of a salamander, or Squirtle who was based after the traits possessed by a turtle.

"Others might really focus on the regions and think that this type of Pokémon might really fit with Alola," added Ohmori. That's certainly something we've seen with the Hawaii-inspired Alola region. Just take a look at the Lei-like Comfey. Or the bird Oricorio that has different forms depending on the island it's found on. To come up with Oricorio we looked at birds in the Galapagos Islands, who take on different evolutionary paths depending on what island

they live on. [The Galapagos Islands were] another great inspiration for *Sun and Moon*.
"Or perhaps we're making a Pokémon that's going to appear in a cave, so perhaps it would fit well with that location." Zubat from the original 151 and the new Alolan Forms for Vulpix and Ninetails in *Sun and Moon* have changed form due to the chilly mountain air.

"Other designers might think more of the planning behind the game's mechanics itself. So perhaps look at the battle system and think it would be really interesting to create this kind of type combination and go from there." That could be the reason why we've got the new Type: Null Pokémon in *Sun and Moon*, which synthesizes the strengths of various Pokémon, enabling it to adapt to any situation.

"With all these different ways of thinking about designing Pokémon and different ideas, we always talk them out and have conversations with our designers to gradually build up the Pokémon that we design.

"We think that these various different types of ideas and ways of coming up with those ideas is exactly what gives us the huge variation of Pokémon that we have."

Interestingly, it doesn't sound like the developers ever leave a Pokémon behind on the drawing board. Every one is eventually molded into something that makes the final game.

"We don't really throw away our ideas that we've had, everything is valuable. So rather than say, 'Well, OK, this won't go into the game', we say, 'Well, what can we do to make this part of the game?' "We tweak ideas and make them fit as best we can into the game we're designing and go from there. That's how we make things work."

Adapted from an article by Digital Spy, found at: http://www.digitalspy.com/gaming/pokemon/feature/a811377/heres-how-the-pokemon-company-design-pokemon/

Design Plan: What will my Pokémon be?

What will be the form of my Pokémon's body? Why?

_____

_____

_____

What will be my Pokémon's facial features? Why?

_____

_____

_____

What will be my Pokémon's size? Why?

_____

_____

_____

What other special features will my Pokémon have? Why are these features beneficial for survival?

_____

_____

_____

Initial drawing of my design concept:

What are some other considerations you have? Please list them below and explain why they may be important to your species' survival:

TEACHER NAME			Lesson #
Meghan Antol			3
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Socratic Seminar	Science	3-5th	
CONCEPTUAL LENS		**LESSON TOPIC**	
Evolution		Animal Adaptations	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

English/Language Arts Standards:
RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
RI.3.6 Distinguish their own point of view from that of the author of a text.
RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g. in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Science Standard Course of Study:
4.L.1.4 Explain how differences among animals of the same population sometimes give individuals an advantage in surviving and reproducing in changing habitats.
5.L.3.1 Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Evolution influences survival.	***How does evolution influence survival?***
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	**PROCESS SKILLS** (What will students be able to do as a result of this lesson?)
-Students will know that an organism's characteristics can be similar or different from previous generations. -Students will know that animal adaptation can be influenced by environmental factors (i.e. available food sources, predators living in surrounding environment). -Students will know that adaptations often take place based on an organism's desire to increase chances of survival. -Students will know that scientists have shown connections between genetic change and evolution. -Students will learn that sometimes adaptations have a positive net result, while other times these changes end up having consequences for the species. -Students will learn about specific species that provide examples of the effects of evolution on survival. -Students will know that scientists' knowledge about evolution has changed over time.	Students will be able to: • Analyze texts in order to determine causes and effects of species survival. • Draw conclusions about the effects of trait evolution on survival. • Formulate individual opinions on the benefits/disadvantages of species adaptation. • Compare and contrast information to form opinions on desirable species traits. • Justify their opinions and ideas, based on information in a variety of texts. • Build an oral argument that extends or challenges the ideas of peers. • Craft questions that deeply examine content. • Work both with a group and individually to design a unique species, incorporating their learning from multiple perspectives and

	sources. • Work both with a group and individually to provide recommendations for species improvement.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
-What is happening in the picture? -What connections can you make to this picture? -How might the events depicted impact the characters in this image? -How do you feel about the illustrator's message? -In what ways does this image represent evolution?	-When can evolution be positive? -When can evolution be negative? -How does the speed of evolution impact survival? -What other aspects of evolution impact survival? -In what ways does evolution impact a species' future? -When is a Pokémon's (or species) ability to "power up" and evolve too much? -How closely do you identify with the author's message in ____ article? Why? -How is a Pokémon like a wooly mammoth? What evidence from the text helps you to your comparisons? -How is a Pokémon like city dwelling animals that evolve? What evidence from the text helps you to draw your comparisons? -How is a Pokémon different from these animals? How do these differences support their survival? -Which Pokémon have "retired?" What has contributed to their retirement? *Opening questions might include: (can also be inserted if dialogue falters)* *-How does evolution influence survival?* *-How are these readings related to survival?* *-Why does it matter that species evolve in different ways?* *-What does it mean for species that evolution is not always positive?* *-When do the costs of evolution outweigh the benefits?*	-What was one "big idea" you discovered after participating in this seminar? -What concepts did this seminar help you explore? -What generalizations can you make about the impact of evolution? -How did your seminar role impact your feelings during the seminar? -What challenges did you experience as a result of this seminar? -What ideas are you still questioning as a result of this seminar? -How does evolution influence survival? -In what ways will this seminar affect your future work on your Pokémon design? - How will adaptation impact Pokémon development? -Why is adaptation an issue for Pokémon survival? -What does it mean for a Pokémon to survive? -

DIFFERENTIATION *(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.*			
Content	**Process**	**Product**	**Learning Environment**
Reading texts used in this lesson contain vocabulary and advanced content ideas that are geared toward gifted learners.	**The process of this Socratic Seminar leads to increased student ownership. Students are responsible for crafting their own questions and guiding the direction of the discussion through their inquiry.**		**Students will work individually, in small groups, and as a whole group through this experience, varying the environment of learning according to the many different learning styles and interests of gifted students.**

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

As students enter for the day, a picture is projected on the Smartboard*: https://s-media-cache-ak0.pinimg.com/736x/8b/1a/fa/8b1afa4232859d2b53a1e5a61eb9054b.jpg*

(The image shows several Pokémon visualizing eventual evolution into strong forms, while one Pokémon is sitting depressed, visualizing a ham that will be eaten by someone instead of a powerful evolution).

As students come in, they are asked to consider the image and write the answer to the following questions on a small sheet of paper: What does this image make you think about? How does it impact you or make you feel?

After some time to write, students come back together whole group to share what they wrote on their paper. Once students have had a chance to share their own views, they will explore the following questions together:

-What is happening in the picture?
-What connections can you make to this picture?
-How might the events depicted impact the characters in this image?
-How do you feel about the illustrator's message?
-In what ways does this image connect to evolution?

A scribe records the answers shared to each question on the board or on posters with the question stated. The whole class participates in a discussion around the questions posted.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

The Pokémon designers were very impressed with the research you completed yesterday! They have mailed us something else exciting… what do you think it could be? (on the table is a mysterious box with Pokémon on it. Students don't know yet, but inside is an individual invitation for each student, inviting them to take part in a formal gallery walk which showcases designs to the developers). After some speculation, students will open the box and receive their formal invitations.

Now we must really make sure our prototypes are ready to impress the game makers, your work to this point has been so thorough that you have each received a formal invitation! However, as we learned yesterday a big part of being a character designer is discussing ideas with your design team to find the best solutions. Today we will participate in a group discussion called a Socratic Seminar to help us share ideas with your fellow character designers.

Students will each be provided with copies of the following articles:

http://www.livescience.com/58088-woolly-mammoths-doomed-by-dna-mutations.html

https://www.treehugger.com/clean-technology/birdfeeders-found-to-cause-evolution-of-new-species.html

Students will be told to read their articles quietly and independently. Once all students have finished, they will then be divided into groups of around five students. Each group will be given a section of the following article:

https://www.sciencenewsforstudents.org/article/cities-drive-animals-and-plants-evolve

They will read their section silently and independently, employing annotation strategies. Students will be given post it notes to record key words, important phrases, and questions as they read. Students will be told that they will be expected to jot down notes about their reading and also write five questions that they have as a result of reading the article excerpts. Questions should be framed in a way that promotes higher thinking. (If students are struggling to frame higher-level questions, they may be provided with sentence frames that can help them transform a few of their questions into higher levels of thinking. For example, select students might be given a handout with the following sentence frames if it is seen that they might need an additional scaffold to transform their questions.

-How would it be different if…?
-What are the reasons…?
-Suppose that…?
-What if…?
-What if we knew…?
-What would change if…?
-Why?

These questions and the notes will be used during the Socratic Seminar.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

When students have finished the above tasks, the teacher asks the following questions to help guide student thinking:
-When can evolution be positive?
-When can evolution be negative?
-How does the speed of evolution impact survival?
-What other aspects of evolution impact survival?
-In what ways can evolution impact the future of a species?
-When is a Pokémon's (or species) ability to "power up" and evolve too much?

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts,*

and apply their understandings to the world around them in new ways.

Students will be reminded that they are going to be taking part in a Socratic Seminar, which will allow them to explore their ideas further. Expectations will be discussed and established (be courteous to others, actively listen to others through eye contact and without verbal interruptions, add on to what others say by asking questions, adding on to their ideas, or clarifying an idea they already discussed, support all opinions with text evidence, keep an open mind and participate as openly as possible)

Students will also be provided with an anchor chart that provides sentence frames, such as "I agree with_____," "I disagree with _____," "I am confused by____," "Can you clarify that?" "It states in _____ part of the text that… this makes me feel/conclude" "I can conclude _____ because of _____ evidence" (might not be directly in text)

Students are divided into two groups: The Pokémon Red Development Team (Inner circle) and the Pokémon Blue Development Team (outer circle). The inner circle begins the dialogue and discussion while the outer circle takes notes, craft questions they might have and observe a target member of the inner circle (pre-determined partner). The leader, a student, begins the Seminar with a question that promotes deeper thinking. Inner circle students will respond using the prompts or other dialogue as needed. Students will actively follow expectations that were established before the seminar began.

Opening questions might include: (can also be inserted if dialogue falters)
-How does evolution influence survival?
-Why does it matter that species evolve in different ways?
-What does it mean for species that evolution is not always positive?
-When is evolution "too much?" (When do the costs outweigh the benefits?)
-How is a Pokémon like a wooly mammoth? What evidence from the text helps you to your comparisons?
-How is a Pokémon like city dwelling animals that evolve? What evidence from the text helps you to draw your comparisons?
-How is a Pokémon different from these animals? How do these differences support their survival?

Students will dialogue for ten minutes and then inner and outer circles will change places. The new outer circle members will now be crafting questions, taking notes, and observing a targeted student in the inner circle (pre-assigned partner).

When students have completed the above process, the teacher will ask the following questions*:*

-What was one "big idea" you discovered after participating in this seminar?
-What concepts did this seminar help you explore?
-What generalizations can you make about the impact of evolution?
-In what ways will this seminar affect your future work on your Pokémon design?
-How did your seminar role impact your feelings during the seminar?
-What challenges did you experience as a result of this seminar?
-What ideas are you still questioning as a result of this seminar?
- How will adaptation impact Pokémon development?
Why is adaptation an issue for Pokémon survival?
What does it mean for a Pokémon to survive?

-How does evolution influence survival?

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

The game designers are very eager to learn about how your design is going to outlast them all. We have begun our prototypes over the past two days and will work today to refine them with our new knowledge gained from this discussion. As we refine our designs, we will start to think more about how we can present it to the game developers tomorrow.

Students will work to refine their designs they have been working on over the past few days. Some additional materials such as paper, crayons, scissors, clay, feathers, beads, etc. will be placed around so that students can enhance their prototypes to their final evolutionary form.

Students will work independently to create a visual that demonstrates the path of their Pokémon's evolution and justifies how the choices they have made in its evolution will ultimately play a positive role in its survival. They will complete independent research, using sources such as bulbapedia.bulbagarden.net to research existing Pokémon and gain ideas on advantages or disadvantages in these creatures' adaptation path and ultimately draw conclusions to create their own creature's adaptations.

As part of this visual, students will write on the following prompt: How does my species' evolution ultimately impact its survival? What makes it a particularly viable species?

Students will conclude the experience by sharing their reasoning in small groups, justifying why their choices in species evolution will impact their creature positively.

Transforming Questions:

-How would it be different if…?

-What are the reasons…?

-Suppose that…?
-What if…?

-What if we knew…?

-What would change if…?

-Why?

(Image to be projected as students walk in)

DNA Mutations May Have Doomed the Woolly Mammoth

By Knvul Sheikh, Live Science Contributor | March 2, 2017 02:12pm ET

This mural at the American Museum of Natural History in New York City shows woolly mammoths near the Somme River.

Credit: Charles R. Knight

By the end of the ice age, the last remaining woolly mammoths had acquired so many genetic mutations that their numbers were practically guaranteed to spiral toward extinction, a new study has revealed.

Mammoths were once among the most common large herbivores that roamed across North America, Siberia and Beringia, a geographic area that once stretched from Siberia to the Canadian Yukon but is now mostly submerged under the Bering Strait. The giant beasts first appeared about 700,000 years ago. But, at the end of the last ice age, about 10,000 years ago, their population suddenly declined.

Scientists think a warming climate and the effects of human hunters led to the extinction of woolly mammoths on the mainland. Small populations continued to persist on isolated northern islands until they, too, vanished about 3,700 years ago.

Researchers from the University of California, Berkeley, recently compared the existing genomes of two different mammoth specimens. One was a 45,000-year-old woolly mammoth found in northeastern Siberia, and the other was a 4,300-year-old mammoth from Wrangel Island, off the coast of Russia. The scientists found that the DNA of the

Wrangel Island mammoth, which represents the last members of the species, had multiple harmful mutations that would have interfered with normal functions and compounded the difficulties of survival.

"It's sort of like a Greek tragedy that's written into the DNA of the poor mammoth," said lead study author Rebekah Rogers, an evolutionary geneticist at the University of North Carolina in Charlotte. "You look at this mammoth's DNA and you see all these bad mutations."

The findings suggest that in the end, as sea levels rose and cut off Wrangel Island mammoths, their small population and resulting inbreeding would have rendered the process of natural selection ineffective.

In larger populations, mutations that occur naturally are weeded out by competition, Rogers said. But with such a small population, there would have been no mechanism to prevent these mutations from being passed on to the next generation of mammoths. As such, harmful changes in the mammoth genome that deleted large chunks of DNA, or messed up how genes were read and translated, would have accumulated, according to Rogers.

By looking at which genes were affected by these harmful mutations, Rogers and her colleague, Montgomery Slatkin, a population geneticist at the University of California, Berkeley, were able to guess what functions or behaviors might have been affected as mammoth populations dwindled. The animals probably lost many olfactory receptors, which detect odors, as well as urinary proteins, the researchers found. This could have affected their social status and mate choice, Rogers said. The genome also revealed that the island mammoth had certain mutations that likely created an unusual translucent satin coat, as well as several other mutations with effects that scientists don't fully understand yet.

While the researchers said that their analysis was limited to one individual from the Wrangel Island mammoth population, they said they were fairly certain that this "genetic meltdown" would have occurred in the remaining mammoths as well.

"We would expect that if you got another mammoth from the island and you looked at its genome, that it would also have an excess of bad mutations," Rogers told Live Science. "They might not be the exact same mutations — some of them would be shared, and some of them might be different — but we would expect the same pattern." [Photos: 6 Extinct Animals That Could Be Brought Back to Life]

Other biologists agreed that the findings support a long-standing theory that genomes start unraveling as animal populations decline.

"It makes sense that the researchers would find an accumulation of deleterious mutations in a population that was very small," said Beth Shapiro, an evolutionary biologist at the University of California, Santa Cruz, who was not involved in the new study. "[This] reveals that it's not necessarily just a small population size that is potentially dangerous for populations but also the content of those genomes that's important."

The study offers a warning to conservationists, Shapiro said. If bad mutations start accumulating in small groups of isolated animals, it might not be sufficient to try and preserve endangered species after they have already undergone generations of inbreeding and genomic meltdown. Conservationists probably need to intervene much sooner, she said.

It might also provide an interesting twist to mammoth "de-extinction" experiments. If some mammoth genomes carry an overabundance of negative mutations, researchers need to carefully screen the genes before they are inserted into mammoth-elephant hybrid genomes, Rogers said. In fact, screening the mutations and testing what their functions are could also inform scientists about how the mutated genes affected mammoths just before they went extinct, she added.

Rogers and her colleagues detailed their analysis of the mammoth's genetic mutations in a study published online today (March 2) in the journal PLOS Genetics.

Original article on Live Science.

Birdfeeders Found to Cause Evolution of New Species

Up until now, most people have likely regarded bird-feeders as merely a pleasant addition to their gardens. But scientists have just discovered that bird-feeders in the UK are actually having a serious long term impact on bird life--they've found that the feeders have brought about the first evolutionary step in the creation of a brand new species.

According to the BBC, the European blackcap bird's natural instinct has historically been to migrate to Spain to spend their winters, where they feed on fruits and berries. But the rise of bird-feeders in the UK have changed that. Scientists discovered that blackcaps "follow a different "evolutionary path" if they spend the winter eating food put out for them in UK gardens."

A Species of Bird that Eats Only From Bird-feeders?

Those blackcaps that have opted instead to head north to the UK begun to form a brand new species of bird, all thanks to the British putting bird-feeders in their yards. The researchers report:
the team found that blackcaps that migrated to the UK for the winter were in the very earliest stages of forming a new species. [Lead researcher Dr. Shaefer] explained that some blackcaps would always have migrated "a little further north" than others and eventually ended up in Britain in the winter. But those birds would have had nothing to eat," he said. It was when garden bird feeders became more popular in the UK that an evolutionary division began to emerge.

Since the British were providing food for the birds, that gave them a huge advantage in surviving the winter. Over time, the group of birds that didn't migrate south began to mate only with other moochers--creating the first step in the formation of their own species. The researchers had a hunch that this was precisely what was going on, that there would soon be a brand new species of blackcaps. But they needed proof. Que up the lab work:
The team were able to use a chemical "signature" from the birds' claws to identify where they spent the winter, and what food they ate. "Then we took blood samples and analysed those to assess whether... we had two distinct populations. And that's

exactly what we found," said Dr Schaefer.

The new blackcaps sport different plumage, beaks, and wings. They have rounder wings thanks to the shorter trip they now make, and longer narrower beaks--the better to eat from bird feeders, of course. These evolutionary changes took place in a mere 50 years.

The Impact of a Bird Feeder-Created Bird

So what's the end impact of all of this--has man intruded on nature and disrupted yet another fragile ecosystem by sticking bird feeders all over the place for his own amusement? Or created a Frankenstein bird never meant for life in this world?

Thankfully, no--the scientists actually seem to think that the Brits have done the birds a favor: Dr. Schaeffer says, "[The birds have] found a better overwintering area that is closer to the breeding ground, where they can obtain food easily. And I also think its positive news for us, because it means not all the changes we produce are necessarily bad, and that some species have the potential to adapt quickly to the changes." Well, that's good to know--we humans are capable of doing a little good on this planet after all.

Cities drive animals and plants to evolve

Species are adapting to urban pollution, traffic and shrinking habitats through changes in their genes

SHARON OOSTHOEK

APR 6, 2017 — 7:10 AM EST

Even in Chicago, here, home to almost 2.7 million people, there are parks and spaces where wildlife live. Some species may have made genetic accommodations, however, to survive in such congested landscapes, studies now show.

MARCHELLO74 /ISTOCKPHOTO

Ever seen a raccoon unlatch a garbage can in search of leftovers? Or shimmy across power lines to get from one rooftop to another? If so, you've witnessed an animal adapting its behavior to city life. That's been going on since people started building cities thousands of years ago.

Now, biologists are seeing signs that animals and plants are also adapting in a more basic way to survive in cities. Their genes are changing.

Genes are segments of DNA that influence how an organism looks and functions. An animal or plant's DNA is like an instruction book for how it develops and grows. Some instructions guide its reproductive habits. Others influence the way it moves. Still others might let it withstand poison.

Urban *pollution,* traffic and shrinking wild spaces have been causing changes in these genetic instructions. And scientists have been tracking more and more signs of these genetic changes. They've seen it in fish in New York's polluted Hudson River, in weeds growing out of sidewalks in France, in cliff swallows living near highways in Nebraska and in the mice scampering through New York City parks.

When genes change in response to their environment, it's called *evolution*. Some of those changes may leave animals and plants better suited to their homes. It may offer new traits that increase the odds of surviving long enough to reproduce. This means the individuals will pass on these new traits to their offspring. Eventually, traits that had once been rare can now become common throughout a population.

Until fairly recently, scientists thought evolution happened very slowly — too slowly for people to notice during their lifetimes. But no more. "We are now showing evolution can occur a lot faster than most people think," says Isaac Wirgin. And, he adds, that's true "especially in urban environments."

Wirgin is an expert in environmental medicine at New York University Medical Center in New York City. He studies how the environment affects the health of animals, including humans. It may seem like a good thing for animals and plants to adapt to city life. But he warns that there can be costs that biologists are only beginning to understand.

"In my mind, it's not a good thing," he says. "Usually if you evolve to become less sensitive to a pollutant, you're less good at reproduction or life expectancy, or you're more sensitive to other stressors."

Wirgin is talking about evolutionary *costs*. These are trade-offs. To gain some advantage, a species often will pay a price. For example, if an animal evolves to become bigger, fewer predators can kill it. But being bigger will now mean the animal needs more food. And that can be a problem when food becomes scarce.

The case of the Hudson River PCBs

Urban evolution is hardly new. During the Industrial Revolution in the 1800s, heavily polluted areas of Britain turned black with soot. The light-colored peppered moths that lived there now stood out against dark walls and tree trunks. In no time, they were picked off by predators. But some mutations — accidental genetic changes — caused some peppered moths to have black wings. This camouflaged them in the newly sooty environment. And over time, they survived to breed more black moths. The light-colored ones didn't. In short order, most peppered moths were **now black**.

In the past hundred years, humans have built and enlarged cities at a much faster pace than ever before. As cities grew, so did their impacts on the environment — and on evolution. A century ago, just two in every 10 people lived in towns. Today, more than half of us do. And our cities are rapidly spreading across more and more of the globe.

A growing number of scientists are asking what this means for city wildlife. Wirgin is among them. He led a research team that studied fish living in a very polluted segment of the Hudson River. Some these fish, called tomcod, carried a*genetic variant*. That's a gene with a slightly different DNA sequence — or genetic blueprint — from most others of its species.

This genetic variant helped the tomcod that carried it withstand some toxic chemicals called PCBs, for polychlorinated biphenyls (Paal-ee-KLOR-ih-nay-ted By-FEE-nuls)).

Manufacturers relied on these chemicals for many decades as a fluid to insulate industrial equipment. And from 1947 to 1976, two General Electric plants spewed PCB pollution into the Hudson River. In all, they released nearly 600,000 kilograms (about 1.3 million pounds) of those oily chemicals. PCBs don't easily break down, so they can remain in air, water and soil for a long time.

Eventually, the United States banned the production of PCBs, as did other nations. Prompting that decision: Research showed PCBs could cause cancer in animals, and likely posed a similar risk to people.

What about those Hudson River fish living amidst all of that PCB pollution? Many young fish exposed to PCBs are severely deformed. For instance, they may lack a jaw. With such defects, these fish can starve.

Some protection comes with a cost

But the tomcod with the newfound genetic variant survived. This variant showed up in a gene called AHR2. It appears to shield the fish from PCBs' normal toxicity. Wirgin and his team published their findings in *Science*.

Here's how the gene adaptation works: The normal form of AHR2 gives instructions for building a certain protein in the fish. To do damage, PCBs must attach to this protein. But the variant gene gives slightly different protein-building instructions. This change makes it hard for PCBs to latch on.

Researchers discovered a mutation in tomcod that is now common among those in a polluted stretch of the Hudson River. It lets these fish survive in these waters, still heavily contaminated with PCBs.

Mark Mattson of Normandeau Assoc.

A small number of tomcod carried this gene variant before this region of the Hudson River became heavily polluted with PCBs. After the oily pollutants started pouring into the river, tomcod with the more common gene mostly died off. Today, nearly all tomcod in this part of the Hudson carry the protective form of the AHR2 gene.

Elsewhere, in less polluted areas — in Canada and New England, for example — tomcod populations still have the susceptible form of the gene.

Wirgin's group did not look for a cost to the tomcod's resistance to PCBs. But other researchers found such a trade-off in a different fish, the Atlantic killifish.

Joel Meyer and Richard Di Giulio of Duke University in Durham, N.C., studied this species in Virginia's Elizabeth River. A former wood-treatment plant had polluted the water with a family of chemicals known as PAHs, for polycyclic (PAH-lee-SIK-lik) aromatic hydrocarbons. These chemicals have been linked to cancers and heart deformities.

The killifish in this river showed no sign of such effects. They did, however, show less tolerance than most of their species for the low oxygen levels that sometimes occur in many lakes and rivers. Concluded Meyer and DiGiulio: These fish paid a price for evolving the ability to resist these toxic pollutants.

But back to the Hudson River tomcod. When they evolved resistance to PCBs, there may have been wider effects on the ecosystem, says Wirgin. Tomcod are a favorite snack for larger fish. When predators eat those tomcod, they now get a toxic bonus — some PCBs in every bite. Pollutants from the smaller fishes' bodies build up in larger fish. This process is known as *bioaccumulation*.

There is no research on how it affects tomcod-munching fish. But Wirgin says this points to how urban evolution could affect entire food webs.

City weeds and cliff swallows

Plants have also evolved to meet the challenges of city living. Pierre-Olivier Cheptou is an *evolutionary ecologist* at the University of Montpellier in France. He studied a common weed called *Crepis sancta*. It grows in small patches of soil around sidewalk trees in Montpellier. He compared city-dwelling members of this species to those in the surrounding countryside.

University of Montpellier evolutionary ecologist Pierre-Olivier Cheptou and his student collect seeds from weeds growing around sidewalk trees in Montpellier, France.

S. Popy

Those in the country tend to make lightweight seeds, they found. These easily travel with a breeze. But in the city, such seeds would probably fall onto concrete and die. So there, the city weeds produced compact seeds. Being relatively heavy, they drop close to the plant. That allows them to sprout in the surrounding soil. Cheptou published his team's study in the *Proceedings of the National Academy of Sciences.*

This change will likely have an evolutionary cost for the plants, he says. If their seeds don't travel far, the weeds are unlikely to breed with those in other patches of soil. This means the population will develop less variation in its DNA. In other words, they will have little genetic diversity. Wildlife with little genetic diversity tend to be more vulnerable to disease.

Traits that help an organism survive in the short term, such as heavier seeds, "may lead to extinction in the longer term," worries Cheptou.

Still, there may be plants and animals that have evolved to handle city living without paying a price. Cliff swallows nesting under highway overpasses in Nebraska might be among them.

Charles Brown is an ecologist who works at University of Tulsa in Oklahoma. Since 1982, he and Mary Bomberger Brown have been studying cliff swallows. Mary is an ornithologist, or bird biologist. She works at the University of Nebraska in Lincoln.

The cliff swallows they study have been building their gourd-shaped mud nests under highway overpasses in southwestern Nebraska. Over 30 years, the two scientists saw a steady drop in the number of birds killed by cars and trucks. And this surprised them. After all, the bird colonies were growing and the traffic had not declined.

Mist nets are pieces of see-through mesh hung between two poles. Scientists use them to safely capture birds for study. The researchers set up such nets close to the bridge. And as they compared road-killed birds with those caught

in nearby mist nets, they got another surprise. Birds in their mist nets had much shorter wings than those killed by the cars.

A cliff swallow flies by its nesting site under a highway in Nebraska. These birds have evolved shorter wings that may help them better swerve to avoid oncoming traffic.

Charles Brown

The researchers now think shorter wings help birds dodge traffic better. That's why short-winged birds were more likely to end up alive in the nets, not dead on the street.

A change to a major physical trait, such as wing length, is almost certainly a result of a genetic change, says Charles Brown. Unlike the road-killed birds, these short-winged fliers have survived long enough to pass down their genes. The researchers published their results a few years ago in the journal*Current Biology*.

Brown says birds evolving shorter wings over a few decades really surprised him. He agrees with Wirgin and Cheptou that such evolution can sometimes make an animal or plant less able to deal with other types of stress. But he and Bomberger Brown did not find any harmful side effect in the birds they studied.

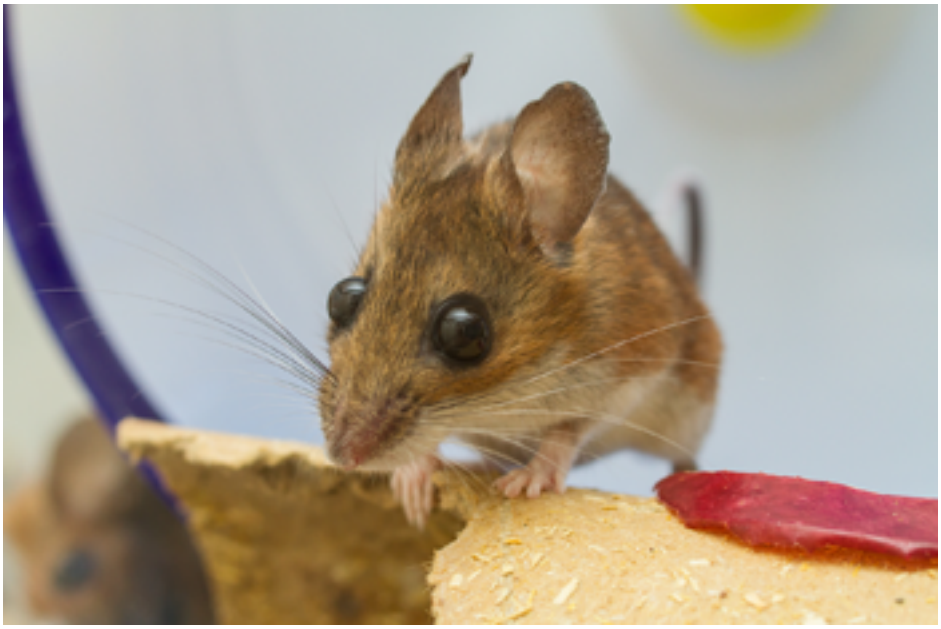
"It would appear to be a win-win situation for the swallows," he concludes.

Lonely mice

White-footed mice also may be evolutionary winners.

These mice once lived all over North America. But in New York City, they are now stuck mostly in city parks. Those in each park are separated from those elsewhere by roads and buildings. This means that those in one park can't breed with those in another. The mice in each park have therefore evolved genes that help them survive in their specific home turf.

Some populations have evolved a genetic variant that protects them from being poisoned by heavy metals such as lead and chromium. (Heavy metals can be part of a waste produced by some industries. Lead and chromium, for instance, can cause organ damage and probably also cancer.) The mice exposed to such heavy metals likely evolved the genetic variant because the soil in their parks has accumulated so much chromium or lead over the years.



White-footed mice in New York City parks have evolved genes that help them survive exposures to heavy metals and infectious germs.

Other populations of park mice evolved genes that boost their ability to fight disease. That is probably because they are crowded into a particularly small area. Such tight quarters tend to make it easier for diseases to spread.

That's the conclusions that Jason Munshi-South came to, anyway. He's a biologist at Fordham University in New York City. He has been studying these mice. His team described its findings a few years ago in *PLOS ONE*.

A small number of mice were likely already carrying the genes that protect against heavy metals or infectious diseases. Mice with these variant genes lived long enough to have babies and pass down their genes. Eventually, more and more of them made up most of the population.

That's good news for the mice. But Munshi-South says that doesn't mean other animals can similarly evolve rapid changes to survive the challenges of city living. Indeed, he observes: "Most species do not do well in cities and no longer occur there."

Power Words
(for more about Power Words, click here)

adaptation (in biology) A process by which living things become better suited to their environment through inheritance. When a community of organisms does this over time, scientists refer to the change as evolution.

bioaccumulate A term for the body's process of picking up substances (usually from the environment) and then storing them within tissues (such as fat or bone) in ever-growing quantities.

biology The study of living things. The scientists who study them are known as**biologists**.

breed (verb) To produce offspring through reproduction.

cancer Any of more than 100 different diseases, each characterized by the rapid, uncontrolled growth of abnormal cells. The development and growth of cancers, also known as malignancies, can lead to tumors, pain and death.

chemical A substance formed from two or more atoms that unite (become bonded together) in a fixed proportion and structure. For example, water is a chemical made of two hydrogen atoms bonded to one oxygen atom. Its chemical symbol is H_2O. Chemical can also be an adjective that describes properties of materials that are the result of various reactions between different compounds.

contaminant Pollutant; a chemical, biological or other substance that is unwanted or unnatural in an environment such as water, soil, air or food. Some contaminants may be harmful in the amounts at which they occur or if they are allowed to build up in the body over time.

DNA (short for deoxyribonucleic acid) A long, double-stranded and spiral-shaped molecule inside most living cells that carries genetic instructions. It is built on a backbone of phosphorus, oxygen, and carbon atoms. In all living things, from plants and animals to microbes, these instructions tell cells which molecules to make.

ecosystem A group of interacting living organisms — including microorganisms, plants and animals — and their physical environment within a particular climate. Examples include tropical reefs, rainforests, alpine meadows and polar tundra.

ecology A branch of biology that deals with the relations of organisms to one another and to their physical surroundings. A scientist who works in this field is called an **ecologist**.

environment The sum of all of the things that exist around some organism or the process and the conditions that those things create for that organism or process. Environment may refer to the weather and ecosystem in which some animal lives, or, perhaps, the temperature, humidity and placement of components in some electronics system or product.

evolution (v. to evolve) A process by which species undergo changes over time, usually through genetic variation and natural selection. These changes usually result in a new type of organism better suited for its environment than the earlier type. The newer type is not necessarily more “advanced,” just better adapted to the particular conditions in which it developed.

evolutionary ecologist Someone who studies the adaptive processes that have led to the diversity of ecosystems on Earth. These scientists can study many different subjects, including the microbiology and genetics of living organisms, how species that share the same community adapt to changing conditions over time, and the fossil record (to assess how various ancient communities of species might be related to each other and to modern-day relatives).

evolve (adj. evolving) To change gradually over a long period of time. In living organisms, evolution usually involves random changes to genes that will then be passed along to an individual's offspring. But the term may be applied more casually to point to things (such as an individual's brain development) that change in form or function, over time, in response to cues (such as developmental hormones).

extinction The permanent loss of a species, family or larger group of organisms.

food web (also known as a food chain) The network of relationships among organisms sharing an ecosystem. Member organisms depend on others within this network as a source of food.

gene (adj. genetic) A segment of DNA that codes, or holds instructions, for producing a protein. Offspring inherit genes from their parents. Genes influence how an organism looks and behaves.

Peer Observation Checklist for Socratic Seminar

Make a Check Mark Each Time Your Partner Contributes!

Name of Person You're Observing: _____

Your Name: _____

Seminar Topic: _____

Speaks loudly and clearly to contribute to the discussion _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Stays on topic _____ _____ _____ _____ _____ _____ _____ _____

Talks directly to other students (not the teacher) _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Invites other people into the discussion _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Makes eye contact with speakers _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Refers to the text to cite reasons or evidence _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Asks a follow up question _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____

Adds to another speaker's ideas _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Dominates the conversation _____ _____ _____ _____ _____ _____ _____

Interrupts another speaker _____ _____ _____ _____ _____ _____ _____

After the discussion, reflect:

What is the most interesting thing you heard your partner say?

What is something else you would have liked to add to the discussion?

Peer Analysis of Final Project (Checklist)

I evaluated _____'s project

My name: _____

Place a check in the box showing your rating. Make sure to explain why underneath.

	1 (could be stronger)	2 (okay)	3 (excellent)
My peer's project contains at least two reasons explaining how his/her species' evolution is related to its survival. Summarize reasons given below:			
My peer's species was highly unique			
My peer's presentation was entertaining and professional.			

What my peer did well: _____

Suggestions for additional adaptations my peer's species could make. Why?

_____

TEACHER NAME			Lesson #
Meghan Antol			4
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Simulation	**Science**	**3rd-5th**	

CONCEPTUAL LENS	LESSON TOPIC
Evolution	**Animal Adaptations**

LEARNING OBJECTIVES *(from State/Local Curriculum)*

Science Standard Course of Study:
4.L.1.4 Explain how differences among animals of the same population sometimes give individuals an advantage in surviving and reproducing in changing habitats.
5.L.3.1 Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

English/Language Arts Standards:
RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
RI.3.6 Distinguish their own point of view from that of the author of a text.
RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
W.4.4, W.5.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience

SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Math Standards:
3.NBT.A.2 Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Evolution influences survival	*How does evolution influence survival?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	**PROCESS SKILLS** (What will students be able to do as a result of this lesson?)
-Students will know that an organism's characteristics can be similar or different from previous generations. -Students will know that animal adaptation can be influenced by environmental factors (i.e. available food sources, predators living in surrounding environment). -Students will know that adaptations often take place based on an organism's desire to increase chances of survival. -Students will know that scientists have shown connections between genetic change and evolution. -Students will learn that differing species may evolve at different rates, depending on environment and need -Students will recognize that evolutionary traits can be both physical and behavioral in nature. -Students will recognize that some traits are more beneficial for species' survival than others.	Students will be able to… • Analyze information to create generalizations. • Create inferences based on observational, text, and discussion data. • Compare and contrast information to form opinions on desirable species traits. • Draw conclusions about the effects of trait evolution on survival. • Justify why some traits are more advantageous for a target species than others. • Justify their opinions on advantageous traits, based on information gathered during simulation and discussion. • Work both with a group and individually to provide recommendations for species

	improvement.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
-What connections can you make to this picture? -In what ways does this image connect to evolution? -How does this image relate to survival? What factors make up "evolution?" -What factors cause species to evolve in different ways? -How would you define "resiliency?" -In what ways can you challenge this picture or text? Why?	-What traits contribute to species survival? -How do factors in the environment shape evolution? -Which factor plays the greatest role in causing an organism to evolve? What makes you say that? -Which overall trait's evolution has the most net impact for the species' survival? What evidence did you use to support your choice? -What role does security play in evolution? -What traits contributed to resiliency in a variety of environmental situations? Why? -When would be a time that it's advantageous for a species to not evolve?	-What generalizations can you make about evolution? -What generalizations can you make about survival? -In what ways does this simulation differ from real life? How do these considerations effect your conclusions about evolution and survival? -How does balance relate to evolution? -What is another scenario we could have added to this simulation? In what ways would it have impacted the decisions you made on behalf of your species? -If you had the chance to start over and design another Pokémon, what would you do differently? Why? -How does evolution influence survival?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
	Students will experience both the essential understanding and the concept through particpation in a simulation.	**Students are creating and adapting their own species during this simulation, which requires skills such as high levels of critical thinking, and processing , and creativity that are geared towards gifted abilites.**	

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

As students walk in the classroom, the following image is projected on the board:
https://www.toonpool.com/user/997/files/evolution_timing_fish_1288825.jpg

As students come in, they are asked to consider the image and write the answer to the following questions on a small sheet of paper: What does this image make you think about? How does it impact you or make you feel?

After some time to write, students come back together whole group to share what they wrote on their paper. Once students have had a chance to share their own views, they will explore the following questions together:

-What connections can you make to this picture?
-In what ways can you challenge this picture?
-How is this image related to evolution?
-How is this image related to survival?

To expand their knowledge and set the stage for the simulation activity, the students will read the following article:
https://www.livescience.com/59188-difference-between-shark-and-whale-tails.html

Students will share ideas as a class using Pre Lesson Questions, including:
-What factors cause species to evolve in different ways?
-What effect do differences in evolution ultimately have?

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

You have worked hard all week designing a new species to "outlast them all." Before we present our final prototypes to the Pokémon design team this afternoon, we will put your species' adaptations to one final test.

Today we will be participating in a simulation, which will help us think more about possible outcomes for your Pokémon design. In this simulation, you will take on the role of a Poke Master, helping to determine how your Pokémon adapts in order to survive against the challenges presented.

Before we begin, you will determine a few more characteristics that your species will possess.

Student rolls a dice to determine outside characteristics for this particular simulation: (adapted from "Evolution: Building Beasts from Getting Nerdy, LLC).

What kind of vegetation is it most able to eat?
1- Tall trees with long branches and large leaves

2- Small dwarf trees and shrubs with tiny leaves
3- Vines with thorns
4- Thin tall straw-like grasses
5- Low-lying mosses and grasses
6- Short plants with thick succulent leaves

What type of mouth does it have?
1- Piercing, mosquito-like mouth
2- Fangs that deliver venom
3- Flat teeth for grinding
4- Sharp pointy teeth for tearing and shredding
5- Large front teeth for clipping leaves
6- No teeth (swallows things whole)

What is its exoskeleton like?
1- colorful
2- very thick skin
3- color blends with surroundings (camouflaged)
4- spikes on skin
5- covered in a layer of slime
6- very lightweight (thin) skin

Students will roll the dice to come up with a plausible story about their creature and his current characteristics. Based on the rolled characteristics, students will also tell about a preferred habitat from the Pokémon games (Kanto, Johto, Hoenn, Sinnoh, Unova, Kalos, Alola, Ferrum, Orre, Fiore, Almia and Oblivia) and some of the species' potential predators. Time will be given for students to research independently online, finding comparable species or Pokémon that will help them to draw conclusions and justify their Pokémon's story for this simulation.

Students briefly share with the group the story they have determined for their creature.

The teacher states the rules for the simulation:
- The teacher (simulation leader) is the supreme leader of the Pokémon League and Pokémon World. She has final authority on all matters related to the simulation.
-You may choose to challenge the simulation leader on point values only once in the entire simulation. You must justify why you think you deserve a higher point value and successfully convince the simulation leader.
-Time passage in the simulation will be determined by new or catastrophic events that occur at intervals
-Your Pokémon must adhere to the characteristics that were rolled/decided. Any evolution that occurs during the simulation must be realistic and exist in nature.

Goal: After all rounds, your goal is to achieve a high score in resistance

Teacher begins the simulation with the first event: Your Pokémon has enjoyed a life of leisure so far in its current environment, eating lots of food, evading predators, and finding lots of time to play and practice its battle skills in the beautiful weather. One day, however, this all changes.

Show the following image of a smoking volcano: https://s-media-cache-

ak0.pinimg.com/736x/19/92/96/1992967d1cd2b0b99cfa835daea11a89.jpg

Students discuss what might be occurring and decide on an environmental scenario as a group. The teacher adds to their scenario, stating that all vegetation has been killed off by this catastrophe, except for tall trees with wide leaves

Students decide on one adaptation their will help their species to survive. After they share their adaptation with the group, they score themselves using the rubric and add points accordingly (attached to lesson plan). Teacher will reward or take away points in addition to the rubric, based on occurrences that happen in the simulation or individual student choice.

After some time, the teacher introduces another event: (rocks falling everywhere)
https://i.ytimg.com/vi/ahvpyv_cPFI/maxresdefault.jpg

Students speculate with the group about what might be happening. Teacher may add to their speculations: the heat from the volcano made the climate of Pokémon World much drier. One day a large landslide and many falling rocks threatened the Pokémon's habitat.

Students consider one adaptation for their creature to help it outlast this new challenge. Time may be provided to research as needed. Once adaptations are shared with the group, students calculate their score using the rubric. Depending on occurrences in the simulation, the teacher will also award or take away points in addition to the rubric.

Teacher presents the final event in the simulation (a new creature that has shown up in the habitat)
The teacher adds to student speculation about what might have happened: This new creature has strong jaws that can easily crush its prey.

Students consider one adaptation for their creature to help it outlast this new challenge. Time may be provided to research as needed. Once adaptations are shared with the group, students calculate their score using the rubric.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Much time has passed, and your species has been able to evolve and outlast many challenges. Now the ultimate challenge has come however; your Pokémon is meeting another evolved species! They must battle using their scores to see who can be the final victor of the territory.

Students total their scores for the three categories, adding the quantities from their rubrics. They are then assigned a partner who they "battle" against. The higher score in resistance wins.

Students are given a chance to reflect with their partner on the experience and what factors added to their species' resiliency. Teacher prompts discussion with During Lesson Questions.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Teacher wraps up simulation and gives students a chance to reflect on the experience, using Post Questions as a Guide for a class discussion, including:

In what ways does this simulation differ from real life? How do these considerations effect your conclusions on survival?

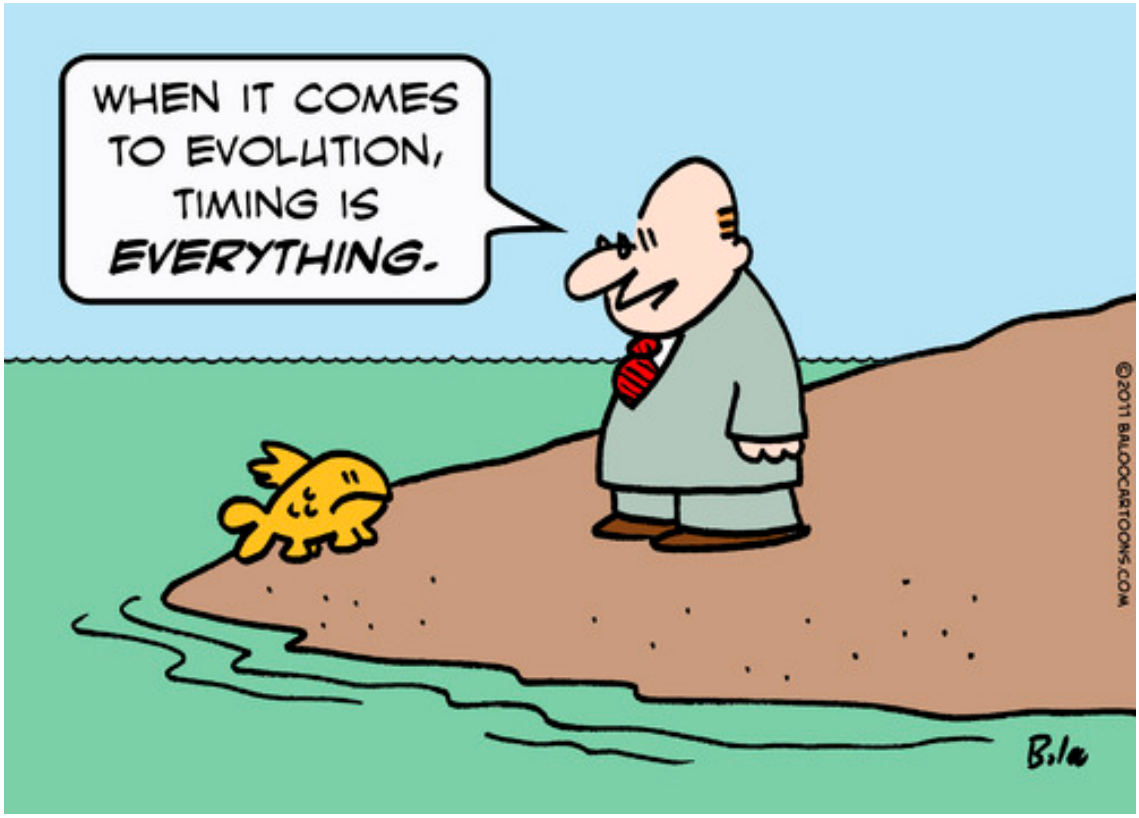
Students are given time to reflect on their observations and learning from the simulation. They will then work independently to evaluate their own species and make any final revisions on their design before presenting to game designers. Students will update their design and write a paragraph justifying: "how do my changes to my species' evolution increase its chance of survival?"

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

After all changes are made, students participate in the final gallery showing of their product to the "Pokémon game producers." They must answer, both orally and through the written product of their presentation: How does my species' evolution influence its survival? They must answer questions from the "game producers" to justify why their species is the most resilient of them all.

After the presentations, students are given a chance to wrap up and say goodbye to their friends in the camp. The teacher presents small awards to each student to celebrate their hard work as designers.

Students are asked in closing to reflect on the process and what they learned. *If you had the chance to start over and design another Pokémon, what would you do differently? Why?*



(Will be projected on the board as students walk into classroom)

Tale of 2 Tails: Why Do Sharks and Whales Swim So Differently?

By Laura Geggel, Senior Writer | May 20, 2017 11:45am ET

We hope you enjoyed this tale about tails.
Credit: Sergey Uryadnikov/Shutterstock

The graceful whale swims by undulating its wide tail up and down. And so does the shark, right?

Wrong.

Like other fish, sharks swim by moving their tails side to side. So, why do these two marine creatures — the shark and the whale — swim in such different ways?

Whales move their tails up and down because they evolved from mammals about 50 million years ago, said Kenneth Lacovara, a professor of paleontology and geology and the dean of the School of Earth & Environment at Rowan University in Glassboro, New Jersey.

"When quadrupedal [four-legged] mammals run, their spine flexes up and down," Lacovara told Live Science. Whales retained this anatomy, which allows them to gallop underwater, so to speak, Lacovara said.

The oldest known relation in the modern whale lineage is Pakicetus attocki, a four-legged, wolf-size mammal that likely had webbed feet. P. attocki lived on the edges of a shallow ocean and chowed down on fish about 50 million years ago, Live Science previously reported.

As evolution progressed, the lineage that led to whales became more, for lack of a better term, whale-like. For instance, the 35-million-year-old Basilosaurus lived in the water and measured about 60 feet (18 meters) long, as long as a bowling lane. However, the animal still had tiny, dog-size hind limbs, a remnant of its quadrupedal past, according to PastTime.org.

"[The limbs] were on their way to becoming vestigial appendages," Lacovara said. But, even as these vestigial limbs disappeared, whales were "retaining that same musculature that they got from their quadrupedal ancestors," he said.

On the other hand, because sharks are fish, they move their tales back and forth. Even when fish first ventured onto land, they still moved in a side-to-side motion. For example, the 375-million-year-old Tiktaalik roseae, the first fish thought to venture out of the water, likely moved in a side-to-side motion, Lacovara said.

In fact, many modern reptiles, such as lizards and snakes, still move in a side-to-side shimmy. As ancient animals evolved, some developed an up-and-down motion as their muscles and bones changed over time, Lacovara said.

This change didn't affect every animal, however. For instance, the mosasaur, an ancient sea reptile that lived during the dinosaur age, swam with a side-to-side stroke, even though its ancestors once lived on land. "Their ancestors probably hadn't shed that side-to-side motion" while they were terrestrial, Lacovara said.

In contrast, dinosaurs developed an up-and-down step, which is part of the reason for their success, as it helped them move faster than their lizard-like reptilian ancestors and crocodilian cousins, Lacovara said. Dinosaurs didn't move

like lizards at all, he said. Rather, their limbs were under their bodies, "more like a horse than like a lizard, and their feet were hinged for straight-ahead motion."

However, for movement in the water, neither the side-to-side nor the up-and-down motion seems to offer an obvious advantage, Lacovara said. If one of those options were superior, there would be an evolutionary pressure to change, and there isn't an "evolutionary pressure to switch from an up-and-down motion to side-to-side motion [or vice versa]," he said.

Original article on Live Science.

My Species' Story:

Roll the dice. Circle the number that you roll for each category:

What kind of vegetation is it most able to eat?
1- Tall trees with long branches and large leaves
2- Small dwarf trees and shrubs with tiny leaves
3- Vines with thorns
4- Thin tall straw-like grasses
5- Low-lying mosses and grasses
6- Short plants with thick succulent leaves

What type of mouth does it have?
1- Piercing, mosquito-like mouth
2- Fangs that deliver venom
3- Flat teeth for grinding
4- Sharp pointy teeth for tearing and shredding
5- Large front teeth for clipping leaves
6- No teeth (swallows things whole)

What is its exoskeleton like?
1- colorful
2- very thick skin
3- color blends with surroundings (camouflaged)
4- spikes on skin
5- covered in a layer of slime
6- very lightweight (thin) skin

Other notes that make up my Species' story (ie preferred habitat and potential predators, etc.)

_____
_____
_____
_____
_____

Simulation Rubric (Choose one adaptation):

	Other	Exoskeleton	Mouth Characteristics
	Grows extra feet to help it run more quickly	Colorful	Piercing, mosquito-like mouth
	Grows a longer neck to help it reach high places	Very thick skin	Fangs that deliver venom
	Grows a longer body to help it slither close to the ground	Color blends with surroundings (camouflaged)	Flat teeth for grinding
	Adapts food tastes to try additional plants	Spikes on skin	Sharp pointy teeth for tearing and shredding
	Learns to cohabitate with another species	Covered in a layer of slime	Large front teeth for clipping leaves
	Grows fins and learns to swim	Very lightweight (thin) skin	No teeth (swallows things whole)

Point Values (for scoring Round 1):

	Other	Exoskeleton	Mouth Characteristics *(- 15 if you chose any of these, except swallowing whole… this does not help your species' survival!)*
+ 15	Adapts food tastes to try additional plants	Colorful	Piercing, mosquito-like mouth
+ 30	Grows fins and learns to swim	Very lightweight (thin) skin	Fangs that deliver venom
+ 45	Learns to cohabitate with another species	Color blends with surroundings (camouflaged)	No teeth (swallows things whole)
+60	Grows a longer neck to help it reach high places	Spikes on skin	Sharp pointy teeth for tearing and shredding
+75	Grows a longer body to help it slither close to the ground	Covered in a layer of slime	Flat teeth for grinding

Points for Scoring (Round 2):

	Other	Exoskeleton	Mouth Characteristics *(- 15 if you chose any of these, except swallowing whole… this does not help your species' survival!)*
+ 15	Adapts food tastes to try additional plants	Colorful	Piercing, mosquito-like mouth
+ 30	Grows fins and learns to swim	Very lightweight (thin) skin	Fangs that deliver venom
+ 45	Learns to cohabitate with another species	Color blends with surroundings (camouflaged)	No teeth (swallows things whole)
+60	Grows a longer neck to help it reach high places	Spikes on skin	Sharp pointy teeth for tearing and shredding
+75	Grows a longer body to help it slither close to the ground	Covered in a layer of slime	Flat teeth for grinding
+100	Grows extra feet to help it run more quickly	Very thick skin	Large front teeth for clipping leaves

Points for Scoring (Round 3):

	Other	Exoskeleton	Mouth Characteristics
+ 15	Learns to cohabitate with another species	Colorful	Large teeth for clipping leaves
+ 30	Adapts food tastes to try additional plants	Very lightweight (thin) skin	Flat teeth for grinding
+ 45	Grows a longer neck to help it reach high places	Color blends with surroundings (camouflaged)	No teeth (swallows things whole)
+60	Grows fins and learns to swim	Spikes on skin	Sharp pointy teeth for tearing and shredding
+75	Grows a longer body to help it slither closer to the ground	Covered in a layer of slime	Fangs that deliver venom
+100	Grows extra feet to help it run more quickly	Very thick skin	Piercing, mosquito-like mouth

Total Points = _____

Unit Resources

For Teachers:

Bartholomew, S. R. (2017). Using Pokémon GO to Teach Integrative STEM. *Technology And Engineering Teacher*, *76*(5), 24-27.

This scholarly article gives ideas for how to incorporate concepts from Pokémon into general classroom lessons, especially STEM. This article can give some background information for teachers unfamiliar with tenets of the game. However, educators should keep in mind that this is geared specifically towards STEM and general education classrooms and will need to be adjusted to fully fit gifted needs.

http://www.pbs.org/wgbh/evolution/educators/teachstuds/tguide.html
This resource provides general information on various aspects of evolution, specifically designed to give teachers background information before teaching a unit on evolution. It also contains various resources for teaching evolution in the classroom, though teachers should be aware that these resources are generally for older ages and are not designed necessarily with gifted students in mind; they will need to be adjusted accordingly.

http://www.indiana.edu/%7Eensiweb/lessons/unt.ev.f.html
This website is designed specifically for teachers and focuses on common student misconceptions that might arise during a study of evolutionary topics. This source could be used to build teacher background knowledge before teaching the unit.

http://www.project2061.org/publications/guides/evolution.pdf?txtRef=http%3A%2F%2Fwww%2Enclark%2Enet%2FEvolution&txtURIOld=%2Fpublications%2F2061connections%2F2006%2Fmedia%2Fevo%5Fhandout%5Fteachers%2Epdf
This resource is another that could be used to build teacher background knowledge on evolution before beginning this unit. It's probably most useful, however, because it recommends various trade books for student use that are related to the topic, which the teacher might want to acquire as an extension to texts already included.

http://www.ucmp.berkeley.edu/education/lessons/clipbirds/
This gives another simulation-type activity that teachers could use with students to expand on the first day's lesson on bird survival. Similar to the bird beak activity included in the first lesson, this activity would more fully explore variation within a population by focusing on beak size.

https://www.biologycorner.com/worksheets/pepperedmoth.html
This resource provides another simulation, which examines the peppered moth and helps students to examine what factors caused it to adapt over time. This activity could be used as an extension to the bird activity that is used on Day 1.

http://thesetemporarytents.com/2014/12/04/100-learning-resources-kids-want-game-designers-programmers/
This site provides one hundred different resources for kids who are interested in becoming game designers. This could be a great resource to give teachers background before teaching the Bruner lesson on Day 2. In addition, teachers could use this site to expand content and exploration for students who show interest in the profession itself.

For Students:

http://www.pokemon.com/us/pokedex/
This site allows students to look up various existing Pokémon and their traits. This tool is great for giving students background knowledge of existing Pokémon in order to draw conclusions about trait resiliency and evolution patterns as they create an entirely unique species.

https://bulbapedia.bulbagarden.net/wiki/Main_Page
This is another site that allows students to look up various existing Pokémon and their traits in order to draw conclusions about trait resiliency and evolution patterns as they create an entirely unique species. Both teachers and students should be aware, however, that "Bulbapedia," like "Wikipedia," can be edited by the general public. Therefore, this could be a great chance for students to analyze multiple perspectives and analyze sources as they complete research.

https://litl.sesp.northwestern.edu/FrogPond/index.html?debug=true
This website allows students to manipulate various traits in an online simulation. The goal is to find a combination of traits that allows more frogs of greater size to exist, as this has been shown to be the strongest form of the species. By manipulating traits, students can draw conclusions about which traits ultimately lead to resiliency and why.

http://www.bbc.co.uk/sn/prehistoric_life/games/evolution/
In another online simulation produced by BBC, students act as small primates existing 50 million years ago. They must make decisions about evolution as the Earth begins to change. This activity could be a potential extension or precursor to the simulation on Day 4.

http://www.creativeuncut.com/video-game-design-career-paths.html
This site provides additional information for kids on different aspects of a video game designer's job. It might be a helpful additional resource to examine as students complete the Bruner lesson centered on the structure of the discipline during Day 2.

https://kids.nationalgeographic.com/animals
This site can serve as a springboard for research on various species. This is a great basic resource to help students who are more unfamiliar with independent research learn more about animal adaptations and traits that promote survival.

https://www.nationalgeographic.org/encyclopedia/adaptation/
Similar to the site above, this website is an online encyclopedia that allows students to investigate existing animal adaptations. The sophisticated vocabulary and content could be specifically geared to research investigations of gifted students.

https://www.sciencedaily.com/releases/2017/06/170630105008.htm
This article could be a possible addition or follow up to the Socratic Seminar on Day 3, or used as a source of additional research for students. It debates whether there is evidence that size is a trait that influences survival, and works to debunk the common belief that bigger is more resilient through an example with a species of fish.

https://newsela.com/articles/gargantuan-dino/id/5127/
This article could be used in coordination with the above as a possible addition or follow up to the Socratic Seminar on Day 3, or used as a source of additional research for students. It again examines size as a trait that influences survival, and presents a prehistoric creature. Did the creatures' extremely large size make it invincible?

http://whyfiles.org/125galapagos/index.html
This site is mostly useful for the background knowledge it provides on Charles Darwin's study of diversity among finches on the Galapagos Islands. This resource could be used in coordination with the bird activity on Day 1 or during independent research time.