Jurassic SPARK

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1st grade

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I. INTRODUCTION

The conversation about dinosaurs is one that unequivocally send its spectators into a time loop that requires imagination. It is not a trip made from a vision but based in science that dates back to 1859 when Charles Darwin initiated the conversation about Natural Selection.

Darwin (On the Origin of Species, p. 108), defines Natural Selection as "(…) variations useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If so do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance surviving and procreating their kind? On the other hand, we may feel that any variation in the least degree injurious would be rigidly destroyed. This preservation of favorable variations, I call Natural Selection."

These variations have become the backbone of biology and all the subsequent sciences that have emerged from it. Evolution is a concept that came as a direct consequence of Natural Selection. Gregory Morgan (2011) describes the modernization of natural selection into genetic evolution that has been extensively studied by Richard Dawkins "One of the more convincing examples Dawkins marshals is the recurrent laryngeal nerve in giraffes: it takes a 15-foot unnecessary detour down the neck and back up again that can be explained by looking at the evolution of giraffe necks but not easily explained (if at all) if the giraffe was intelligently designed. He draws an insightful analogy between local assembly rules in virus self-assembly and natural selection treated as local rules that operate over long periods of time."

This unit will provide students with the opportunity to identify these very same patterns amongst dinosaurs. Starting with background knowledge that refers to the first unicellular organisms in water to the evolution of the latest species of dinosaurs, birds. Students will be able to analyze evolutionary continuance through exposition to open-ended questions and chances to explore the different dimensions that sustain evolution.

Gifted learners possess the desire to explore and research topics in-depth and independently when the concepts are founded on challenging, relevant, and entertaining subjects. The study of dinosaurs and the sciences involved in this process, such as, paleontology, biology and genetics have been popularized by the Jurassic Park movie franchise since 1993. Therefore, motivation to explore theories like evolution, is ignited through pop culture.

Advanced learners require distancing from more traditional classrooms that can be rigid in the developing of standards. However, this exploration does not mean to abandon rigor to a "busy work" activity, but to the complex planning that merges developmentally appropriate interests with proficiency.

This unit will present four lessons that were carefully crafted to support gifted learners' needs. The first lesson will allow students to explore rich ideas, issues, and values, presented in an article that is centered in evolution studied through the lens of genetics that will support extended and thoughtful dialogue that will raise questions in the participants while one classmate serves as a moderator. The second lesson provides the opportunity to understand the study of dinosaurs through a paleontologist's vision by developing ideas and connecting areas

across the discipline that sustain appreciation for the science, as well as, the chance to problem solve beyond paleontology itself. The third lesson introduces the complexity of interacting sciences to understand real life phenomena that takes place in a fantasy setting that is crafted to send the students in a quest supported on the creation multiple species of dinosaurs by chances and creativity that must endure challenges that require understanding of higher-level concepts. The final lesson teaches students the varying levels of questioning through Costa's levels of inquiry and requires them to begin to develop higher-order questioning techniques.

This unit was designed, but not limited, for 1st Grade students from multiple ethnicities and socioeconomic status with ages that average on 6 to 7 years old who have demonstrated not only intellectual curiosity but the ability to synthesize complex scientific concepts that are beyond the grade level standards in previous units. For them, Carol-Ann Tomlinson (2015) highlights the relevance of differentiated instruction and "teaching up" when she describes that "Others begin by crafting a learning experience that focuses on the essentials for students who have more difficulty with particular content in order to ensure clarity about the essentials, and differentiate from that foundational position. Teaching up asks teachers to begin by crafting tasks that represent effective challenge for advanced or high-end learners and then to differentiate or scaffold learning in ways that support a very broad range of students in working with that "advanced" level of knowledge, understanding, and skill."

Therefore, the students are met where they are, regardless of their backgrounds and needs by offering lessons that facilitate class discussions at higher levels that allow them to offer opportunities to share freely since outcomes are open-ended and encouraged by a teacher that

supports independence and celebrates to whichever difference each student displays regardless of what it might be.

Since understanding is multi-faceted, this unit intents to focus on the development of performances such as, explanation and interpretation, and insights such as, perspective and empathy. The performances can be seen through the capacity students have to describe, justify, predict, compare and contrast, illustrate and judge the impact that evolution has had in the evolution of dinosaurs into birds. Furthermore, the Bruner and simulations models provide the opportunity to gain insights while students analyze, argue, make inferences, imagine, and assume the roles of scientists.

II. UNIT GOALS AND OUTCOMES

Unit Topic:	Jurassic Spark
Unit Concept:	Evolution
Essential Understanding:	Evolution sustains survival
CONTENT Goal and Objectives:	• **GOAL:** Students will understand the relevance of evolution for the survival of a species **OBJECTIVES:** *The students will know that…* • Evolution is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. • Species possess traits and adaptations to their environment to allow survival of the species. • Life evolved from the first unicellular organism in water over 400 million years ago. • Life on Earth first appeared as early as 4.28 billion years ago. • The study of fossils by paleontologists have given a wide understanding of evolution. • Life on earth evolved gradually beginning with one primitive life form • Paleontologists study fossils • Anatomy are physical structures • Heredity is the passing on of physical or mental characteristics genetically from one generation to another • Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring • New technologies support evolution • Species are a group of living organisms • There are similarities between species body parts that are called analogous structures. • Fossils are naturally preserved remains • Evolution is supported by evidence • Environments impact physical structures • Scientists use charts or family trees to relate species to one another
PROCESS Goal and Objectives:	**GOAL:** To develop research skills applicable to science

	OBJECTIVES: *The students will be able to…* • Analyze concepts to understand the depth of survival • Summarize information present in articles • Work collaboratively in groups that generate independent questions • Categorize ideas and concepts about evolution • Investigate the relevance of concepts • Compare and contrast similarities of traits amongst different species • Create generalizations about evolution
CONCEPT Goal and Objectives:	**GOAL:** To understand the concept of evolution **OBJECTIVES:** *The students will understand that…* • Evolution sustains life • Species change overtime supporting the rise of new species with a common ancestor

III. FORMATIVE ASSESSMENTS

Students will be given a data collector that will be filled out by the moderator on the Socratic Seminar that provides the teacher with the opportunity to analyze the complex conversation that it is taking place in each group, as well as, systematically identify if goals are being met. In addition, the teacher will provide an exit ticket containing the essential question for the Costa's Levels of Questioning lesson.

In addition, the teacher must record and report her observations about class discussions as a base to demonstrate the understanding of the concepts developed in each lesson. These observations will track skills, behaviors, knowledge and the depth in the facets of understanding the students take.

Contributes with a new idea	Asks a question	Refers to text	Makes a positive comment	Makes a negative comment	General feedback

Data Collector

EXIT TICKET
How does evolution sustain survival? _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

_____

_____

Costa's Levels of Questioning Exit Ticket

In addition, the teacher must record and report her observations about class discussions as a base to demonstrate the understanding of the concepts developed in each lesson. These observations will track skills, behaviors, knowledge, and the depth in the facets of understanding the students take.

Performance Task

Duke University has been granted the honor to hold the prestigious worldwide "Paleontological Association Annual Meeting" of this year. They have selected to combine the talent of Duke's Evolutionary Anthropology Department and the Duke Lemur Center where you happen to be the Assistant to the Director of the Division of Fossil Primates.

The Board of Directors of the Paleontological Association has decided that the topic for this year's meeting will be the sustainability of life through evolution. They launched a contest to select the key-note speaker for the Meeting and the most prestigious biologists, anthropologists and paleontologists are submitting their work.

The parameters to participate consist on writing a 500 to 700-word essay where must synthesize the clear links between life's first appearance on Earth 4.28 billion years ago, and modern-day birds in relationship with the theme chosen for this year's meeting: *Evolution sustains survival*. This happens to be your area of study since one of your most recent publications described the T-Rex and turkey skeletal structures.

- **Goal:** They launched a contest to select the key-note speaker for the Meeting and the most prestigious biologists, anthropologists and paleontologists are submitting their work.
- **Role:** They have selected to combine the talent of Duke's Evolutionary Anthropology Department and the Duke Lemur Center where you happen to be the Assistant to the Director of the Division of Fossil Primates.
- **Audience:** The Board of Directors of the Paleontological Association
- **Situation:** They launched a contest to select the key-note speaker for the Meeting and the most prestigious biologists, anthropologists and paleontologists are submitting their work.
- **Performances:** The parameters to participate consist on writing a 500 to 700-word essay where must synthesize the clear links between life's first appearance on Earth 4.28 billion years ago, and modern-day birds in relationship with the theme chosen for this year's meeting: *Evolution*

sustains survival. This happens to be your area of study since one of your most recent publications described the T-Rex and turkey skeletal structures.

- **Standards:**

Criteria	Beyond Expectation x5	Meets Expectations x4	Developing x3	Not Addressed x2
Depth of Coverage	There are multiple original ideas that have been highly explored	Essay has a clear and original idea that is promptly presented and elaborated.	Idea is present but lacks depth and substantiation	Ideas cannot be identified on the essay
Grammar and Mechanics	Essay has no typographical errors. Spelling, punctuation, and capitalization norms are present	Spelling, punctuation, and capitalization norms are present.	There are some typographical, spelling, punctuation, and capitalization errors	Typographical, spelling, punctuation and capitalization error are persistent
Best Practices	Writing is coherent and consistent with central ideas. Essay possess outstanding organization	Information is well integrated. Some sentences are inconsistent with main idea and do not follow logic	Information is scattered and lacks continuity. Unrelated word choices	Essay is confusing and hard to follow.
Methodology	Citations are pertinent and from outstanding scientific papers. Norms are followed in all citations	Citations in the text are consistent.	Citations are not consistent. Some references were missing either from the text or body of the paper.	There are no citations

IV. LESSON PLANS

TEACHER NAME		Lesson #
Elena Rodriguez		3
MODEL	**CONTENT AREA**	**GRADE LEVEL**
Socratic Seminar	Science / ELA	1st

CONCEPTUAL LENS	LESSON TOPIC
Evolution	The Anatomical Evidence of Evolution

LEARNING OBJECTIVES *(from State/Local Curriculum)*

RI.3.7. Use information gained from illustrations and the words in the text to demonstrate understanding of the text.

RI.3.8. Describe how the author connects ideas between sentences and paragraphs to support specific points in a text.

5.L.3. Understand why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.1. Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.2. Give examples of likenesses that are inherited and some that are not.

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 sustains survival	How does evolution sustain survival?

	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Students will know that: • Evolution is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. • Species possess traits and adaptations to their environment to allow survival of the species. • Life evolved from the first unicellular organism in water over 400 million years ago. • Life on Earth first appeared as early as 4.28 billion years ago. • The study of fossils by paleontologists have given a wide understanding of evolution.	Students will be able to: • Explain • Analyze • Predict • Synthesize • Infer • Experiment • Recreate • Compare and contrast • Create connections • Craft questions

- Life on earth evolved gradually beginning with one primitive life form
- Paleontologists study fossils
- Anatomy are physical structures
- Heredity is the passing on of physical or mental characteristics genetically from one generation to another
- Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring
- New technologies support evolution
- Species are a group of living organisms
- There are similarities between species body parts that are called analogous structures.
- Fossils are naturally preserved remains
- Evolution is supported by evidence
- Environments impact physical structures
- Scientists use charts or family trees to relate species to one another

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:
• ***Opening questions***: How could you explain what species are? • Why do you think there are species that do not survive? • Why do you think there are so many kinds of animals? • Why are similar looking species located in different places in the world? • How would you describe natural selection? • Why do organisms need to evolve every time they reproduce? • How would you explain the impact of mutations in survival? • How would you explain the impact of mutations in evolution?	• What did you underline? • Why did you underline or circle the word or phrase? • What questions do you have because of reading the article? • What questions did you record? • What does this article remind you of? • How could you describe the similarities between the videos we previously watched and the text? • What questions emerged while you were reading the article?	• How would you describe evolution now? • How would you describe the survival of a species? • How could you describe the importance of fossils to the study of evolution? • How does the study of fossils support evolution? • How do scientists keep track of hereditary traits? • Why is keeping track of hereditary traits relate to evolution? • How does technology support the investigation of evolution? • How do you think ecosystems impact the evolution of new traits in species?

• How does mutation relate to evolution? • How would you explain the impact of mutations in survival? • How would you explain the impact of mutations in evolution? • How could one species ever evolve into another? • Why does the bird preserve in amber is so important to the paleontologists? • Why do you think the paleontologist says the bird was carnivorous if she didn't see it feed? • Why do you think the observation of bones provides so much information about an extinct animal? • Why do you think the paleontologists make informed speculation looking are related animals? • Why do you think the paleontologists look at emus and ostriches to infer how the t-rex was? • Why do you think the paleontologists say the T-rex was related to the dinosaur fossil from China? • Why do you think the paleontologist speaks about the evolutionary steps the T-Rex ancestors made to become the T-Rex?	• What can you infer about evolution after reading the text? • Why is evolution relevant in this discussion? • Why do you think similarities are so important when speaking about evolution? • How do adaptations relate to evolution? • How have your ideas of survival been impacted after reading this text? • How have your ideas of evolution been impacted after reading this text?	• How is the ecosystem related to the evolution of a species? • How is the ecosystem related to the survival of a species? • How do ecosystems sustain survival? • How could you infer this relationship between ecosystems and animals exist? • What parts of the discussion did you find most interesting? In what parts were you least engaged? • How does evolution sustain 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**
Extending ideas and topics beyond the regular curriculum. Presenting different materials to access concepts within content.	**Creating and ask open-ended questions to promote critical thinking beyond regular curriculum.**		**Student led simultaneous seminars**

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.*

The teacher welcomes the students into the classroom and asks them to come to the carpet. She tells them that they are going to watch a group of videos about Animals and then asks the following opening questions:

1. How could you explain what species are?
2. Why do you think there are species that do not survive?

Students watch a TheKidShouldSeeThis video list that is linked below on animal evolution composed by 4 short videos. Before each one of the videos the teacher asks the following questions:

3. First Video:

- How would you explain the impact of mutations in survival?
- How would you explain the impact of mutations in evolution?
- Why do you think there are so many kinds of animals?
- Why are similar looking species located in different places in the world?
- How would you describe natural selection?
- Why do organisms need to evolve every time they reproduce?

4. Second Video:

- How does mutation relate to evolution?
- How would you explain the impact of mutations in survival?
- How would you explain the impact of mutations in evolution?
- How could one species ever evolve into another?

5. Third Video:

- Why does the bird preserve in amber is so important to the paleontologists?
- Why do you think the paleontologist says the bird was carnivorous if she didn't see it feed?
- Why do you think the observation of bones provides so much information about an extinct animal?

6. Fourth Video:

- Why do you think the paleontologists make informed speculation looking are related animals?
- Why do you think the paleontologists look at emus and ostriches to infer how the t-rex was?
- Why do you think the paleontologists say the T-rex was related to the dinosaur fossil from China?
- Why do you think the paleontologist speaks about the evolutionary steps the T-Rex ancestors made to become the T-Rex?

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 teacher will model the reading of the following article three times:

The Anatomical Evidence of Evolution (article at the end of the lesson)

Each time will prepare furthermore to take notes about relevant concepts and/or underline main and secondary ideas. Before starting the last read, the teacher will give away sticky notes and will instruct to take notes or questions on specific passages of the article.

Then, the teacher asks the following questions:

- What did you underline?
- Why did you underline or circle the word or phrase?
- What questions do you have because of reading the article?
- What questions did you record?
- What does this article remind you of?

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 divides the class in groups of 3-4 and instructs them to find a space where they can sit as far from one another as possible. Then, asks the following question:

- How could you describe the similarities between the videos we previously watched and the text?

The students instructed to engage in a discussion using their notes to expand their understanding of the article. One of the students will be selected to monitor the flow of the conversation. As the groups start to find their places across the room the teacher hands the monitor a set of instructions.

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***

The student monitoring the conversation will use chart paper provided by the teacher to keep track of this dialogue by marking the choices each of the participants are taking as the conversation develops. The chart paper will be previously labeled as follows:

Contributes with a new idea	Asks a question	Refers to text	Makes a positive comment	Makes a negative comment	General feedback

The monitor will use the following opening question:

- What questions emerged while you were reading the article?
- What can you infer about evolution after reading the text?

After a 10-minute dialogue, the monitor will continue to ask the following questions and proceed with note taking:

- Why is evolution relevant in this discussion?
- Why do you think similarities are so important when speaking about evolution?
- How do adaptations relate to evolution?

- How have your ideas of survival been impacted after reading this text?
- How have your ideas of evolution been impacted after reading this text?

Then, as the dialogue unravels, the monitor will mark the boxes that exemplify each contribution being made. They will make these marks with an X or a Circle on the corresponding box showing the position in the circle where the classmate was seated. They will also be instructed to mark the order the speakers are contributing.

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

Finally, the groups come together and the teacher hangs the chart paper noting the contributions made by each group. Then, shows their findings to them and instructs them to prepare to find common ground on their findings. She asks the following questions:

- How would you describe evolution now?
- How would you describe the survival of a species?
- How could you describe the importance of fossils to the study of evolution?
- How does the study of fossils support evolution?
- How do scientists keep track of hereditary traits?
- Why is keeping track of hereditary traits relate to evolution?
- How does technology support the investigation of evolution?
- How do you think ecosystems impact the evolution of new traits in species?
- How is the ecosystem related to the evolution of a species?
- How is the ecosystem related to the survival of a species?
- How do ecosystems sustain survival?
- How could you infer this relationship between ecosystems and animals exist?
- What parts of the discussion did you find most interesting? In what parts were you least engaged? How does evolution sustain survival?

As the students begin to answer, the teacher records their responses on chart paper and shares notations made by their monitors starting with amount of new contributions and finalizing with general feedback. This will serve the purpose to set goals for a next seminar.

MONITOR RULES

1. You are an observer, not an active participant.
2. You will ignite the dialogue with these questions:
    - What questions emerged while you were reading the article?
    - What can you infer about evolution after reading the text?

Then, moderate such dialogue with these questions:

- Why is evolution relevant in this discussion?
- Why do you think similarities are so important when speaking about evolution?
- How do adaptations sustain survival?

- How have your ideas of survival been impacted after reading this text?
- How have your ideas of evolution been impacted after reading this text?
- Take notes on the type of contribution by selecting the corresponding box.

3. Mark who made the contribution by showing with an X or a Circle the position of your classmates in the group.
4. Be sure to record each contribution being made.
5. Share with your group that they need to be nice to one another and avoid sarcasm.
6. They also need to allow classmates enough time to finish their contribution before responding. It is not okay to interrupt them.
7. They need to use their best active listening skills: nod, make eye contact, provide feedback, and listen carefully to others.
8. They will participate openly supporting their opinions with evidence from the text.

Science & Math

The anatomical evidence of evolution

Image 1. Fossils can help us paint a picture of what life was like in time periods from long ago. They also give us clues about organisms that are long extinct. Photo by: E. R. Degginger/Science Source

By ThoughtCo.com, adapted by Newsela staff

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Today, scientists continue to find more evidence to help them better understand evolution. New technologies allow them to do this. Scientists can compare the DNA similarities between species. They can also track microevolution; however, they did not always have these technologies. Scientists used other forms of evidence to support the theory of evolution by natural selection.

Anatomical Evidence For Evolution

Over the years, scientists have gathered large amounts of evidence of the evolutionary development of species. The most important evidence came from anatomical similarities. Scientists studied how the body parts of one species were similar to those of another.

Scientists also tracked accumulating adaptations in species. They saw how organisms physically adapt to challenging environments. These adaptations keep adding up, or accumulating. Soon, physical structures in one species can change. In some cases, they become similar to those of other species surviving in similar environments. Fossils of long-extinct organisms can provide anatomical evidence, as well. They help fill in the picture of the changes in a species over time.

Fossil Record

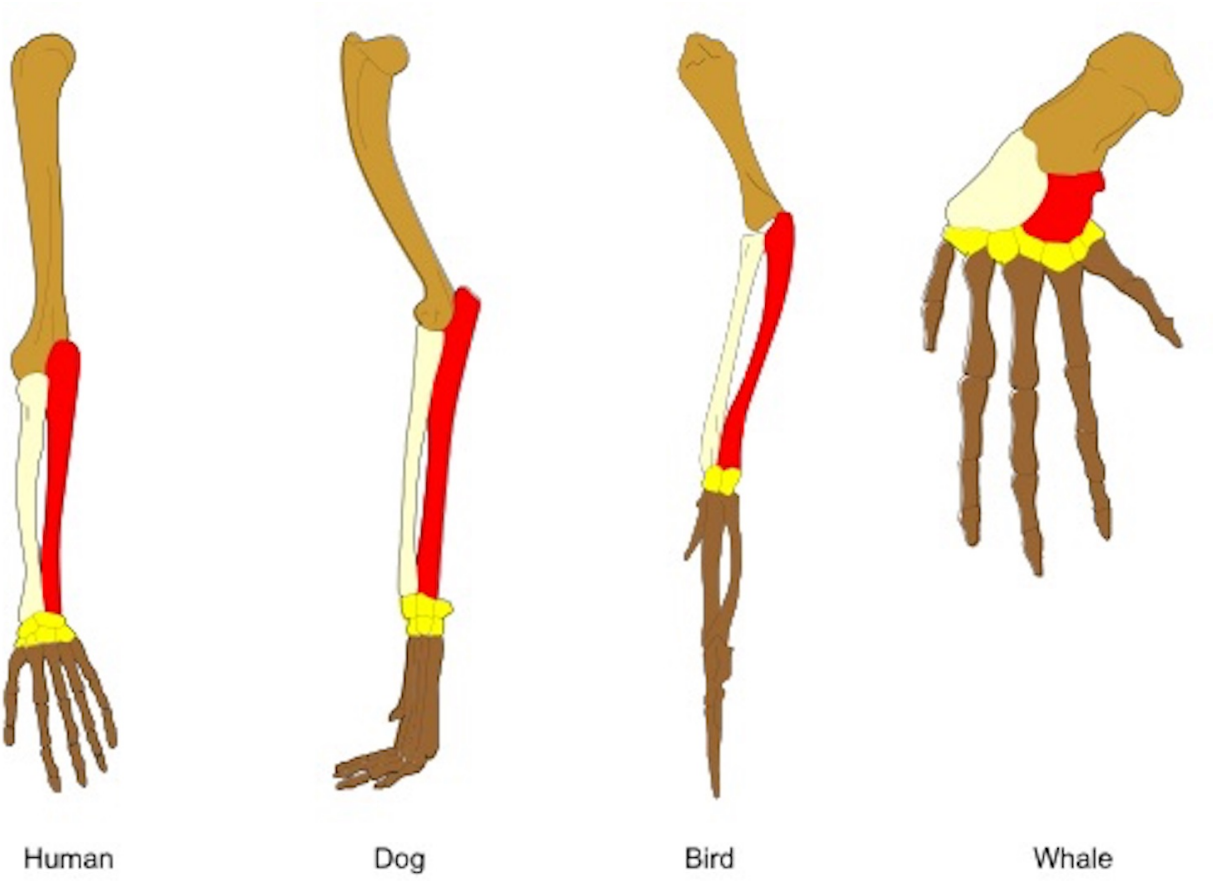
Fossils are naturally preserved remains of organisms that lived in the past. They provide evidence of life evolving through natural selection. Fossilized bones, teeth, shells or even entire organisms can paint a picture of life from long ago. Fossils provide evidence of organisms that are long extinct. They also show us some of the changes that species underwent. Fossils can show how new species formed.

Scientists can figure out how long ago the fossilized organisms existed. They use various techniques to date fossils. Knowing a fossil's age can help fill in gaps in our understanding. It shows scientists how and when a species changed. That lets them see where the change fits in the geologic time scale (GTS). The GTS is the sequence of events. These events happened throughout the history of the Earth.

Some opponents of evolution say that the fossil record supports their argument. They argue that there is no evolution. They say this is because there are "missing links" in the fossil record. They are referring to the links between modern species and extinct species from the past. This argument is not

scientifically valid. Fossil formation is a complex process. Conditions need to be just right for dead organisms to fossilize. Not every organism shows up in fossils. Not every change shows up, either. Nevertheless, year after year, more previously undiscovered fossils are found. This helps scientists fill in gaps in the fossil record.

Homologous Structures



Zoom-inImage 2. Homologies of the forelimb among vertebrates, giving evidence for evolution. The bones correspond, although they are adapted to the specific mode of life of the animal. Image credit: Encyclopædia Britannica, Inc.

To track how closely related species are to each other, scientists use the phylogenetic tree of life. That is a chart. It is like a family tree. It lays out the evolutionary relationships between species. To determine these relationships, scientists study homologous structures. These are structures, or body features, that are similar in two different species. The structures are similar because they were inherited from a common ancestor.

You can compare homologous structures in hippos and dolphins, for example. Dolphins and hippos are closely related. Scientists see evidence of this relationship by comparing hippo and dolphin limbs.

Dolphins have pectoral fins. The fins help them steer as they swim. These are the flippers at their chests. They appear to look very different from a hippo's forelimbs. When scientists compared the bones in a dolphin flipper with the bones in a hippo forelimb and foot, however, they found the same bone structures. These are homologous structures. This is one of the ways scientists classify organisms. They place organisms in phylogenetic groups. These groups branch off from a common ancestor.

Analogous Structures

Animals can look alike even if they are not closely related to one another. Consider the example of dolphins and sharks. They look similar in body shape, size, color and fin location; however, they are not closely related at all. So why do they look so much alike?

The answer lies in evolution. Species change in response to their environments. They do this in order to fill a niche. A niche involves a species' role in an environment. It is determined by a set of environmental conditions. These conditions include the presence of food and prey, predators, water, etc. Dolphins and sharks live in similar conditions. They both eat fish. They fill a similar niche. Unrelated species that fill similar niches tend to accumulate similar adaptations. These can add up, making the different species resemble each other.

These similarities in unrelated species are called analogous structures. They are not like homologous structures. They do not come from a common ancestor. For example, dolphins have fins and tails. Sharks also have fins and tails. Although these structures look similar, they developed independently. Both sharks and dolphins developed these structures to help them to swim quickly and catch prey. This helped them survive in their environments. Dolphins and sharks did not inherit the similar structures from a common ancestor.

These developments show us evolution at work. They show us species changing independently in order to fit into their niche. Such change is the driving force behind speciation. This is the change in a species over time.

Vestigial Structures

Some parts of an animal's body no longer have any use or function. These are leftovers from an earlier form of the species. Over time, the species accumulated several adaptations. Eventually, some body part did not serve a purpose. It didn't, however, completely disappear.

Such body parts are called vestigial structures. Humans have vestigial structures, too. One example is the tailbone. It is all that's left of a human ancestor species' tail. We also have an organ called an appendix. Some scientists think it no longer serves any purpose in humans. Vestigial structures are like fossils within an organism's body. They give clues to earlier forms of the species.

TEACHER NAME			Lesson #
Elena Rodriguez			2
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Bruner	Science / Social Studies	1st	

CONCEPTUAL LENS	LESSON TOPIC
Evolution	What does a paleontologist do?

LEARNING OBJECTIVES *(from State/Local Curriculum)*

3.G.1.2. Compare the human and physical characteristics of places.
3.C&G.2. Understands how citizens participate in their communities.
3.E.2.1. Explain why people become entrepreneurs.
5.E.2. Understand that personal choices result in benefits or consequences.

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 sustains survival	How does evolution sustain 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: • Evolution is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. • Dinosaurs are divided by the geological period they lived in • Dinosaurs lived in three distinctive periods: Triassic, Jurassic and Cretaceous. • Paleontologists study the cycle of life in dinosaurs • Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring • Paleontologists study fossils • Fossils are naturally preserved remains • Paleontologists may work in a lab or in excavations depending of their research	Students will: • Analyze • Summarize • Work collaboratively in groups • Categorize • Investigate • Compare and contrast • Create generalizations • Empathize • Adopt perspectives

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 you know about paleontologists?	• How would you imagine the work of a paleontologist? • Why would you infer that paleontologist study evolution? • Why would you infer that paleontologists study survival? • Why would you infer that paleontologists study the relationship between survival and evolution? • What are some of the tools paleontologists use? • What personality skills do you believe a paleontologist should have? • How would you evaluate the work of a paleontologist? • How would you make sense of Quintin's ideas in the role of a paleontologist? • What are the characteristics that Quintin considers essential to become a paleontologist? • Why is paleontology so important according to Quintin? • How would you define evolution from Quintin's perspective? • What do you think he'll say about evolution's relationship to survival? • Why do paleontologists map the sites? • What does jacketing mean? • What does Thomas Carr conclude about preservation? • How would you describe the evolution of a paleontologist? • How would you describe the life of a paleontologist? • What did you observe? • How do you imagine it feels to be working on the site with these tools? • What do you think this observation mean? • What do you believe about paleontologists to support this? • What has changed between your individual observations and the group discussion? • How do you think paleontologists study survival? • How do you think paleontologists study evolution?	• How would you imagine being paleontologist looks like? • What characteristics do you believe a paleontologist must have? • How do you think a paleontologist should behave in an excavation? • How do you think a paleontologist should behave in a Museum? • How do you think a paleontologist should behave in a University? • How do you think a paleontologist should behave in a lab? • How would you illustrate the obligations of a paleontologist as a scientist? • How do you believe the role of a paleontologist evolves? • How does a paleontologist study survival? • How does a paleontologist study evolution? • How do you think a paleontologist would illustrate the relationship between evolution and survival? • How do you believe a paleontologist lives their life? • How could you illustrate how your ideas about the role of a paleontologist have evolved during this lesson? • How does evolution sustain survival?

	• How can we use our combined observations to make a generalization about paleontology?	

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
Extending ideas and topics beyond the regular curriculum by studying the life cycle of dinosaurs and their origin.	**Student driven high level thinking discussion to understand the role of a paleontologist within the different areas if their discipline**		**Simulation rotations to increase high level thinking and deep discussions**

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 into the classroom, the teacher is displaying at the front of the room a brush, a ruler, a hardhat, a camera, gloves, a hammer, a compass and a magnifying glass. The teacher will also place on their tables some props inside buckets like a map, plastic dinosaur bones and plant fossils, a small hovel, string, clay and small pick.

The teacher line up the students and conduct a silent gallery walk across the room to observe the artifacts and then, will send them to their seat to list independently everything they know about paleontologists after she asks the following opening question:

- What do you know about paleontologists?

After 10 minutes of listing, the teacher will call the students to the front carpet and ask them to share their findings while supporting their answers. While students are sharing, the teacher will make a graph on chart paper that shows the students' answers. The teacher will invite students to share the reasoning behind their findings to moderate the discussion.

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.*

Once they are done, the teacher asks the following questions:

- How would you imagine the work of a paleontologist?
- Why would you infer that paleontologist study evolution?
- Why would you infer that paleontologists study survival?
- Why would you infer that paleontologists study the relationship between survival and evolution?
- What are some of the tools paleontologists use?
- What personality skills do you believe a paleontologist should have?
- How would you evaluate the work of a paleontologist?

Then, the teacher presents the following videos while asking the students to stay focused on the paleontologists' characteristics, skills, habits and feelings:

- The first video, Quintin Powers - The Paleontologist's Passion, is a TED talk by the young paleontologist Quintin Powers and what dinosaurs meant for him as a child and what was required from him to become one as an adult.
- The second video best describes A Day in the Life of Thomas Carr, a Paleontologist, showing the ups and downs of the profession. It also shows how excavations and research look like.

Once the students are done the teacher will set up a second chart paper on the board and will ask the students to enrich the existing list from the beginning of the lesson by asking the following questions:

- How would you make sense of Quintin's ideas in the role of a paleontologist?
- What are the characteristics that Quintin considers essential to become a paleontologist?
- Why is paleontology so important according to Quintin?
- How would you define evolution from Quintin's perspective?
- What do you think he'll say about evolution's relationship to life?
- Why do paleontologists map the sites?
- What does jacketing mean?
- What does Thomas Carr conclude about preservation?

- How would you describe the evolution of a paleontologist?
- How would you describe the life of a paleontologist?

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.*

As the characteristics of the discipline are clearer, the students will be sent to their tables in groups of 5 to go through short simulation stations with the paleontologist materials and illustrations that show the correct use of these materials. These materials and illustrations were previously placed inside the buckets to match the stories. They will also be given 6 recording sheets to gather their observations about each simulation. One of the recording sheets will remain blank until the end of the session.

The observations will be completed in silence for 5 minutes at a time after which the group must gather and quietly debrief about what they saw on each station.

These simulations go as follows:

1. **Table 1:** A local rancher from the Patagonia has approached the Museum you are working at in Argentina with very large bones to be investigated. The team looks into these bones and concludes that they belong to a massive T-Rex and you need to start preparing for an excavation. How would you set up the excavation?
2. **Table 2:** You are working in the Chinese Academy of Sciences. A recent discovery was made, a new species of dinosaur and a primitive form of bird was just found in an excavation. The dinosaur has been called Oculudentavis. What protocol would you follow to preserve its state?
3. **Table 3:** You are working in Montana with Dr. Jack Horner and have found similarities in two sets of fossils that were thought to be different species until now. These fossils are proof that there are changes in the structure of the bones depending on the age of the dinosaur. Now, the time has come for you to present your finding at Montana State University, how would you prepare the fossils?
4. **Table 4:** You are head researchers at Khovd University in Mongolia. A tomb excavation has just been concluded and it is time for you to jacket your findings and head back to the lab. How would you proceed?
5. **Table 5:** You are part of the Paleontology Department at Duke University. Miners from Husky Energy Inc., a Canadian oil company, have found some bones that have been dated to 110 million years ago and your team has been called on site to start prospecting the excavation. What would the team need to do?

Once the groups are done with the rotations, they will be given 5 min to revise their observations and add any other detail they might consider relevant. Then, other 10 minutes will be granted to discuss their observations as a group and fill out the 6th recording sheet with the common data.

The discussion will be guided by the following questions:

1. What did you observe?
2. How do you imagine it feels to be working on the site with these tools?
3. What do you think this observation mean?
4. What do you believe about paleontologists to support this?
5. What has changed between your individual observations and the group discussion?
6. How do you think paleontologists study survival?
7. How do you think paleontologists study evolution?
8. How can we use our combined observations to make a generalization about paleontology?

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*

The teacher calls the groups to the carpet where the Graph from the beginning of the session is hanged on the board. The teacher hands a blank piece of paper with the heading **"A paleontologists job is…"** as the students sit on

the carpet and instructs them to compare and contrast their group findings with the Graph and write a concrete description on what a paleontologist does.

The teacher instructs them to consider the following guidelines:

- How would you imagine being paleontologist looks like?
- What characteristics do you believe a paleontologist must have?
- How do you think a paleontologist should behave in an excavation?
- How do you think a paleontologist should behave in a Museum?
- How do you think a paleontologist should behave in a University?
- How do you think a paleontologist should behave in a lab?
- How would you illustrate the obligations of a paleontologist as a scientist?

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

Finally, the teacher conducts one last discussion about the characterization the students just completed by asking these questions:

- How do you believe the role of a paleontologist evolves?
- How does a paleontologist study survival?
- How does a paleontologist study evolution?
- How do you think a paleontologist would illustrate the relationship between evolution and survival?
- How do you believe a paleontologist lives their life?
- How could you illustrate how your ideas about the role of a paleontologist have evolved during this lesson?
- How does evolution sustain survival?

TEACHER NAME			Lesson #
Elena Rodriguez			3
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Simulations	Science / ELA	1st	

CONCEPTUAL LENS	LESSON TOPIC
Evolution	Jurassic Spark

LEARNING OBJECTIVES *(from State/Local Curriculum)*

RI.3.7. Use information gained from illustrations and the words in the text to demonstrate understanding of the text.

RI.3.8. Describe how the author connects ideas between sentences and paragraphs to support specific points in a text.

5.L.3. Understand why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.1. Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.2. Give examples of likenesses that are inherited and some that are not.

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 sustains survival	How does evolution sustain survival?

	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Students will know that: • Evolution is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. • Species possess traits and adaptations to their environment to allow survival of the species. • Life evolved from the first unicellular organism in water over 400 million years ago. • Life on Earth first appeared as early as 4.28 billion years ago. • The study of fossils by paleontologists have given a wide understanding of evolution. • Life on earth evolved gradually beginning with one primitive life form • Paleontologists study fossils	Students will be able to: • Explain • Role play • Analyze • Predict • Synthesize • Infer • Compare and contrast • Create connections

- Anatomy are physical structures
- Heredity is the passing on of physical or mental characteristics genetically from one generation to another
- Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring
- New technologies support evolution
- Species are a group of living organisms
- There are similarities between species body parts that are called analogous structures.
- Fossils are naturally preserved remains
- Evolution is supported by evidence
- Environments impact physical structures
- Scientists use charts or family trees to relate species to one another

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:
• *Opening question*: How would you describe evolution according to this video? • How would you describe what evolution means? • How would you infer survival relates to evolution? • How would you describe what a fossil is? • What information can we infer from studying fossils? • How would you describe the relationship between birds and dinosaurs? • How would you describe the impact of transition in survival? • How would you describe the impact of transition in evolution? • How do you think similar traits are related to survival?	• How can we describe what DNA is? • How would you describe the importance of DNA evolution in the survival of a species? • How would you infer that DNA is the key to track the steps of evolution? • Why do you think the chicken was chosen to complete the DNA of the dinosaur? • Why might we infer that dinosaurs survived until our day? • What are some characteristics you think dinosaurs might have if they were alive today? • How would you infer that the backwards evolution process might affect how the dinosaurs are now in comparison to how they were millions of years ago?	• Why do you think this dinosaur was able to survive in this environment? • Where do you think these physical characteristics come from? • What are some examples of how other animals have evolved to survive? • Why do you think evolution plays such an important role in survival? • How can we make these inferences about the lives of animals we have never seen? • What would you say if I told you the studies presented in the scenario are real? • Why do you think the scientists have chosen chicken's DNA to complete the DNA code of dinosaurs?

	• What can you infer about your dinosaur physical characteristics? • What other characteristics have you inferred about your dinosaur? • How could you illustrate how your dinosaur moves? • How do you think this element affects the survival of your dinosaur? • How would you infer your dinosaur might react under this circumstance?	• How does evolution sustain 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**
Extending ideas and topics beyond the regular curriculum by studying relationship between dinosaurs to document content differentiation, as well as, rigorous vocabulary	**Concept driven simulations and role playing to increase high level thinking and deep discussions.**		**Teacher led simulation**

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.*

Students will read before the lesson the Readworks Article "Birds and Other Dinosaurs" and as the students log on to the zoom call, the teacher plays the Survival Video. Once it is done, the teacher asks the opening question:

- How would you describe evolution according to this video?

Then, the teacher proceeds to explain the meaning of evolution as the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. After what she shares a picture of the fossil referenced in the previous reading next to a picture of what that dinosaur might have looked like when it was alive and asks the following questions:

- How would you describe what evolution means?
- How would you infer survival relates to evolution?
- How would you describe what a fossil is?
- What information can we infer from studying fossils?
- How would you describe the relationship between birds and dinosaurs?
- How would you describe the impact of transition in survival?
- How would you describe the impact of transition in evolution?
- How do you think similar traits are related to survival?

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.*

Now, the teacher sets up the scenario for what the simulation is going to be:

> It is June 2020 and a new publication on genetics by the Dr that inspired the Jurassic Park movies has been made. His name is Dr Jack Horner.
> He has found the key to identify the necessary materials in old fossils and replicate them.
> Harvard and Yale University have started investigations to replicate the fossils materials with the help of an evolved relative with incredible survival skills, the chicken.
> Dr Horner says the key has been to look at similarities instead of differences and this has helped to establish relationships between species that were thought to be distant and in fact are close to one another.
> It turns out that as evolution found its way from dinosaurs to birds, we might be able to reverse that process all the way from chickens to dinosaurs.
> The materials Dr. Horner speaks about are called DNA. DNA is what has been making transitions to evolve and allow species to survive. The fun part here is that this transition will go backwards, starting with the chickens all the way to dinosaurs.

Then, she asks the following questions:

- How can we describe what DNA is?
- How would you describe the importance of DNA evolution in the survival of a species?
- How would you infer that DNA is the key to track the steps of evolution?
- Why do you think the chicken was chosen to complete the DNA of the dinosaur?

- Why might we infer that dinosaurs survived until our day?
- What are some characteristics you think dinosaurs might have if they were alive today?
- How would you infer that the backwards evolution process might affect how the dinosaurs are now in comparison to how they were millions of years ago?

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 introduces a virtual number generator that will play an important part in the game. Then, she shares a slide deck where she now sets up the rules for a game that will be played based on the scenario that was just presented:

- Each student must get a piece of paper and crayons.
- Each one of you will be given 6 turns to draw a number from the roller, each number has been previously assigned to a characteristic that will affect how your dinosaur looks like. You will take each turn one at a time. You are not allowed to reveal your picture before it is complete.

1	Herbivore
2	Carnivore
3	Omnivore

1	Bipedal
2	Quadrupedal
3	Flies
4	Swims

1	Small
2	Medium
3	Large
4	Extra Large

1	Fur
2	Feathers
3	Scales
4	Skin

1	Spikes
2	Horns
3	Plates
4	Talents

1	Fast
2	Slow
3	Jumps

- You have five minutes complete your dinosaur and habitat that you think it is essential for its survival.
- Each one of you will share your dinosaur one at a time.
- Answer the following questions about your dinosaur:
  - What can you infer about your dinosaur physical characteristics?
  - What other characteristics have you inferred about your dinosaur?
  - How could you illustrate how your dinosaur moves?
- Each student will take turns rolling the virtual number generator until one of them makes it to the Finish Line.
- If you land on a Hazard or Advantage space, you will roll the virtual dice to pick a card. These cards have been previously assigned 1-4 numbers.

The teacher shows the game board and explains the goal of the game is to make it to the Lab. The dinosaur that makes it first is the one that the scientists are going to be able to create from the chicken's DNA.

The teacher introduces the advantage and hazard cards and shows the symbols on the gameboard.

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 play the board game until one of them makes it to the finish line. As the students make it to the Challenge and Hazard spaces the teacher will engage in the following questions:

- How do you think this element affects the survival of your dinosaur?
- How would you infer your dinosaur might react under this circumstance?

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

After a dinosaur makes it to the Finish Line and the group celebrates the winner and other dinosaur creations, the teacher concludes asking the following questions:

- Why do you think this dinosaur was able to survive in this environment?
- Where do you think these physical characteristics come from?
- What are some examples of how other animals have evolved to survive?
- Why do you think evolution plays such an important role in survival?
- How can we make these inferences about the lives of animals we have never seen?
- What would you say if I told you the studies presented in the scenario are real?
- Why do you think the scientists have chosen chicken's DNA to complete the DNA code of dinosaurs?
- How does evolution sustain survival?


pixers

Rules

1. Each student must get a piece of paper and crayons.
2. Each one of you will be given 6 turns to draw a number from the roller, each number has been previously assigned to a characteristic that will affect how your dinosaur looks like. You will take each turn one at a time. You are not allowed to reveal your picture before it is complete.

1	Herbivore
2	Carnivore
3	Omnivore

1	Bipedal
2	Quadrupedal
3	Flies
4	Swims

1	Small
2	Medium
3	Large
4	Extra Large

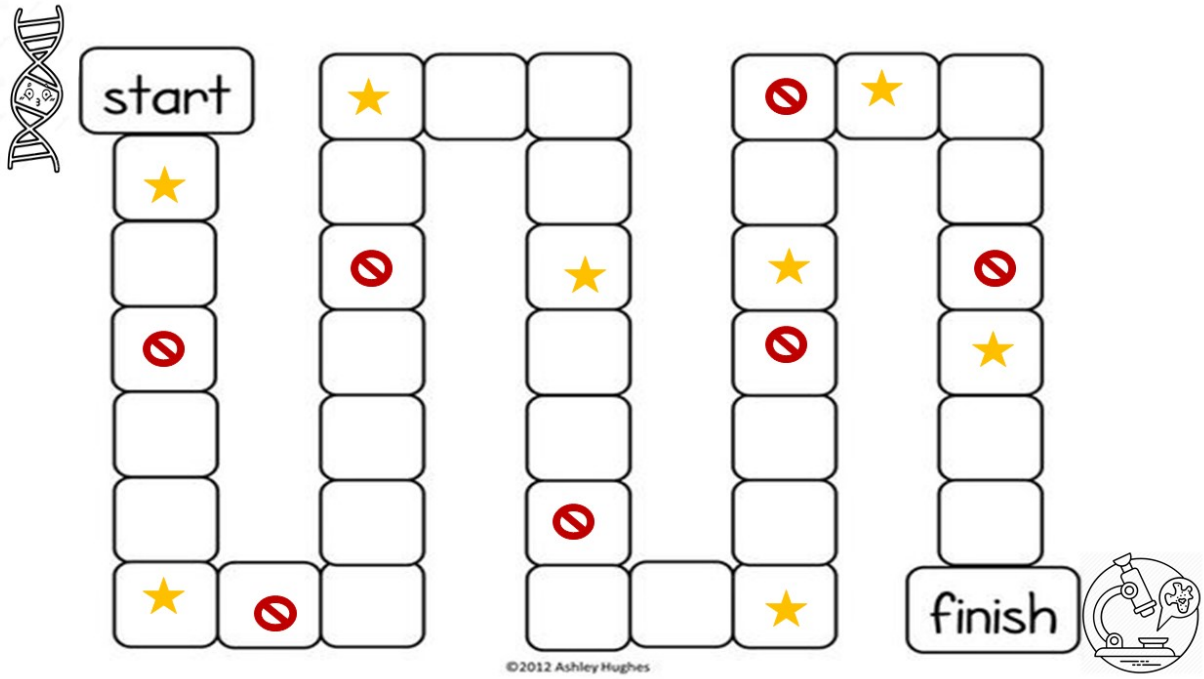
1	Fur
2	Feathers
3	Scales
4	Skin

1	Spikes
2	Horns
3	Plates
4	Talents

1	Fast
2	Slow
3	Jumps

Rules

1. You have five minutes complete your dinosaur and habitat that you think it is essential for its survival.
2. Each one of you will share your dinosaur one at a time.
3. Answer the following questions about your dinosaur:
   - What can you infer about your dinosaur physical characteristics?
   - What other characteristics have you inferred about your dinosaur?
   - How could you illustrate how your dinosaur moves?
4. Each student will take turns rolling the virtual number generator until one of them makes it to the Finish Line.
5. If you land on a Hazard or Advantage space you will roll the virtual dice to pick a card. These cards have been previously assigned 1-4 numbers.



	★		⊘
1	You have been given the opportunity to roll again and trade one of your chosen dinosaur traits	1	You have encountered a predator. You will be able to advance to the next space if you can explain how your dinosaur would defeat or escape this predator
2	You have successfully evaded a predator. Trade spaces with a player of your choice	2	Your staple food source is no longer available. You will be able to advance to the next space if you can explain which characteristics of your dinosaur will help you find a new food source?
3	You have found a sustainable food source. Move two spaces.	3	A meteorite will land on this space. You will be able to move to the next space if you can explain what skill will help you survive
4	You have developed communicational skills to share your thoughts with the scientists in the lab. Advance one space.	4	You have created a nest and laid eggs. You can advance to the next space if you can explain how you will protect you eggs.

	★		⊘
5	You have been given the opportunity to ask a friend to join you at this space to fight a flying predator	5	A blizzard is on the way, you will be able to advance to the next space if you can explain which characteristics of your dinosaur will help you survive
6	You have evolved into having the strongest bite in the Lab. Next time you must face a predator you get to chew your way out of that space	6	Your natural food sources have disappeared. However, your habitat is full of rich aquatic meals. Advance to the next space if you can explain what skills will help you adapt to the water
7	Your brain has evolved into a much bigger size than expected. Next time you encounter a challenge you will be able to think your way out of it	7	You have stepped on a very scared venom spitting Dilophosaurus. You will be able to evade it if you can explain which adaptations will help you escape
8	You have developed the skill to climb trees. Make it two spaces ahead with a full tummy of a new food source	8	You were running away from a predator and have fallen from a cliff. Luckily, you are caught on vines, but now you need to figure out how to make it out of them. Advance to the next space if you can explain what skills will save you

Birds and Other Dinosaurs

by American Museum of Natural History

This text is provided courtesy of the American Museum of Natural History.

Long ago, many kinds of dinosaurs lived on Earth. Some dinosaurs were as tall as a house. Others were smaller than you! Different dinosaurs had different body parts. The biggest dinosaurs had long necks that could reach leaves that were far away.

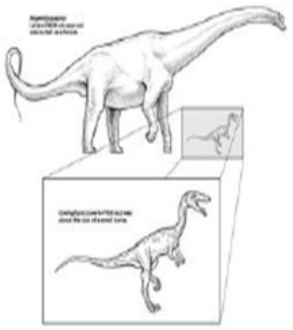


Illustration Credits: Argentinosaurus, © AMNH/Sean Murtha; Coelophysis, © AMNH/Ed Heck

Dinosaurs moved in different ways too. Some walked on four legs. Others walked on two. The dinosaurs that lived long ago are extinct. This means that there are none of them living today.

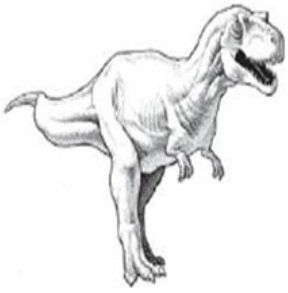


Illustration Credit: © AMNH/Sean

Tyrannosaurus rex (tie-ran-uh-SAW-rus rex) walked on two legs. It used its powerful jaws to catch animals.

Illustration Credit: © AMNH/Ed Heck

Stegosaurus (steg-uh-SAW-rus) walked on four legs. It had thick skin and a spiky tail.

But one kind of dinosaur survives: birds! We know that birds are a kind of dinosaur because birds and extinct dinosaurs are alike in lots of ways.

Compare the two animals in the pictures below. *Sinornithosaurus* (sigh-NOR-nith-oh-sawr-us) is a dinosaur that lived long ago. The roadrunner is a bird living today. Both animals walk and run on two legs. They are alike in other ways too. They both have claws, and their bodies are covered with feathers.

Image Credit: © AMNH

No one has ever seen a living Sinornithosaurus. This is a photograph of a model that was made by an artist.

Roadrunners are birds living today. A photographer took this picture of a roadrunner in a field.

Photo Credit: © Sandy & Chuck Harris

Let's take a look at more dinosaurs. See if you can spot other ways they are alike and different.

Living Dinosaurs

Here are three birds, or living dinosaurs:

Cardinals are familiar birds in many parts of the United States. The northern cardinal male is very easy to spot because of its feathers. It has a bright red body, a black face, and a pointed crest of feathers on its head. The males show off their feathers to attract females. They might stick up their crest and sway back and forth while chirping a song. Feathers aren't just for finding mates. They also help keep cardinals warm and dry. Without feathers, cardinals couldn't fly!

Photo Credit: © Craig O'neal

The ostrich is a very different kind of bird. This large bird is covered with feathers, but it doesn't fly. It runs!

Ostriches stand and run on two long, powerful legs. When they're chased, ostriches can run over 70 kilometers per hour (43 miles per hour). That's as fast as a car on a city street. And if they can't run away, they use their strong legs to deliver a mighty kick!

Photo Credit: © Davida De La Harpe

Eagles are big, strong birds. They can fly high and far.

They can also dive very fast to catch dinner. This eagle has sharp, curved claws. These claws are good for grabbing and carrying small animals. It also has a big, sharp beak shaped like a hook. The eagle uses its beak to kill and eat the animals it catches.

Extinct Dinosaurs

Compare those birds to these dinosaurs from long ago. Remember, these dinosaurs have never been seen alive. The drawings are based on clues that scientists have found.

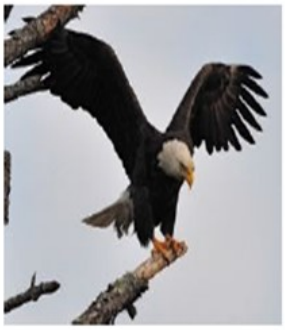


Photo Credit: © Bob Harris

Living birds aren't the only dinosaurs with feathers. Some dinosaurs that lived long ago had feathers too! Look at *Anchiornis* (an-kee-ORN-is). Red, black, and white feathers covered its body from its head to its tail. These feathers kept the dinosaur warm. Feathers may have helped it get around, too. *Anchiornis* could not fly. But it may have used its wings to glide through the air.

Image Credit: © Zhao Chuang, Courtesy of Peking Natural Science Organization

Yutyrannus (yoo-tee-ran-us) was a big, strong hunter like its cousin *Tyrannosaurus rex*. Like *T. rex*, it could walk on two legs. This meant it could run fast to catch animals. This dinosaur also had huge jaws and sharp teeth for eating meat. But unlike its cousin, this dinosaur was covered with spiky feathers. They may have used these feathers to stay warm and show off for other dinosaurs.

Image Credit: © Zhao Chuang, Courtesy of Peking Natural Science Organization

Coelophysis (see-low-FIGH-sis) was a small, fast hunter that ran on two legs. It had sharp claws for catching and holding small animals. And it had lots of sharp, jagged teeth for biting and eating them. One *Coelophysis* fossil was found with small lizard-like animals in its belly. This was probably what the dinosaur ate right before it died. Small lizard-like animals may have been a typical meal for all *Coelophysis*.

Image Credit: © Zhao Chuang, Courtesy of Peking Natural Science Organization

Dinosaurs Past and Present

We used to think that dinosaurs were extinct. Now we know birds are dinosaurs too. Like some of their extinct dinosaur relatives, birds walk on two legs. They also have feathers and claws. Scientists are still learning about dinosaurs of the past and the dinosaurs flying above us today!

Dinosaurs live among us today. Look at all the different kinds of birds!

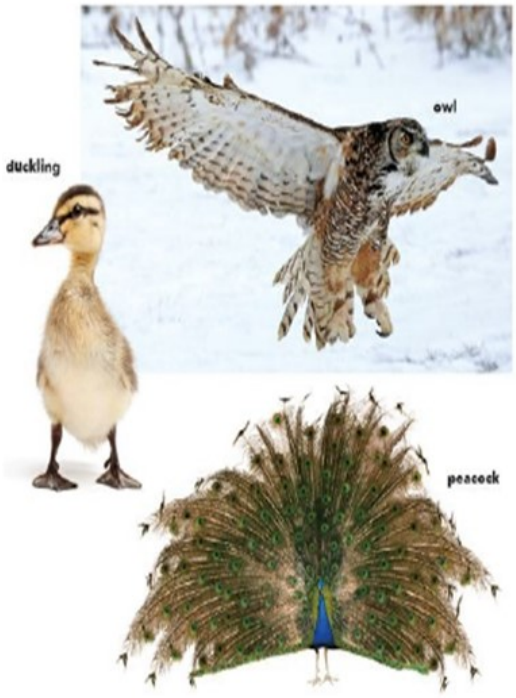


Photo Credit: owl, Shutterstock; duckling, CSP-Alptraum/AGE Fotostock; peacock, iStockphoto

TEACHER NAME			Lesson #
Elena Rodriguez			4
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Questioning	Science / ELA	1st	

CONCEPTUAL LENS	LESSON TOPIC
Evolution	Jurassic Spark

LEARNING OBJECTIVES *(from State/Local Curriculum)*

RI.3.7. Use information gained from illustrations and the words in the text to demonstrate understanding of the text.

RI.3.8. Describe how the author connects ideas between sentences and paragraphs to support specific points in a text.

5.L.3. Understand why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.1. Explain why organisms differ from or are similar to their parents based on the characteristics of the organism.

5.L.3.2. Give examples of likenesses that are inherited and some that are not.

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 sustains survival	How does evolution sustain survival?

	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Students will know that: • Evolution is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. • Species possess traits and adaptations to their environment to allow survival of the species. • Life evolved from the first unicellular organism in water over 400 million years ago. • Life on Earth first appeared as early as 4.28 billion years ago. • The study of fossils by paleontologists have given a wide understanding of evolution. • Life on earth evolved gradually beginning with one primitive life form • Paleontologists study fossils	Students will be able to: • Identify • Describe • Explain • Analyze • Predict • Synthesize • Infer • Compare and contrast • Create connections

• Anatomy are physical structures • Heredity is the passing on of physical or mental characteristics genetically from one generation to another • Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring • New technologies support evolution • Species are a group of living organisms • There are similarities between species body parts that are called analogous structures. • Fossils are naturally preserved remains • Evolution is supported by evidence • Environments impact physical structures • Scientists use charts or family trees to relate species to one another	

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:
• ***Opening questions***: What do you think we are looking at in this video? - Where do you think these events are taking place? • Where does life begin? • What is the relationship between life and evolution in this video? • How do you think the transformation of life affects survival? • How do you think transformation relates to evolution? • Why do you think we see in the video dinosaurs evolving over time into birds? • How would you describe the affirmation "dinosaurs never went away" made in the video? • Why do you think only one group of dinosaurs evolved into birds?	• How is this article related to the video we just watched? • Why do you think the author makes the affirmation "dinosaurs still live among us"? • Why do you think a large group of dinosaurs didn't survive? • What do you think extinct means? • What would you infer is the relationship between survival and extinction? • What would you infer is the relationship between extinction and evolution? • What would you infer is the relationship between survival and evolution? • How would you describe the relationship between non-bird dinosaurs and living birds?	• How do you think these articles relate to one another? • What are some behaviors described by the author that you can compare to living birds? • Why do you think we find similar traits between theropods and living birds? • What could we infer from the theropod's discoveries? • How do you think these traits have survived over 25 million years? • Why do you think evolution plays such an important role in survival? • Why do you think the characteristics observed both in theropod's and living birds are evidence of evolution? • How do you think these relationships between theropods and living birds

• When do you think evolution takes place? • How do you think evolution relates to survival? • What do you think is the relationship between non-bird dinosaurs and regular birds? • Why do you think so many different bird species have survived?	• Why do you think paleontologist study fossils to understand behaviors? • What are some behaviors described by the author that you can compare to living birds? • Why do you think the flying ability of some dinosaurs sustained survival?	can be observed in other species? • How does evolution sustain 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**
Extending ideas and topics beyond the regular curriculum by studying relationship between dinosaurs to document content differentiation, as well as, rigorous vocabulary	**High level questioning and critical thinking driven by open-ended questions and concept-based learning experiences.**		

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 the students come into the classroom the teacher plays the Evolution Video. Once it is done, the teacher asks the opening question:

- What do you think we are looking at in this video?
- Where do you think these events are taking place?

Then, the teacher asks the following questions:

- Where does life begin?
- What is the relationship between life and evolution in this video?
- How do you think the transformation of life affects survival?
- How do you think transformation relates to evolution?
- Why do you think we see in the video dinosaurs evolving over time into birds?
- How would you describe the affirmation "dinosaurs never went away" made in the video?
- Why do you think only one group of dinosaurs evolved into birds?
- When do you think evolution takes place?
- How do you think evolution relates to survival?
- What do you think is the relationship between non-bird dinosaurs and regular birds?
- Why do you think so many different bird species have survived?

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 teacher distributes the Readworks Article "Shedding Light on the Dinosaur-Bird Connection" and gives students 10 min to do silent reading. Then, divides students into groups of no more than three and hands a piece of paper containing the following questions which they are instructed to answer and discuss in their group:

- How is this article related to the video we just watched?
- Why do you think the author makes the affirmation "dinosaurs still live among us"?
- Why do you think a large group of dinosaurs didn't survive?
- What do you think extinct means?
- What would you infer is the relationship between survival and extinction?
- What would you infer is the relationship between extinction and evolution?
- What would you infer is the relationship between survival and evolution?
- How would you describe the relationship between non-bird dinosaurs and living birds?
- Why do you think paleontologist study fossils to understand behaviors?
- What are some behaviors described by the author that you can compare to living birds?
- Why do you think the flying ability of some dinosaurs sustained survival?

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.*

Once students have finished, they are instructed to go back to their sits and share their thoughts on the questions and text which the teacher records on a piece of chart paper and places on the side of the board. Then, she displays Costa's levels of inquiry and conducts a mini lesson on the 3 levels of questioning.

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*

Following the mini lesson, the students are instructed to read independently the Readworks Article "Piecing Together the Story of Dinosaurs from Fossils" while the teacher hands over post-it notes.

The teacher asks the students to think of questions they could ask their teammates in a similar manner to what they did with the first article. In addition, the teacher explains they will use the Costa's levels chart displayed on the board as a tool to come up with words to create pertinent questions. The teacher gives 5 minutes.

Once they are done, they regroup and are instructed to come up with 9 questions that they will record on their post-it notes. The questions must include 2 on level 1, 3 on level 2 and 4 on level 3 of Costa's Model.

Finally, the teacher will partner groups for 10 minutes and instruct them to engage in a discussion where each group must answer the opposite group's questions.

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

As the 10 minutes pass, the teacher calls the students to the carpet and asks the following questions:

- How do you think these articles relate to one another?
- What are some behaviors described by the author that you can compare to living birds?
- Why do you think we find similar traits between theropods and living birds?
- What could we infer from the theropod's discoveries?
- How do you think these traits have survived over 25 million years?
- Why do you think evolution plays such an important role in survival?
- Why do you think the characteristics observed both in theropod's and living birds are evidence of evolution?
- How do you think these relationships between theropods and living birds can be observed in other species?

Finally, she sends them to their seats and are given 10 minutes to answer an exit ticket with the following question:

- How does evolution sustain survival?

Shedding Light on the Dinosaur-Bird Connection

by American Museum of Natural History

When people think of dinosaurs, two types generally come to mind. There were the huge herbivores, like *Apatosaurus*, with their small heads and long tails. There were also those fearsome carnivores, like *Tyrannosaurus rex*, that walked on two legs and had a mouthful of teeth like kitchen knives.

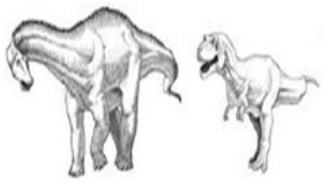


Image Credit: © AMNH

Living Dinosaurs

These large dinosaurs are no longer around, but dinosaurs still live among us today. They are the birds. It's difficult to imagine that a bird on your window sill and a *T. rex* have anything in common. One weighs less than a pound. The other was the size of a school bus, tipping the scales at eight tons. But for all their differences, the two are more similar than you might think. In fact, birds and *T. rex* are close relatives. They all belong to a group of dinosaurs called theropods.

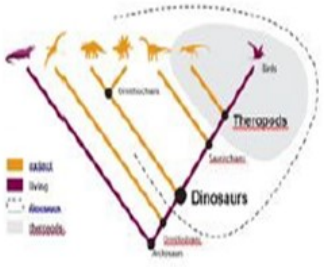


Image Credit: © AMNH

This is a cladogram, a "tree" showing the relationships among organisms. The group called dinosaurs includes the extinct dinosaurs and all their living descendants. All its members, including living birds, descended from the very first dinosaur-their common ancestor. That's why birds are a kind of dinosaur (just as humans are a kind of primate).

Finding the Evidence

To better understand the link between non-bird dinosaurs and birds, scientists look for features they share. When studying living birds, they can observe their behavior and study their anatomy. It's a different story altogether when it comes to long-extinct dinosaurs. Behavior cannot be observed, and all that's left of these animals are the clues found in ancient rocks. This evidence includes fossilized bones, teeth, eggs, footprints, teeth marks, and even dung.

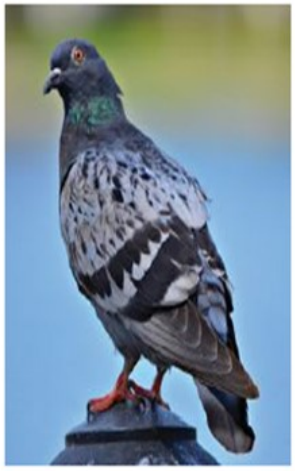


Photo Credit: © Pamala Wilson

Skeletal Evidence

When paleontologists compare a skeleton of a living bird to the fossilized skeleton of a non-bird theropod, like *Sinornithosaurus*, they see many similarities. They both have a hole in the hipbone, a feature that distinguishes most dinosaurs from all other animals. This feature allows an animal to stand erect, with its legs directly beneath its body. All theropod dinosaurs, including birds, have a furcula, also known as a wishbone. Another shared characteristic is the presence of hollow bones. Hollow bones reduce the weight carried by an animal. This feature enables the animal to run faster. It probably also played a role in the evolution of flight.

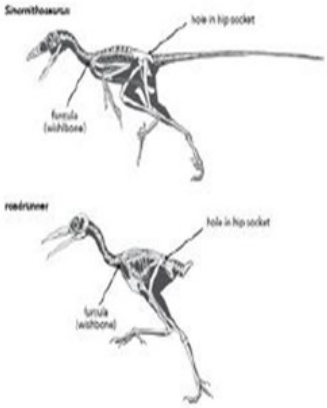


Image Credit: © AMNH / Sean Murtha

Sinornithosaurus and the roadrunner are both theropod dinosaurs.

Behavioral Evidence

Birds build nests, lay eggs, and brood their nests. When scientists look at some non-bird theropod fossils, they see evidence of these same behaviors. The first discovery of this evidence was in 1993 in the Gobi Desert in Mongolia. Scientists unearthed a *Citipati* fossil brooding a cluster of eggs. Its limbs were folded back against its body. It is one of the few fossils ever found that demonstrates behavior. In this case, parental care. It shows that the behavior of brooding the nests that we see in living birds was already present in the non-bird ancestors of birds.

Photo Credit: © AMNH / Mick Ellison

Citipati, like many other non-bird dinosaurs, had feathers. Yet it could not fly. Feathers were once thought to have evolved for flight. The discovery of more and more non-flying dinosaurs with feathers disproved that explanation. For these dinosaurs, feathers may have served other functions, like gliding, insulation, protection, and display. Feathers play that same role in many bird species today.

Based on the evidence of shared characteristics, scientists have concluded that birds are a type of theropod dinosaur.

Brain Evidence

Birds are the only dinosaurs with the ability to fly. This is very interesting to scientists who want to know when the capability of flight emerged. To find out, some scientists study the brains of bird and non-bird dinosaurs. Soft tissue, such as brains, is almost never preserved in the fossil record. What is preserved is the imprint the brain left on the inside of the skull. Now scientists are using computed tomography (CT) scanners to create endocasts. These are detailed, three-dimensional reconstructions of the interiors of fossilized skulls.

Photo Credit: © AMNH / Mick Ellison

Sinornithosaurus had feathers similar to those of modern birds-even though it could not fly.

In a recent study, researchers were able to peer inside the braincases of more than two dozen specimens. "Technology allows us to look inside these specimens without destroying them," says Dr. Amy Balanoff, a Museum research associate. "It's a non-destructive way to basically slice up a dinosaur brain. We look inside and see what it can tell us about the evolution of the brain within dinosaurs. Most of us grew up thinking that dinosaurs had tiny brains, but actually some had really big brains."

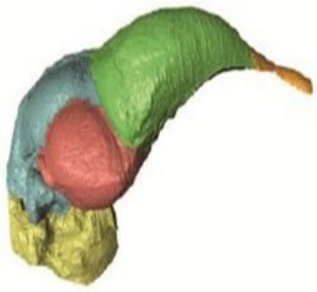


Image Credit: © AMNH / Amy Balanoff

Scientists use computed tomography (CT) scans of dinosaur skulls to create detailed, 3-D reconstructions of their interiors. This one shows the space inside the skull of Archaeopteryx.

The endocasts allow Balanoff and other researchers to explore the outer shape of the brain in more detail. In addition, the casts also provide new information about the volume and shape of different regions of the brain. For example, scientists looked at a detailed view of the dinosaur cerebrum, a region of the brain related to cognition and coordination. They found that this region was very large in non-bird dinosaurs closely related to birds. Dr. Balanoff's research suggests that these dinosaurs developed big brains long before flight and that these bigger brains prepared the way for them to fly.

When examining skeletal, behavioral, and brain evidence, scientists see that birds and non-bird dinosaurs share many features. This helped them conclude that dinosaurs aren't extinct after all. They're living among us today.

Piecing Together the Story of Dinosaurs from Fossils

by American Museum of Natural History
This text is provided courtesy of the American Museum of Natural History.

You've probably seen pictures, models, or movies about dinosaurs that lived millions of years ago. But how do we know so much about these animals? How do we know what they looked like and how they lived? Since the early 1800s, scientists have been piecing together this mystery with fossils.

Fossils are the remains of ancient life that are usually buried in rock. Most fossils formed from the hard parts of organisms such as teeth, shells, and bones. They also form from things a plant or animal leaves behind, like a footprint, a leaf print, and even eggs. Fossils show us what Earth was like long ago. They give us a picture of ancient environments. Scientists compare fossils from different time periods to investigate how life on Earth has changed over time.

Photo Credits: © AMNH

From left to right: fossil skin impressions, fossil eggs, fossil theropod foot, fossil dinosaur trackway

Think of fossils like puzzle pieces. The more pieces you have, the easier it is to put them together and tell what the whole picture looks like. And sometimes when you find and add new pieces, the picture looks very different from how you thought it would be.

Egg Thief or Egg Protector?

In 1923, a team of paleontologists from the American Museum of Natural History made a surprising discovery in Mongolia's Gobi Desert. They found three large rocks that turned out to be fossilized dinosaur eggs. Then they discovered another fossil nearby: a toothless

dinosaur.

The leader of the expedition, Roy Chapman Andrews, guessed that the dinosaur had been stealing the eggs from the nest. He named it *Oviraptor* (OH-vee-rap-tor) or "egg thief."

Seventy years later, in 1993, another team from the Museum found very similar fossil eggs in the same desert. One of the eggs held an embryo, or developing baby dinosaur. It turned out to be a baby *Citipati* (sit-uh-PAH-tee), a kind of dinosaur very similar to *Oviraptor*. Later, the team discovered an adult *Citipati* over a nest. It was brooding, or sitting on the nest, the same way birds do: with its arms spread to protect the eggs. And if its arms were covered with feathers, as scientists suspected, these wings would have shielded the eggs from heat and cold. Paleontologists realized that these dinosaurs nested like birds living today.

Photo Credit: © AMNH / M. Ellison

This is one of the Citipati fossils. The feathered wings are spread over the nest to protect the eggs, the same way birds do today.

These dinosaurs didn't steal eggs. They were caring parents!

When the discovery was made, the group of dinosaurs that includes *Citipati* and *Oviraptor* had already been named "oviraptorids." Even though scientists no longer think these dinosaurs were "egg thieves," the name stuck.

The Link Between Ancient Dinosaurs and Birds

Over 100 years ago, scientists started to notice similarities between birds and a group of dinosaurs called theropods (THERE-uh-pods).

This group included *Tyrannosaurus rex*, *Velociraptor*, and *Citipati*. As new theropod fossils were discovered, the link with birds became even clearer. Scientists discovered that like birds,

theropods laid eggs. And they walked on two feet with their legs directly underneath them. They also had three-toed feet with claws, an s-shaped neck, and hollow bones. Some even had sharp, bird-like beaks. And many theropods had feathers!

Illustration Credit: Zhao Chuang, Courtesy of Peking Natural Science Organization

Citipati lived about 80 million years ago. These bird-like theropods grew to about nine feet long, with a toothless beak and feathered tail and front limbs.

Because birds are so similar to these animals, scientists have placed them in the same group. Birds are theropods. This means birds are a kind of dinosaur! By piecing together fossils of extinct dinosaurs, we've learned that dinosaurs aren't extinct after all.

EXIT TICKET

How does evolution sustain survival?

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V. REFERENCES

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