Why do I see so many squirrels but I can't find any stegosauruses?

Primary: (ages 7-11)	**Science**

Students conduct fieldwork to observe and investigate squirrels and how they meet their needs in a particular environment. They compare how extant animals and plants meet their needs with what is known about prehistoric environments and the animals that lived there. They make, discuss, and revise models for how squirrels would or would not have survived in the Jurassic period and how they could adapt to survive in an imagined future environment

Time allocation	About 13 lesson periods
Subject content	Environments, animals' needs, structures, and survival, extinction and adaptations, Jurassic period
Creativity and critical thinking	This unit has a **creativity** and **critical thinking** focus: • Reflect on and challenge assumptions about the natural environment and how it came to be the way it is. • Create and model predictions about an animal's structures related to meeting its needs for survival and compare with structures of prehistoric species to reflect on how some prehistoric species may have met their needs. • Imagine past and future environments and how different animals and plants could survive these environments.
Other skills	Collaboration, Communication
Key words	Survival, Environment, Prehistoric, Structure, Extinction, Adaptation

Products and processes to assess

There are two models that can be used to assess. The first model shows the relationship between the squirrel's structure, need for survival and the environment in which it lives. The students, in groups, make the initial model and then make one revision or adaptation based on feedback from their peers. The final artefact is a student-created model and is

accompanied by a written explanation of that model showing how the squirrel might adapt in an imaginary environment. The students should apply information from the unit about the relationship between environment, structures and needs for survival. The written explanation should align with the model.

Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity	Critical thinking
1	Lesson period 1	Engage students in a video of the Jurassic period. Have them list the animals and plants they saw in the video, and whether they are the same or different from plants and animals living today. Go outside to look for organisms that the class saw in the prehistoric video. Compare what students expected to see outside with the video, then record their reflections in their science notebooks. Introduce the DQ, "Why do I see so many squirrels but I can't find any stegosauruses?" Record all the questions that students propose.	Investigate the natural environment and compare it with prehistoric plants and animals.	Inquiring: Observing, describing, and comparing animals and plants.	Inquiring: Question assumptions, check accuracy of facts and interpretations, analyse gaps in knowledge.
2	Lesson periods 2 and 3	Watch the video again, and focus on the *juramaia*. Ask students, "Does the *juramaia* live anymore? What animal do you know that is similar to the *juramaia*?" Have students think about how it might be similar to the squirrel (or local squirrel-like animal). They conduct field work on that local animal, take notes (data), and discuss what behaviour they noticed. Use the students' observations to make a chart and construct claims with evidence about how the squirrel meets its needs. Examine all the questions from period 1 and categorise them into groups.	Collect and analyse data to compare extant and prehistoric animals and make claims about present-day animals.	Imagining: Explore, seek and generate ideas,	Imagining: Identify and review alternative theories and opinions and compare or imagine different perspectives on the question.
3	Lesson periods 4 and 5	Help students use observations and the chart (slide 6) to develop an initial model of how a squirrel meets a basic need for survival outside (i.e., runs up trees to escape predators; finds acorns to eat). Have students explain their model in writing. Have each group share with the class, and respond to feedback about one revision they could make to the model. The class returns to the questions they categorised in period 3 and consider whether any of them have been answered. After agreeing that a question was addressed, remove the question. Add any new questions students have. For homework, students read a survival reading (see resources) and interview families about squirrels (or local squirrel-like organism).	Develop, share and revise a model of how the squirrel meets a survival need. Communicate ideas through writing and drawing.	Doing: Envision and produce a model in a personally novel way.	Doing: Justify reasoning based on logical or aesthetic criteria.
4	Lesson period 6	Students present information from family interviews about a squirrel (or local squirrel-like organism). Help students mine this information and the survival readings for evidence about how squirrels survive. Record the evidence in the same location as the field notes data from lesson period 2. Place students' names next to the new data they provided. Return to the questions from previous lessons, and ask, "Are any of these questions answered now?"	Gathering, synthesizing and presenting information from families.	Imagining: Stretch and play with unusual or unexpected ideas.	Imagining: Identify and compare different perspectives on a question.

5	Lesson period 7	Review the question and the observation data about squirrels. The class asks questions (about life cycle, seasons, source of food, predators), then they engage in text and media (shared/partner reading), and then write answers to the questions they generated, and share their findings with the class. They revise their models to add some of the information they gathered from the texts, or from other students' presentations. As a class, examine the questions generated for the lesson, and add the ones that were not answered to the appropriate categories. Ask, "have any of our questions been answered with today's new evidence?"	Gathering, recording, presenting information that addresses student-generated questions through texts. Revising models.	Inquiring: Make connections to other concepts and ideas, integrate different disciplines.	Inquiring: Check accuracy of facts and information, analyze gaps in knowledge.
6	Lesson period 8	Students examine some of the food (i.e., acorns, seeds) that the squirrel (or local squirrel-like organism) eats and the dental and jaw structure of the squirrel. Partners work together to make a claim that the structure of the teeth and jaw allows the squirrel to collect and consume the foods it eats. Students observe and analyse another structure of the squirrel in photographs, video, or first-hand observations (i.e., tail, legs, claws, eyes) and make a claim that the structure allows the squirrel to survive (i.e., keep warm, escape from predators). Review questions that relate to today's lesson, or previous lessons, and discuss whether any of them have been answered.	Conducting an investigation of structures and making claims that show how the structure enables squirrels to do things they have to do to survive.	Inquiring: Observe, describe relevant information, and frame the boundaries of the problem.	Inquiring: Understand the context, frame the boundaries of the problem.
7	Lesson period 9	Engage in text and media about the Jurassic Period, and rewatch the video of the *juramaia* from period 1 to make a chart with the class, recording differences in structures, needs. Discuss how the prehistoric animal was able to meet its needs in the Jurassic Period's environment. Support the class in thinking about the structures as adaptations that correlate with needs for survival. They discuss the stegosaurus and other Jurassic animals that are now extinct.	Using evidence to describe and imagine prehistoric animals and their environments.	Doing: Envision a solution in a personally meaningful way.	Doing: Justify a solution based on logical criteria.
8	Lesson periods 10 and 11	Introduce students to fossils and to the idea that scientists know that there were no nuts, seeds, fruit, grass, or berries during the first half of the Jurassic Period. In groups, they make a model that shows how the squirrel that is living today would have, or would not have, met its needs in that environment. Students then write about how the squirrel and the *juramaia* had different structures and behaviours and compare their chances for survival in the Jurassic Period. Student groups present their models, and compare the models in a museum walk, writing one idea they got from another group that they will add to their model. Review questions from previous lessons, and add new ones that arise in the lesson.	Integrating text and observational evidence to create a model that answers a novel scientific question	Reflecting: Reflect and assess the novelty and relevance of chosen solution.	Reflecting: Evaluate and acknowledge the limits to the position, and compare alternative positions.
9	Lesson periods 12 and 13	Students create their final artefact. They imagine a world 200 years from now, in which the entire squirrel environment is covered in water. The students need to imagine that the squirrel adapted and was able to survive.	Developing and sharing a model of how a squirrel might	Reflecting: Reflect and assess the novelty and	Reflecting: Evaluate and acknowledge the limits to the

	They make a model (individually or in groups) showing how the squirrel behaviour and structure could adapt to meet different needs in a flooded world. They are invited to think of unusual and original ideas for how squirrels could adapt given the evidence gathered throughout the unit. Students write text that explains their model and share their ideas with the class. The class provides feedback on each model, and compares models for similar and different ideas. Address all the questions that remain on the Driving Question Board.	adapt to an imaginary environment.	relevance of chosen solution.	position, and compare alternative positions.

Resources and examples for inspiration

Web and print

- Jurassic Period video
- Squirrel Survival Readings
  - What do squirrels eat? (WeRead version)
  - How do squirrels survive winter? (WeRead version)
  - How do squirrels change as they grow? (WeRead version)
  - What eats squirrels, and how do squirrels protect themselves? (WeRead version)
- Structure and Survival Function Chart
- Jurassic Period Text and media

Other

- Binoculars, samples of fossils

Opportunities to adapt, extend, and enrich

- This mini-unit is based on portions of the four learning sets in a sequence of six learning sets. Remaining learning sets have students examine local and prehistoric environments as systems in which parts work together. They sort and describe fossils and use texts to connect those fossils to prehistoric ecosystems and climates. They make models that show how fossils can provide scientists insights that can be used to understand how prehistoric animals met their needs in very different environments.
- Remaining learning sets, along with additional STEM project-learning units and related resources can be found at https://sprocket.lucasedresearch.org/course/science3/squirrels and https://mlpbl.open3d.science/

ML-PBL Units were co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2020.

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Creativity and critical thinking rubric for science

Mapping of the different steps of the lesson plan against the OECD rubric to identify the creative and/or critical thinking skills the different parts of the lesson aim to develop

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other scientific concepts or conceptual ideas in other disciplines	1, 5, 6	Identify and question assumptions and generally accepted ideas of a scientific explanation or approach to a problem	1, 5, 6
IMAGINING	Generate and play with unusual and radical ideas when approaching or solving a scientific problem	2, 4	Consider several perspectives on a scientific problem	2, 4
DOING	Pose and propose how to solve a scientific problem in a personally novel way	3, 7	Explain both strengths and limitations of a scientific solution based on logical and possibly other criteria (practical, ethical, etc.)	3, 7
REFLECTING	Reflect on steps taken to pose and solve a scientific problem	8, 9	Reflect on the chosen scientific approach or solution relative to possible alternatives	8, 9