Ecology?\* Standards ask students to be able to make an argument for why an organism lives in a particular habitat, can be really specific or just general for younger kids planktic versus benthic, energy pyramid

Title: Foram Paleoecology

Grade: \_\_\_\_\_K-12\_\_\_\_\_

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| **Objective** | To understand what a foraminifera is  To be able to describe different foram morphologies with scientific vocabulary  To be able to describe the habitat of a foram either through a verbal presentation or written essay |
| **Standards** | ***NGSS:***  **K-5:**  [Structures & Processes](https://www.nextgenscience.org/dci-arrangement/1-ls1-molecules-organisms-structures-and-processes)  [Biological Evolution](https://www.nextgenscience.org/pe/3-ls4-1-biological-evolution-unity-and-diversity)  [Cycles of Matter & Energy Transfer](https://www.nextgenscience.org/pe/5-ls2-1-ecosystems-interactions-energy-and-dynamics)  **6-8**:  [Biological Evolution](https://www.nextgenscience.org/pe/ms-ls4-1-biological-evolution-unity-and-diversity)  [Cycles of Matter & Energy Transfer](https://www.nextgenscience.org/pe/ms-ls2-3-ecosystems-interactions-energy-and-dynamics)  **9-12:**  [Cycles of Matter & Energy Transfer](https://www.nextgenscience.org/pe/hs-ls2-4-ecosystems-interactions-energy-and-dynamics)  ***Common Core:***  [Speaking & Listening](http://www.corestandards.org/ELA-Literacy/SL/introduction/) for K-12  [Literacy in Science & Technical Subjects](http://www.corestandards.org/ELA-Literacy/RST/introduction/) for 6-12  ***TNSS:***  **K-5**  [Life Sciences](https://www.tn.gov/content/dam/tn/stateboardofeducation/documents/massivemeetingsfolder/meetingfiles4/10-20-17_III_J_Non-Substantive_Changes_to_Math_ELA__Science_Standards_Attachment_3_-_Science.pdf): Structure & Process, Ecosystems  **6-8**  [Earth & Space Sciences](https://www.tn.gov/content/dam/tn/stateboardofeducation/documents/massivemeetingsfolder/meetingfiles4/10-20-17_III_J_Non-Substantive_Changes_to_Math_ELA__Science_Standards_Attachment_3_-_Science.pdf): Earth Systems, Earth & Human Activity  **9-12**  TN [Environmental](https://www.tn.gov/content/dam/tn/education/standards/sci/std_sci_3260.pdf) Standards  TN [Earth Science](https://www.tn.gov/content/dam/tn/education/standards/sci/std_sci_3204.pdf) Standard  For example, 93204.4.6 Recognize that fossils contained in sedimentary rock provide evidence of past life forms, changes in life forms, and environmental change. |
| **Required Materials** | * Access to [myFOSSIL website](https://www.myfossil.org/members/sumrall-labgroup/ac_media/) or 3D printed foram models * Paper for drawing ecosystems, food webs, and energy pyramids * Print copies of What is a Foram worksheet for intro activity if secondary classroom |
| **Science Background** | Foraminifera, also referred to here as *forams*, are a type of microscopic organism, that live in the ocean. Forams can be either benthic, meaning they live on the ocean floor, or planktic, meaning they float in the water column. Over 100 species of foram fossils can be found throughout geologic history, making them a useful tool for scientists to learn about what paleoenvironments would have been like. For example, some foram species will adapt different morphologies based on the temperature of the ocean, or depth of the water. Tiny organisms like forams are incredibly important for ecosystems because they provide the basis for the food web in their environment. Some forams can use photosynthesis, but many more gain energy by eating smaller nanoplankton. In the same way, forams will be eaten by larger organisms.  Other resources for the instructor:   * [Introduction to the Foraminifera](https://ucmp.berkeley.edu/foram/foramintro.html) * [Foraminifera: Life History and Ecology](https://ucmp.berkeley.edu/foram/foramlh.html) * [Foram Facts](https://ucmp.berkeley.edu/fosrec/Wetmore.html) * [Foraminifera and Paleoclimatology](https://timescavengers.blog/paleo-live/our-research-explained/) |
| **Before the Lesson**  **This can be a short, pre-lesson activity done with the entire group, or can take up an entire instructional period, depending on level of student knowledge** | **Lesson Launch Activity:**  Younger students (K-5) will complete Compare/Contrast shape worksheet  OR  Older students (6-12) will read resources on paleo-ecology, compare/contrast worksheet optional as an intro activity  OR  Students consider where different forams would have lived, create a narrative (and/or visual drawing) around what other animals live there, and draft a food web to explore ecosystem dynamics  Discussion Questions to be asked during activity:  Do you think the environment today is exactly the same as the environment has always been? Give evidence why/why not  Why did you place certain forams in specific environments? Would some live better in high energy versus low energy, seafloor versus water column?  Consider the food web and the abundance requirement(s) of plankton compared to other organisms in the environment. |
| **During the Lesson** | **I do:** The teacher will give a lesson on paleoecology, what is it and why is it important. Emphasizing that environments have changed through time and that some animals prefer specific conditions to live in. For younger students, indicate that sometimes different shapes are adapted to fit better into the organisms habitat. For older students, explore the difference between planktic and benthic foraminifera. For both, describe ecosystem energy pyramids and consider what other animals would live alongside foraminifera.  Facilitate examination of digital or physical models and prompt students to consider discussion points above  **We do:** In pre-selected groups, students will draw, create, their own environment where forams live, incorporating other organisms. From this, older students will create an energy pyramid and compare and present to their environments to their classmates. For younger students, including a word bank of what to include in the environment would help facilitate the drawing.  **You do:**  Older students will be able to independently write summaries of the information gained by creating this environment around their selected foraminifera in their graphic organizers/lab notebooks. Afterwards, they will write several paragraphs on the importance of ecosystem dynamics and the role of plankton.  Younger students can explain their environments to the class and think about different organismal elements between presented environments. Did everyone have similar animals? What differences are present and how does that change the space? |
| **After the Lesson** | Summary:  Join whole class and older student small groups can present brochure/PPT as if wanting to invite another group to visit their drawn environment.  Instructor will ask questions of each group to make sure they can explain how they got their info/answers  Assessment:  Students of any age could be asked to give a presentation or design a travel brochure that displays understanding of where forams live, how their morphology affects where they live, and the impact their increase/decrease has on their environment (This can be differentiated across grades where K-5 focuses on size/shape, 6-8 focuses on energy pyramid, 9-12 can go in depth with specific species/regions affected and how fossils tell us what this means for ancient environments.) |