# Preschoolers Dive in for Authentic Learning of Marine Science

Lesley Chase
State University of New York at Oswego

Allison Chetney
State University of New York at Oswego

Lindsey Faulkner
State University of New York at Oswego

Sara Schwartz
State University of New York at Oswego

Bridget Smithers
State University of New York at Oswego

Stephanie Rubas
State University of New York at Oswego

Audrey C. Rule
State University of New York at Oswego

*Preservice teachers created integrated activities for preschoolers that simulated skills used by marine biologists. Each activity addressed marine biology content appropriate for young children; incorporated a foundational mathematics skill such as matching, one-to-one correspondence, counting, sorting, and forming a series; and practiced fine motor skills through use of spoons, tweezers, tongs, or pincer-grip with fingers. Materials and reactions of preschoolers are described along with preservice teacher reflections on their authentic learning of teaching young children.*

---

Authentic science experiences are those that mimic the work of professional scientists. Even a preschool child can behave as a scientist does by using the same skills in context. In this article, we present seven creative activities that focus on ocean life concepts and are appropriate for preschool children aged three to five years. We explain how each set of materials was assembled and tell how the activity mirrors the work of a marine biologist. Finally, we describe the authentic learning experiences of the preservice teachers involved in the project.

Preservice teachers enrolled in a mathematics methods course volunteered for a special project that resulted in the creation of these materials and validation through use by preschool children at the campus daycare center. Each activity had these components: 1) marine biology concepts; 2) a foundational mathematics skill; and 3) fine motor skill practice with implements or fingers.

*Foundational Skills*

Early mathematics skills such as matching, one-to-one correspondence, counting, forming a series, and repeating or extending a pattern are essential because they form the foundation of thinking skills for later academic success. Many different subject areas require students to differentiate or match items; for example, in reading, students must identify letters by shape and distinguish a "b" from a "d." In mathematics, students need to discriminate between different numerals and shapes; in science, they must identify organisms by characteristics. Similarly, pattern recognition is necessary to many areas: in phonological awareness, students notice similarities between rhyming words or identical consonant sounds (alliteration) or vowel sounds (assonance). In social studies, students recognize patterns of human behavior across cultures and repetition of aspects of historical events. Science, of course, involves the search for patterns in nature.

*Importance of Fine Motor Skills*

Fine motor skills are important to a student's social, emotional, and academic development. Fine motor skills refer to smooth coordination of small muscle groups, particularly in the hands. These skills are necessary for dressing and undressing, self-feeding, and manipulation of pencils, crayons, rulers, scissors, or grasping of books. Without adequate fine motor skills, a student becomes dependent upon others, endures peer-ridicule that lowers self-esteem, and is often prevented from meeting the multi-faceted demands of school (Cantell, Ahonen, & Smyth, 1994; Losse, Henderson, Elliman, Hall, Knight, & Jongmans, 1991; and Richardson, 1992). Losse and colleagues (1991) found that children who lacked fine motor control had more behavior problems and lower achievement than typical children, often accompanied with feelings of anger and depression.

Good fine motor skills are associated with early literacy performance and reading achievement (Reno, 1995; and Share, Jorm, Maclean, & Matthews 1984). Additionally, several studies show that assignments completed in neat handwriting receive higher scores for academic content than identical compositions written in poor handwriting (Briggs, 1980; Chase, 1986; Hughes, Keeling, & Tuck, 1983; and Sweedler-Brown, 1992). Handwriting competence also determined the speed of handwriting, note taking, frequency of writing, planning of compositions, and willingness to revise written work (Graham, 1996; and Graham, & Weintraub, 1996).

Implements such as spoons, tweezers, and tongs are effective for fine motor skill practice because they extend the length of the lever acting upon the small items (Rule & Stewart, 2002). Moving an item precisely grasped between tweezers, tongs, or balanced on a spoon requires greater care than moving the item directly with the fingers because the length of the tool magnifies the motion. Finally, fine motor skills are needed by both genders for handling science equipment during inquiry activities (Kahle, & Lakes, 1983).

*National Science Standards*

The science content addressed by these activities supports national standards. The National Science Education Standards for life science state that K-4 students should develop an understanding of the characteristics of organisms and their environments (National Research Council, 1996). The Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993) state that by the end of second grade, children should know different features of plants and animals that help them live in their environments. The activities described in this article teach basic information about marine organisms and their environments.

## Marine Science Integrated Activities

*Sifting and Transfer*

This activity featured a large plastic lobster against an ocean floor background with a bowl of sand in which the lobster's "food" was hidden. Preschoolers used a slotted spoon to sift through the sand for small buttons showing marine organisms that lobsters eat: fish, crabs, clams, mussels, sea urchins, and smaller lobsters (Northeast Fisheries and Science Center, 2004). When a food button was located, it was transferred with the spoon to the lobster.

As a child worked with the materials, the preservice teacher asked, "Have you ever seen a lobster?" (Some children had seen lobsters in tanks in grocery stores.) "What do you know about lobsters?" (Most children knew that they live in the ocean.) "For what does a lobster use its large claws?

What do you think a lobster eats?" Then the preservice teacher explained how the lobster catches and breaks shells of animals it eats with its pincers. Students helped the lobster search for food in the fine sand by using a slotted spoon. Figure 1 shows part of the activity.

Figure 1. Small lobster food buttons retrieved with a slotted spoon from the sand.

Marine scientists sift through sand for small burrowing organisms or shells of small planktonic organisms that sink and settle in the sediment. When preschoolers sifted the sand with a slotted spoon, they were practicing a skill scientists use.

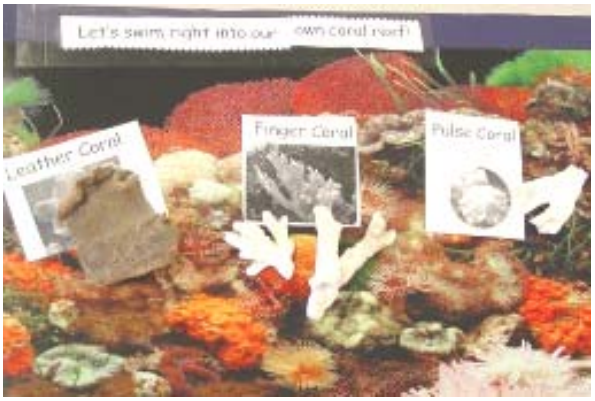
*Matching*

Preschoolers engaged in two different activities in which they practiced matching. The first activity involved sea mammals and large fish. First, the preservice teacher helped the preschooler identify each animal by name. The habits of each animal were discussed. There were whales, seals, and different types of sharks anchored to a board with clear nylon cord. Each animal had a corresponding partner in a bowl; the preschooler used a green long-handled fish tank net to transfer each fish to a box opposite its match. Scientists who study fish and marine mammals often capture them with nets for study and release them afterwards. Marine biologists also compare organisms to models or photographs to identify them. Figure 2 shows a preschooler matching sea animals.

Another matching activity involved marine corals. Real specimens of marine corals were provided for students to match to a colorful photograph of corals in their natural habitat (sold as a fish tank background scene at an aquarium shop). Students compared the specimens to the photographs to match them to their correct location in the environment. As students worked, the preservice teacher explained that corals were animals that filtered food from seawater. See Figure 3.

Figure 2. Preschooler matching sea animals.

Figure 3. Coral match activity.




*Sorting Marine Organisms*

Children practiced visual discrimination skills when they sorted three groups of marine organisms: starfish, seahorses, and crabs. The preservice teacher explained how each organism survived in the marine environment and its defining

visual characteristics. Then preschoolers used heading cards to sort the plastic animals into three groups and transferred each plastic model to the correct group using tongs. See Figure 4.

Marine biologists sort and classify marine organisms in many ways, according to food source, habitat, lifestyle, and genetic relationships. Preschoolers practicing sorting are preparing to use more complex classification systems later.

Figure 4. Sorting Marine Organisms


*One-to-one Correspondence*

One-to-one correspondence is an early skill necessary for counting. In one-to-one correspondence, a member of one set is paired with each member of another set. This occurs in counting as one number name (member of the set of counting numbers) is said (paired) with each object in a group that is being counted (the other set). If two numbers are said for one object, the count will be incorrect. Therefore, it is necessary for the child to understand the concept of just one number word for each object.

Preschoolers practiced this concept by placing one fish in each tank in a set of materials that simulated an ocean research laboratory. See Figure 5. A blue plastic ice cube tray was used as the set of fish tanks. A bowl held small colorful fish erasers that were moved with tweezers to the tray compartments. Children approached the task differently: some placed fish in random tanks, looking for and filling empty compartments until all were filled, whereas others systematically filled the compartments in the bottom row, starting with the tank nearest the bowl and moving to compartments farther way, completing the upper row so that the one nearest the bowl was filled last.

Figure 5. Child completing one-to-one correspondence activity with tweezers.

*Counting Seashells*

Five different types of mollusk shells were used for a counting activity. Students first sorted the shells according to type (e.g., scallops, cockles, conches) and then used tongs to place the correct number of shells next to each numeral card (1, 2, 3, 4, or 5). Numeral cards had pictures of the corresponding shells to help children match and count. The preservice teacher told children the names of the shells and the types of animals that once occupied them. See Figure 6.

Counting is an important skill for scientists. Marine biologists often count organisms in a small marine area, estimating their numbers region-wide to determine the effects of pollution, over-fishing, climate change, or loss of habitat.

Figure 6. Example shells for counting.

*Forming a Series*

A series is a set of nearly identical items that vary in one characteristic that increases from item to item. The series addressed by this activity was a set of starfish of increasing size. Preschoolers put the starfish in order from smallest to largest, moving each starfish with tongs. See Figure 7. Some preschoolers related the series of starfish arranged according to size to a family as father, mother and babies.

The skills children practice when forming a series are used when scientists compare and measure specimens to determine which is larger. Sometimes marine biologists produce figures for scientific papers that show a series of growth stages for an organism.

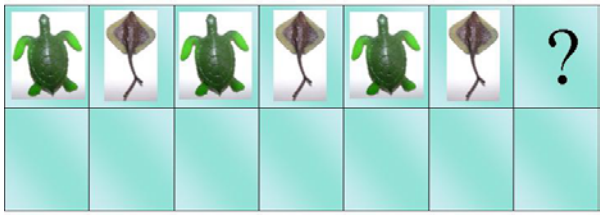
Figure 7. A series of starfish arranged by size.

*Copying and Extending a Pattern*

Perhaps the most challenging activity for preschoolers was forming and extending a pattern of sea animals. Children used tongs to place each plastic animal model onto a card next to its image. The pattern emerged and the child's attention was drawn to it by repeating the sequence of animals in rhythm. Choosing the final animals to extend the pattern proved difficult for the three-year-olds, but several four-year olds were able to complete this part of the activity.

Marine biologists look for many different types of patterns as they study ocean eco-systems. Because all ocean life is interconnected, changes in one population affect other parts of the web. Being able to recognize a pattern of interactions is an important scientific skill that begins with simple pattern work.

Figure 8. One of the turtle pattern cards.



**Preservice Teacher Reflections**

Several themes emerged when preservice teachers reflected on the experience of creating materials for preschoolers.

*Insights into Making Effective Materials*

The preschool children were most attracted to brightly colored, lustrous materials or those having animal figures. Although children eventually worked with the plainer materials, they first crowded around the more attractive ones. A preservice teacher reflected, "Another thing that I realized is that I should have made it more attractive to the eye somehow. Though I felt that my activity, if performed correctly, could be very helpful and useful to the students, they would not stay involved in it if it didn't attract their interest as much as the surrounding objects could."

A different preservice teacher observed that he would like to make his materials self-checking. "One last aspect of my activity that I would like to change... I would like to incorporate a way for the children to get a more instant confirmation of the decisions they were making, and I would like them to get that from the activity. I noticed that even when children were making the right decisions and performing the activity properly, they still had to look to an adult for approval or to know if they were correct. I feel that if they could get that from the activity they would take more ownership of the pride attributed to performing the activity correctly. This could have been achieved by having a picture of the task finished ahead of time that the students could look at to check and see if they were right."

This self-checking aspect is an essential quality of effective Montessori materials. According to Wentworth (1998), there are four important guidelines for creating successful Montessori materials; they must be 1) simple, 2) dynamic, 3) self-checking, and 4) attractive to children. Preservice teachers noted the other aspects not already mentioned above when they reflected on the children's reactions to the activities. Children performed better when the activity was clear and simple and without distracting extras or decoration. Preschoolers enjoyed the dynamic aspects of the materials encompassed in moving the small items around with different implements.

*Preschoolers' Reactions to the Materials*

The preschool children at our campus center were curious about our new activities. Some were shy and had to see the preservice teachers complete the activity before they would attempt it. A preservice teacher noted the reaction of a young girl to her activity. "When we first started the activities, she would not participate at all. We had to do it on our own before she would. When she saw how much fun we were having, she decided to give it a try. She did very well at sorting and matching. It was very important to her to put objects in the exact orientation.... She refused to use the tweezers, tongs, and fishnet to place small objects... I think the reason for that was because she had to be so precise when placing the objects...."

When preschoolers had lost interest in an activity, they directed their attention elsewhere; therefore, it was easy to determine what attracted the children. One preservice teacher noted, "If they are not enjoying themselves, they will let you know about it, and they were not going to be shy about it even with strangers." Another observed, "As I was watching the children interact with the activities, I noticed that they were also watching their classmates. They seemed to be comparing the amount of fun they were having to their friends... They

would walk away from what they were doing and join the "fun" activity. It was a challenge for us to keep their interest...."

Some preservice teachers noted that they changed their activities to match a child's developmental level or to continue the activity in a new way. A preservice teacher wrote, "I found the best way to keep them interested was to modify the activity a little bit. For example, after they had transferred the lobster food pieces into the bowl, I had them return the pieces to the sand. They began to tire of this, so I then modified the activity and told them the lobster had finished eating and we needed to hide the remaining food for his next meal. The kids loved the challenge of hiding the food for the next person to find. It was a small change, but it drew their attention."

## Conclusion

The fine motor skill activities described here having a marine science theme and incorporating early mathematics skills provided exciting practice for preschoolers at our campus daycare center and an opportunity for preservice teachers to create, try out, and reflect upon teaching materials. As the director of the daycare center said when the project was proposed to her, "It's a win-win-win situation." The preschoolers enjoyed the attention and materials, their preschool teachers gained new ideas, and the preservice teachers had a valuable practicum experience. We hope that the reader will also take away some interesting ideas for making authentic learning activities for marine science. The activities described here should be used in conjunction with marine biology inquiry activities: perhaps observations of tropical fish or other creatures in an aquarium, taking care of a hermit crab for a classroom pet, investigation of beach sand with magnifying glasses, or if possible, a field trip to a beach. Many exciting, excellent picture books are available to accompany a unit. We present an annotated bibliography of books we recommend in the next section.

## Annotated Bibliography of Children's Books with a Marine Theme

The following nonfiction books are appropriate and recommended for use with preschoolers during a unit on marine life.

**Davies, N. (2001). *One tiny turtle*. Ill. J. Chapman. Cambridge, MA: Candlewick Press. 30 pp. Picture book.**

The story of a loggerhead sea turtle from birth to laying a clutch of eggs, illustrated with enchanting paintings.

**Llewellyn, C. (2004). *The sea.* North Mankato, MN: Smart Apple Media. 24 pp. Picture book.**

This small, colorfully illustrated book shows photographs of tidal changes, children shoveling sand, animals of the sea, and boats. A glossary, table of contents, and exciting action photographs make this a wonderful book.

**Markle, S. (1999). *Down, down, down in the ocean*. Ill. B. Marstall. New York: Walker & Company. 32 pp. Picture book.**

This picture book illustrates and explains ocean creatures of the Pacific Ocean that live in three different depth zones: 0 to 200 meters, 200 to 1000 meters, and the deep seafloor. A glossary defines difficult terms. Older preschoolers who already have some knowledge of the ocean will be fascinated with the interesting inhabitants of the ocean's depths.

**Pallotta, J. (2004). *Ocean counting: Odd numbers*. Ill. S. Bersani. Watertown, ME: Charlesbridge. 28 pp. Picture book.**

Large, intensely hued colored-pencil illustrations of marine life count through the pages by odd numbers from 1 to 49 and then zero and fifty. Children will enjoy the realistic animal pictures.

**Pringle, L. (2003). *Come to the ocean's edge: A nature cycle book*. Ill. M. Chesworth. Honesdale, PA: Boyds Mills Press. 32 pp. Picture book.**

This book shows activity occurring at a seashore from dawn throughout the day and into the night through watercolor illustrations and explanatory text. The book ends with a final page of facts and explanations related to the preceding pages.

**Rose, D. L. (2000). *Into the a, b, sea: An ocean alphabet*. Ill. S. Jenkins. New York: Scholastic Press. 40 pp. Picture book.**

Captivating textured paper collage images accompanied by simple rhyming text tell about the lifestyles of different sea animals. At the end of the book, more facts are given about each animal.

**Rose, D. L. (2003). *One nighttime sea: An ocean counting rhyme*. Ill. S. Jenkins. New York: Scholastic Press. 40 pp. Picture book.**

This is a rhyming book that counts sea animals from one to ten and then backwards down to one again. Illustrations are made with textured paper collage. The last pages contain facts about the featured sea animals.

**Rose, D. L. (2005). *Ocean babies*. Ill. H. Nakata. Washington, DC: National Geographic. 30 pp. Picture book.**

With charming watercolor illustrations and simple text, this book describes the many different ways babies are born to ocean animals. Following the story, several pages of explanations and facts tell more about the organisms: blue whales, corals, crabs, seals, dolphins, sea horses, rays, salmon, and more.

**Rustad, M. E. H. (2001). *Dolphins.* Mankato, MN: Pebble Books, an imprint of Capstone Press. 24 pp. Picture book.**

Bright, colorful photographs of dolphins in action accompanied by simple text with a supporting glossary of terms. There are many other appropriate titles in this "Ocean Life" series by the publisher.

**Stille, D. R. (2005). *I am a fish: The life of a clown fish*. Ill. T. Ouren. Minneapolis, MN: Picture Window Books. 24pp. Picture book.**

Bold paintings depict the life of a clown fish and its symbiotic relationship with a sea anemone. A diagram of the parts of a clown fish, fun facts and a glossary are helpful additions to the interesting story.

**Stille, D. R. (2005). *I am a sea turtle: The life of a green sea turtle*. Ill. T. Ouren. Minneapolis, MN: Picture Window Books. 24pp. Picture book.**

Large, colorful pictures and simple explanatory text make this book very appealing. It is one in the "I live in the ocean" series. A diagram showing the parts of a sea turtle, fun facts, and a glossary of terms accompany the story.

## References

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. Washington, DC: Author.

Briggs, D. (1980). A study of the influence of handwriting upon grades using examination scripts. *Educational Review*, *32*, 185-193.

Cantell, M., Ahonen, T., & Smyth, M. (1994). Clumsiness in adolescence: Educational, motor, and social outcomes of motor delay detected at 5 years. *Adapted Physical Activity Quarterly*, *11*, 115-129.

Chase, C. (1986). Essay test scoring: Interaction of relevant variables. *Journal of Educational Measurement*, *23*, 33-41.

Graham, S. (1996). A review of handwriting scales and factors that contribute to variability in handwriting scores. *Journal of School Psychology*, *24*, 63-72.

Graham, S. & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational Psychology Review*, *8*, 7-87.

Hughes, D. C., Keeling, B., & Tuck, B. F. (1983). Effects of achievement expectations and handwriting quality on scoring essays. *Journal of Educational Measurement*, *20*, 65-70.

Kahle, J. B. & Lakes, M. K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching*, *20*(2),131-40.

Losse, A., Henderson, S., Elliman, D., Hall, D., Knight, E., & Jongmans, M. (1991). Clumsiness in children—Do they grow out of it? A 10-year follow-up study. *Developmental*

*Medicine and Child Neurology*, *33*, 55-68.

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review*, *8*(3), 299-325.

National Research Council. (1996). *National Science Education Standards*. Washington, D. C.: National Academy Press.

Northeast Fisheries and Science Center (2004). *Fish FAQ: A bouillabaisse of fascinating facts about fish*. Retrieved October 16, 2005, from http://www.nefsc.noaa.gov/faq/

Reno, M. (1995). *Fine motor ability and reading achievement of young children: A correlational study.* Unpublished doctoral dissertation, University of Cincinnati.

Richardson, S. O. (1992). Montessori and learning disabilities. In M. H. Loeffler (Ed.), *Montessori in Contemporary American Culture* (pp. 149-164). Portsmouth, NH: Heinemann.

Rule, A. C. & Stewart, R. A. (2002). Effects of practical life materials on kindergartners' fine motor skills. *Early Childhood Education Journal, 30*(1), 9-13.

Share, D., Jorm, A., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology, 76*(6), 1309-1324.Sweedler-Brown, C. O. (1992). The effects of training on the appearance bias of holistic essay graders. *Journal of Research and Development in Education*, *26*, 24-28.

Wentworth, R. A. L. (1998). *Montessori for the new millennium*. Mahwah, NJ: Lawrence Erlbaum Associates.