Figure 1. A student looks at phytoplankton through the microscope.
based laboratory component each day for students to look at, and try to identify, different types of microorganisms (the Artistic Oceanographer program focuses primarily on phytoplankton) using microscopy (Fig. 1). Additionally, one class is dedicated to learning about the many uses for phytoplankton or algae in the home, and this includes the chance to taste algae-derived ingredients used in items such as chocolate milk. The science-based portion of the project is designed to mesh well with the existing state and federal 5th grade science standards that emphasize adaptations of living things to their environment, energy and living things (e.g., food chains), and the characteristics of plants. The art component of the program is accomplished by devoting one of the four class periods during the program to an art class, allowing the students to draw pictures of what they saw under the microscope. Using media of their choice, the students work with their art teacher and visiting researchers to design their own phytoplankton species. Students are asked to give their new organism adaptations that would help it survive and to give it a name (genus and species) (Fig. 2). This creative exercise gives students an opportunity to document what they observed under the microscope, reinforce what had been presented to them in a lecture format, and also engage those students with different learning styles. Moreover, the art exercise adheres to state and federal standards for 5th grade art that require the creation of 2D representational artwork from direct observation.

The Artistic Oceanographer program has been run for two years in a row at a local school for several classes of 5th graders and, with the recent acquisition of private funding from the Falmouth Education Foundation (Falmouth, MA), it is on the schedule for Spring 2008. The program has proven to be highly successful in several ways. First, based on feedback from students, the program is effective in piquing their interest in the oceans, with nearly 100% of the students reporting that they wanted to learn more about the ocean. Second, it provides considerable opportunities for hands-on learning. For many students, this program yielded the first opportunity to use a microscope. One student exclaimed, while watching phytoplankton move around under the microscope, “This is better than TV!” Third, it promotes learning science through art. In fact, multiple students listed their favorite part of the program as getting to draw phytoplankton. And last, the program promotes the collaboration of educators from science and art and establishes a partnership between local schools and research Institutions. With the success of the program, we have generated interest among other 5th grade teachers for the program to be run in their classrooms and each year we have expanded the number of classrooms in which we run the program. Furthermore, the Artistic Oceanographer program has been presented at several meetings (e.g., 2007 ASLO Aquatic Sciences meeting). The response has been overwhelmingly positive and colleagues from other Institutions have asked us repeatedly for a packet of information to guide implementation of the program in their local schools. At present, we do not have a lesson plan or handbook for the Artistic Oceanographer program that we can distribute, making it difficult to support implementation of the program elsewhere.

**Research Plan:** We request CMORE support for the development of a handbook and outreach curriculum for the Artistic Oceanographer program that provides step-by-step instruction for its
implementation by partnering Institutions and personnel. The specific objectives of this project are as follows:

1. **Create a microbial oceanography handbook and outreach curriculum for the Artistic Oceanographer program:** As this program has been in place for several years, we are confident that it provides a sustainable template for use by partnering Institutions. The handbook will include all the typical elements of a lesson plan. These include the overall goals for the exercise, the academic and skill prerequisites for students (e.g., what must students already be able to do or understand before this program?), the materials needed, the detailed, step-by-step description and time-line of how to replicate the program, and the assessment tools. The goals detailed in the handbook will be adapted as needed to meet existing state education standards, as these are not universal for all states. The prerequisites component will not only include information on the knowledge and skills appropriate for students to appreciate the Artistic Oceanographer program, but it will also include a list of helpful materials for teachers and for the research Institution participants. We have found that teachers often incorporate the information gleaned from this program into other lessons (e.g., math, language arts). Also, it is important for the participating researchers to know what is required from the teachers, what is needed to make the classroom space most useful, and, in general, what to do to make the program run smoothly. The materials will be listed in the handbook, including the brands of food items to look for that have algae or algae-derivatives in them, and the ordering information provided in sufficient detail. The description of the program in the handbook will include copies of the PowerPoint presentations used each day for the lessons and the assessment section will include templates of evaluations appropriate for students and teachers.

2. **Export the Artistic Oceanographer program to partnering CMORE Institutions:** The handbook and associated digital resources may be distributed to the CMORE Central Education office for implementation at UH, and then at the other partner Institutions. I am very interested in seeing this program implemented smoothly in other communities. To accomplish this, I would also like to coordinate an Artistic Oceanographer program presentation or demonstration at the upcoming “all hands meeting,” and the MBARI teacher workshop we anticipate to be held at WHOI next summer. This will provide a useful forum for launching the Artistic Oceanographer program for partnering Institutions (and interested teachers) as it will give us the opportunity to lead a tutorial of the contents of the program, possibly demonstrate a portion of the activities, and address any questions or concerns.

**Summary:** The Artistic Oceanographer program is an age-appropriate, multidisciplinary, hands-on effort to engage elementary school students in microbial oceanography. The program is successful in generating interest in the ocean and forming partnerships between disparate disciplines within local schools and between the school and neighboring research Institutions. This multitiered approach, integrated with a coupling of art and science, supports comprehensive and systematic skills development for students. Moreover, the Artistic Oceanographer program agrees well with the education metrics stated in the CMORE Strategic Implementation Plan. Based at CMORE partner Institutions, the Artistic Oceanographer program will bridge research and education by connecting researchers from these Institutions with K-12 educators in local schools. Moreover, the program is innovative in that it is a synthesis of two very different disciplines that promotes the collaboration of educators from science and art and helps to address and overcome different learning styles. The originality and efficacy of this program has already led to private funding for our group here at WHOI, and we expect the program has tremendous potential for garnering additional external funding. With its resounding success and accord with the educational goals of CMORE, the Artistic Oceanographer program would complement CMORE’s education program. We would like the opportunity to export this program to partnering CMORE Institutions for implementation in other schools through the development and distribution of an Artistic Oceanographer handbook.
Budget Justification

**Personnel:** 3 weeks of support for Haley is requested to fund development of the handbook, and participate in the meeting/workshop as appropriate.

**Travel:** Funds ($1850) are requested to cover travel costs for Haley to attend the CMORE All Hands Meeting to distribute the Artistic Oceanographer handbooks and offer a training session. The funds will cover airfare, accommodations, meals and ground transportation.

**Other Direct Costs:**
Communications: Funds ($800) are requested to cover costs of purchasing binders for handbooks and having the materials printed, as well as copying and communication charges related to the handbook development. These funds will also support reproduction of the digital media.