Manatee Match Card Game:
Student activity to practice authentic science process skills

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Abstract

The *Manatee Match* Card Game is an activity that helps grade 3-9 students develop process skills used by wildlife scientists. The activity accompanies *Conservation Tales: Manatees,* one of a series of books for grades 3-5. An online activity plan accompanies the cards. The activity supports development of observation, analysis and design processes addressed in the NGSS and Indiana Science Standards across grades K-9.

The cards were developed by faculty and students at Ball State University based on tools used by manatee researchers in Florida to identify individual animals from the distinctive scars left by boat collisions and other injuries. Identifying animals helps researchers record the movement, reproductive history and health of manatees over time. Learners match photos of manatees with diagrams researchers use to document scar patterns in the same way new researchers learn the same skills. Students then transfer the skills to develop similar cards for identifying other species.

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You and your students have probably seen news about manatees in recent months. The red tide events along Florida's Gulf Coast in the summer of 2018 were dramatic, and caused the deaths of sea turtles, fish, birds, dolphins and manatees. Television, print and online media reported massive deaths and rescues of animals that were affected by red tide toxins (Bojorquez, 2018). Zoos around the country, including Cincinnati and Columbus were asked to help house some of the manatees rescued in Florida because manatee care units in Tampa, Jacksonville and Orlando were overwhelmed (Fields, 2018).

Fig. 1. Illustration by Sami Pfaff © 2018

Then Hurricane Michael impacted the Gulf Coast in October 2018. While the impact of the storm was most severe in the Florida panhandle, communities farther south felt the effects of the storm surge. In Crystal River and Homosassa, home to many manatees, the rivers rose more than 4 feet, flooding the warm springs and stranding manatees in drainage ditches and on golf courses (Payne, 2018). Rescue teams (see Figure 2) were able to save some individuals, but many manatees do not survive these emergencies.

Fig. 2. Manatee rescue team

Current events like this have sparked renewed interest in manatees, a species that is already engaging for children and adults alike. But have you considered using this species

as an avenue to help your students learn to use the processes and practices of science in authentic ways? This article shares an example of a process-based activity that lets your students use the same types of materials as manatee researchers to identify individual manatees.

The activity was developed by a team of faculty and students at Ball State University as part of the *Conservation Tales* book series. In the spring of 2018, this team created three *Conservation Tales* books about marine animals. The process included spending time with researchers in Florida who study and protect manatees, seahorses and sea turtles. Each of book includes conservation action plans and inquiry-based science activities based on the skills and processes used by the scientists they shadowed. The *Manatee Match* Card Game (Figure 3) is one of the inquiry activities included in *Conservation Tales: Manatees* (McConnell & Stallard, 2018).

Fig. 3. *Manatee Match* (Photo by A. Merkel, 2019).

Manatee Identification

Scientists who study manatees have created an identification database with photos, diagrams, and data for about 4000 individual manatees. By identifying individual animals, the researchers can track an animal's movements through the seasons, record each animal's history of reproduction, injuries and illnesses, determine family relationships between individuals, and even identify dead manatees to help understand their cause of

death. The ID database is one of the most important tools for the identification process. Manatee researchers around the Gulf and Atlantic coasts and Caribbean nations contribute to keep the database up to date.

The Conservation Tales team met with three different groups of researchers who use the database. The U.S. Geological Survey supports the Wetland and Aquatic Research Center that studies manatees and other species. The lead author spent time with these researchers during their semiannual manatee health assessment study. This team photographed eighteen captured animals over a 2-day period, entering each in the database. They also used the database to try to identify the individuals caught to check their past health history (see Figure 4). Scientists from the U.S. Fish and Wildlife Service, also part of the manatee health assessment, met with the Conservation Tales group to share how they use aerial surveys and the manatee ID database to monitor populations over time.

Fig. 4. Researchers at manatee health assessment, & matching illustration (*McConnell* © 2018; Pfaff & Kordesh, 2018).

The entire Conservation Tales team then spent time with researchers at Mote Marine Laboratory and Aquarium in Sarasota. At Mote, researchers conduct behavioral studies with two captive manatees to understand their sensory and cognitive capabilities. Another team of scientists from Mote monitors manatee populations in the local waters by photographing individuals on a daily basis, recording their behaviors and location, and comparing their observations to records in the database.

As part of the manatee researchers' work, identification of individual animals in the photographs is one of the important tasks. Without a positive identification, the data they collect is not as helpful in understanding the lives, habitats and populations of the manatees. The task can be challenging because taking clear photographs of manatees is difficult. The waters are often murky, lighting can be inconsistent, and manatees do not always present their whole body for a photo. Researchers at Mote spend a considerable amount of time checking images against diagrams in the database to compare scars and injury marks before declaring a positive ID of an animal.

Fig. 5. Manatee with scars

The scars and injuries are the most reliable way to identify a manatee. If uninjured, manatees look very similar to each other except for size. There are nearly no differences in manatees' color, and the external structures show very little individual variation. But the scars can produce unique markings that are easily seen and can help the researchers.

When manatees are injured by boat propellers, boat collisions and ropes or fishing lines from crab traps or nets, cuts in their skin heal very quickly, but leave white scars. On the dark gray skin of a manatee, these scars show up very clearly. Some individuals also have pieces of their tails or flippers lost to injury. Many manatees have notches missing from their tails, and might have obvious damage or amputation of parts of a flipper. Over a period of years, the white scars will fade, turn grey and eventually disappear, but the tail and flipper damage are permanent. All of the markings help researchers identify manatees.

In the shared database, scientists use diagrams of manatee bodies. On each diagram, markings are drawn using standardized symbols to create a visual model of an individual manatee. Figure 6 shows a key to explain the markings. In Figure 7, one of the researchers at Mote explains the identification system to the Conservation Tales team. As new injuries and healed scars change the appearance of an animal, these diagrams are updated, with notations in the data record to note the changes.

At Mote, new researchers need to learn to use this system. Mote has developed sets of ID cards to support this training. The new staff members practice matching the photographs with their corresponding diagrams. Mote uses at least three sets of cards, each becoming increasingly challenging as the researcher's skills improve.

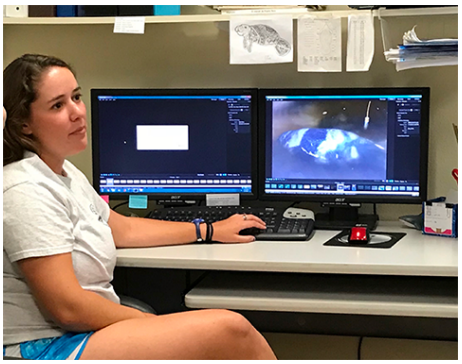

Fig. 7. Mote researcher identifying manatee photographs

The *Manatee Match* Card Game created by the Conservation Tales team is a version of this same practice activity designed for children. The cards are larger than those used at Mote, and the images were selected from photographs that give a clear view of the manatees. But the process for children using the *Manatee Match* Card Game is identical to that used by the Mote research team to learn to recognize individual manatees.

In the activity we describe here, students can develop the same process skills used by researchers in the field. Many of the news stories students might see about manatees feature the work of these same researchers from Mote, the USGS, and USFWS.

The *Manatee Match* Cards

The *Manatee Match* Cards are presented as a set of twenty-four cards of two different types. The set includes twelve cards that show a "scar chart" diagram. The diagrams are the same type of images stored in the manatee ID database used by researchers. Each of these cards includes the name of the manatee shown. The names were chosen by members of the Conservation Tales team, and may not be the names used by scientists in the manatee ID database.

The other twelve cards show photographs of manatees that have distinctive scars. Each photo matches one of the diagrams. Each photo card has a small number to help the teacher match photos with diagrams using a key included in the activity plan and on the instruction card that accompanies each set.

Fig. 8. *Manatee Match* cards (Photo by A. Merkel, 2019)

Some of the images feature manatees with unique scars that are easy to identify. For younger students, these allow some successes in the card matching task. Other cards have pictures of manatees that have similar types of scars. For these images, students will need to work a bit harder to look for details to distinguish the animals. Students may need to check where scars are positioned in relation to each other, or to fins and the tail. In some of the images, the student will only see part of the animal. The diagram may include scars that are not visible, and students will need to compare only the parts that are found on both the diagram and in the photo. A few of the photos show the animal in a different position than

shown in the diagram. For those cards, the user must visualize what the scars would look like when viewed from a different angle. These challenges are features that make the card game more realistic. The cards were designed to give students an authentic experience.

The Activity Plan

The *Manatee Match* Card Game is an activity available for teachers at the website for the *Conservation Tales: Manatees* book. On the *Manatee Match* Card Game site, teachers can download an activity plan. The activity plan includes a teacher guide with standards alignment, context, suggestions for implementing the activity and background information about manatee identification and how it is used by researchers.

The plan also includes student handouts. The first handout is a Student Guide. This includes a short explanation of the process of identifying manatees. The guide also explains the procedure. The Student Guide also offers a list of "Reflection Questions." Teachers have options for using the reflection questions. Students could be instructed to write about the questions as an assignment, a journal entry, or a lab report. The teacher may also ask students to discuss the questions, then lead a whole-class discussion about the questions.

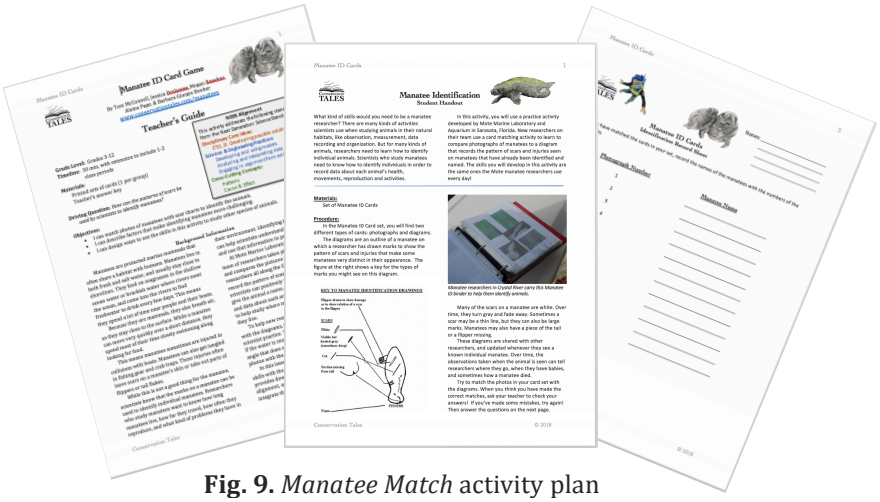

Fig. 9. *Manatee Match* activity plan

The final page of the Student Guide is a "Records Sheet" on which students can write the names they have identified for each manatee photographs. Some teachers may wish to use this page as an assessment to check their students' choices. Teachers could also simply check a group's answers through an oral and visual check of the cards they have matched.

The key goal of this activity is to allow students to practice the observation skills needed in science. Many researchers have to develop similar skills, so the activity represents an authentic process of scientific inquiry. The activity addresses some of the process standards featured in the Indiana Science Standards (IDOE, 2016) and the NGSS (Lead States NGSS, 2013). Students also practice using and interpreting symbols, a skill featured in one of the Literacy in Science/Technology standards at the middle school levels. Figure 10 shows the alignment of the *Manatee Match* Card Game with both Indiana and NGSS standards across a range of grade levels.

Field Testing the Activity

The Manatee Match Card Game has been tested with children in both formal and non-formal education settings. Learners from 1st grade and up have successfully used the cards at outreach events at locations like the Midwest Museum of Natural History in Sycamore, IL, Minnetrista in Muncie, IN, community events like a Master Gardner's event and a community ArtsWalk. Teachers in various grades have also used the activity in their classrooms. The Out-of-Door Academy in Sarasota, Florida, uses a classroom set of the cards with third graders. The third-grade students are able to successfully complete the task, and then base discussions they have with Mote Marine Aquarium staff during visits.

Teachers from six schools in grades 2 through middle school in Florida and Indiana have also implemented in the activity with their students. Learners in primary grades

sometimes struggle to match two of the sets of images on the first try, but this was an intentional feature. These images have some common similarities. The activity encourages discussion of the features of some photos that make identification more difficult. After that discussion, students can usually correct their selections in a process that mimics what the manatee researchers do. Our tests have found that the goal of the activity is achievable by 2nd graders. Many children younger than 2nd grade are less interested in the observation task, but some still excel at the task.

Figure 10. Standards alignment for the Manatee ID Card Game

Indiana Science Standards	Next Generation Science Standards
Science & Engineering Process Standards SEPS.2 Developing and using models and tools SEPS.4 Analyzing and interpreting data SEPS.7 Engaging in argument from evidence **Content Standards** **K.LS.2** Describe and compare the physical features of common living plants and animals. **Literacy in Science/Technical Subjects** **6-8.LST.3.1; 9-10.LST.3.1; 11-12.LST.3.1:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades level texts and topics. **Engineering** **6-8.E.4** Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.	**Science & Engineering Practices** 2. Developing and using models and tools 4. Analyzing and interpreting data 7. Engaging in argument from evidence **Disciplinary Core Ideas** **ETS1.B: Developing possible solutions** Designs can be conveyed through sketches, drawings or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **Cross-Cutting Concepts** 1. Patterns 2. Cause & effect

"Gear Up" Extension Activity

For teachers who wish to extend the activity or move their students thinking to a higher level, the activity includes a "Gear Up" activity. This extension is an elaboration of

the final Reflection Question. The question asks students to discuss other examples in which a researcher might need to use visual identification of individual animals. Some examples of these species could include giraffes, gorillas, zebras, elephants, whales, dolphins, and others. More accessible examples might be cows, cats, dogs or other animals your students might see close to home. Each of these species have observable differences that help scientists identify the animals. For instance, giraffes each have unique patterns of spots, and gorillas have unique "nose prints" of wrinkles on their faces. The coloration on students' pets, like cats or dogs, would be another example that students could describe.

In the Gear Up activity, students are prompted to pick a species that could be identified by its markings, and create cards for those animals based on photographs or direct observations. Students might make a set of cards to identify classroom pets like guinea pigs or fish in an aquarium, pets at home like cats or dogs, or photos they find in the internet such as individual elephants. This task would also be useful for animals seen on a field trip. A class could make cards of the elephants before or after a field trip to the zoo.

The Gear Up activity is especially useful with older learners, and addresses the content, process and engineering standards listed in the alignment table Figure 10. The Gear Up activity helps develop application and synthesis skills while students demonstrate the ability to transfer their understanding the science processes scientists use to identify manatees.

Science teaching should aspire to help students understand and develop the authentic skills used by working scientists. NSTA and HASTI have long supported this goal in their position statements, professional development offerings, and connections between the scientific community and classroom educators. The developers of the *Conservation*

Tales series also share this goal with their focus on presenting authentic models of science and scientists in their books about wildlife conservation.

The *Conservation Tales: Manatee* books and the *Manatee Match Card Game* can be purchased from the Conservation Tales Online Store (conservationtales.com/estore). Teachers can purchase these products at a discounted rate ($12 for the book, $7.00 for the card set), with special prices for sets. Schools can purchase the products at the further discount with a purchase order or online invoice. All proceeds support the development of new *Conservation Tales* books and learning materials. The Manatee Match activity guides and other learning resources are available for free downloads at the Conservation Tales Activities page.

We invite you to explore *Manatee Match* Card Game at the Conservation Tales website, as well as the other inquiry learning activities in the book series.

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