SCIENTISTS IN THE FIELD

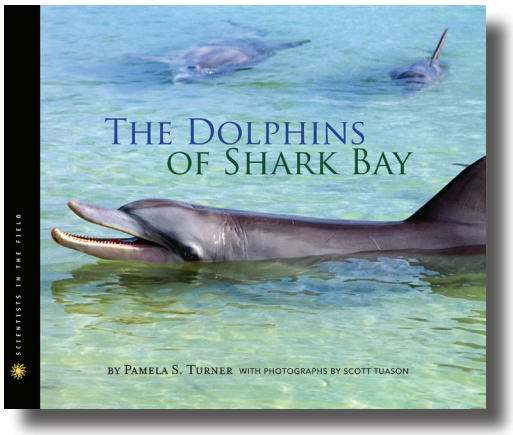
WHERE SCIENCE MEETS ADVENTURE

DISCUSSION AND ACTIVITY GUIDE

The Dolphins of Shark Bay
by Pamela Turner Photographs by Scott Tuason

About the Series

The Dolphins of Shark Bay is part of the award-winning Scientists in the Field series, which began in 1999. This distinguished and innovative series examines the work of real-life scientists doing actual research. Young readers discover what it is like to be a working scientist, investigate an intriguing research project in action, and gain a wealth of knowledge about fascinating scientific topics. Outstanding writing and stellar photography are features of every book in the series. Reading levels vary, but the books will interest a wide range of readers.



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About the Book

Many people have watched dolphins perform tricks at aquariums or zoos and marveled at these amazing animals. But how many of us would have guessed that some dolphins in the wild have figured out how to use a tool? Pamela S. Turner takes readers to Shark Bay in Australia, where for more than twenty-five years, researcher Janet Mann has been studying the bay's dolphins. Among the many fascinating things Mann discovered is a group of clever tool-using dolphins that use box sponges to protect their noses as they fish on the murky bottom of the bay. Turner chronicles Mann's fascinating research and what scientists are learning about dolphins, dolphin intelligence, and the challenges they face.

About the Author

Pamela S. Turner's license plate reads RIIBIIT. She has written three other books for the Scientists in the Field series. *The Frog Scientist* was an ALA Notable Book for Children, and an Orbis Pictus and National Green Earth honor title and won the Cybils Young Adult Nonfiction award. *The Frog Scientist* is also the 2010 winner of the American Association for the Advancement of Science's award for the best science writing (sponsored by Subaru). In addition, Pamela has received numerous starred reviews and other accolades for her excellent books.

Pamela has written about science and nature for many years, winning prizes and acclaim for her ability to present accurate information that is easy to understand and fun to read.

About the Photographer

Scott Tuason is the photographer of another Scientists in the Field book with Pamela Turner, *Project Seahorse*. Scott is a diver and conservationist and is the travel editor for *Rogue* magazine. He lives in the Philippines with his daughter and a menagerie of rescued cats and dogs.

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Pre-Reading Activities

Bring in some tools or objects that students may not recognize, ideally enough to supply each student with his or her own tool. Have students spend about five minutes or so writing down the purpose of their object. Then have the class form groups of about three or four students to a group. Have the groups decide together what the function is of all the tools for the students in the group. Compare these to the individual definitions. When all the groups are done, share the actual function of the tool. Compare the individual definitions with the group definitions with the actual purpose. Discuss how humans develop new tools.

Watch a group of people doing the same thing, like watching a sporting event or eating or reading. What do all the people do that is the same? What are some of the most obvious differences? As you watch, are you able to determine whether some are better at watching or eating or reading? Explain why or why not. Now watch a group of ants and try to make similar evaluations about their actions. Watch a group of fish or other small animals. Is it possible to evaluate whether individual animals within a group are more capable than others?

Discussion Questions

Is it possible to compare the intelligence of different species? Is it even possible to rank creatures by their intelligence when they are the same species? Is it true that the bigger the brain is, the smarter the creature? Would this mean that males are smarter than females?

Is it fair for humans to assess the intelligence of another animal when we are not even convinced that we can accurately measure our own intelligence? Is intelligence capacity something that is hardwired into us at birth or does our experiences factor into the equation?

If we looked at any group of animals, could we determine whether some of those animals are better at being that animal than others? In other words, are some cats better at being a cat than other cats?

What behaviors are indicative of a good mother of any given species?

We can easily come up with standards for humans and their occupations or responsibilities, but can we come up with standards to suggest that some dolphins are better hunters than others? What about squirrels or sparrows or grasshoppers?

What tools do you typically use every single day? Pick a few of these tools to discuss and examine the process for inventing the tool. Are there tools that you or someone you know just can't seem to master? Explain. Why do some folks use tools and others do not?

What is the difference between, say, a soccer ball and a hammer? Does that difference change when we use the object in a different way, for example, using the soccer ball to knock down an item stuck in a tree and using the hammer to tap out a tune?

How do you suppose animals figure out how to make tools? Can you invent a new word or suggest an invention that needs to be created?

Professor Jeanne Altmann discovered the importance of paying attention to the quiet, docile grooming behavior of baboons to understand baboon social structure, which Janet Mann used as a model for studying wild dolphin behavior. What small, quiet human behaviors, if any, mean more to our understanding of other humans than the loud, boisterous fights and quarrels we see on reality television shows or even in the lunchroom?

Since we do not live in the ocean, how can we be sure that our conclusions about the animal behavior of ocean animals is accurate? We have the ability, on land, to use binoculars and other tools. Our ability to see in the ocean is much more limited. How does the difference in visibility impact our understanding?

Applying and Extending Our Knowledge

On page 5, we see a chart comparing the relative brain sizes of five mammals, including humans. According to this chart, humans have the largest brain-to-body ratios of any of these mammals. The implication is that these other four mammals serve as a range from the smartest mammal (us) down to the

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mammal (cat) with average intelligence. Scientists calculate EQ by using the brain and body weights of a large number of mammals to come up with an average brain-to-body ratio, which is set at 1.0. If an animal (bottlenose dolphin) has an EQ of 4.1, that means its brain is four times larger than what we would expect based on its body size.

EQ requires fairly complex calculations. Although less sophisticated than EQ, students can also examine the relative "braininess" of different species using a simpler calculation: the ratio of average brain weight of a species to its average body weight.

- Develop a chart of simple brain-to-body-weight ratios for the mammals in the chart on page 5. Add to your chart by including brain-to-body-weight ratios for non-mammal species such as birds, reptiles, fish, amphibians, and octopuses. Rework the chart to reflect these new additions from the largest brain-to-body-weight ratio to the smallest. What does this new chart suggest? Are there any surprises?
- Even when we compare different species in this way, do we have enough evidence to speak definitively about "intelligence"?
- How confident can we be about our brain-to-body-weight ratio comparisons when comparing animals, like birds and mammals, from widely different evolutionary lineages?

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

We are introduced to the word *cetacean* on page 6: "Yet somehow, in a brilliant stroke of cetacean innovation, Shark Bay dolphins have discovered how to use a sponge as a tool."

- Prepare an online presentation defining the word *cetacean* and showing viewers representatives of all the different types of cetaceans.
- In the presentation, make sure to explain the difference between dolphins and porpoises.
- Make a map showing where various types of cetaceans live, including the Shark Bay dolphins.
- Make a set of cards showing the type of cetacean, its range, what it eats, threats to the animal, and other interesting facts.
- Prepare a poster or an online presentation distinguishing dolphins from porpoises.
- Prepare a map showing the ranges of cetaceans. How many live in each area?
- Are there differences in habitat, diet, behavior, etc. of the different dolphin subspecies?
- Find and watch segments from the *Flipper* television program or watch the *Flipper* movie. Compare the dolphin behaviors and characterizations from the video to what you have learned in the book. Prepare the Snopes entry for readers wondering what the truth is about these movies. See Snopes.com for samples of how this organization presents information about rumors and truth.

Shark Bay is 3,900 square miles! The map on page 3 may not provide readers with an appreciation for the size of this area.

- Have students compare 3,900 square miles to their state. Make a to-scale overlay that shows the shape of Shark Bay compared to their state. If Shark Bay was put in their state, how much of the state would it encompass?
- Shark Bay is bigger than two states. It has a coastline that is 1,500 kilometers. Convert this to miles. Make a map that shows your school. If you drove 1,500 kilometers, where would you be? Use a compass and put the point on the location of your school and draw a circle showing how far 1,500 kilometers would be in any direction.

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Common Core Connections

CCSS.ELA-Literacy.RI.6.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

CCSS.ELA-Literacy.SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.W.6.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

On page 7, Turner writes, "*If a human invades the water near a wild dolphin, the animal will either bolt or (less likely) stop and stare. Neither is helpful if you want to see normal dolphin behavior.*"

- Without violating anyone's privacy, observe family or friends or other students when they are not aware of your presence. Record what they are doing. After observing for several minutes, tell the person what you observed them doing (again, do not violate privacy and do use common sense). Ask them to repeat that action. Let them know that you plan to watch them. Did the person repeat the action exactly the same as the first time? Discuss.
- Have the teacher walk around and listen to each group discussing the observations from the activity above. Think about your own behavior. Does your reaction or behavior change when the teacher is observing?
- Think about a time when you or someone you know was singing to themselves. Sing that same song to classmates (if you dare). Why are so many people unwilling to be observed doing something they enjoy in solitude? Now apply this discussion to the difficulties determining what comprises natural dolphin behavior.
- Watch a wild, healthy bird on your school grounds. How close are you able to get to the bird before it is aware of your presence? What happens? Assuming that your bird was not one like a pigeon, socialized to be more tolerant of humans, how long did it take the bird to become aware of your presence? Did the bird immediately fly away? What was the bird doing before it noticed your presence?
- Try setting up a bird feeder and repeating the last activity. Discuss whether or not watching birds on a feeder represents natural behaviors of birds in the wild.
- Videotape a pet that is not sleeping and also NOT paying attention to you. After a short time, make the pet aware of your presence without calling the animal. Record the action and discuss the change in behavior. Record your pet when it knows you are watching. Compare this video with the one shot while the animal was not aware that you were watching. Compare watching birds or other animals with the difficulties Turner describes on page 7.

Common Core Connections

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related,

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focused questions that allow for multiple avenues of exploration.

CCSS.ELA-Literacy.SL.6.1a Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Human interactions with animals often create unintended consequences that are harmful to the animals and the environment. We read on page 14: "*Away from the beach, they acted like normal mother-calf pairs—except that beach-fed mothers sometimes approached fishing boats to beg. At the Monkey Mia beach, however, their behavior changed. Instead of hunting, nursing their calves, or protecting them from sharks, the mothers spent hours obsessively begging. Fat moms didn't necessarily raise well-fed calves, and the calves of beach-fed mothers didn't learn the foraging skills they needed to survive. Tourists assumed that their fish handouts were helpful. Instead, Monkey Mia's baby dolphins starved in a stew of good intentions.*"

- Debate whether or not humans should feed birds, have rules against feeding squirrels, or put whales in places such as Sea World.
- Include in the debate above scenarios including endangered animals like cetaceans or have a separate debate involving just these animals. Should the park rangers at Monkey Mia even feed the five adult females, as mentioned on page 17?

On page 11, Turner describes the way that Professor Altmann changed the way researchers view animals in the wild. "A scientist trying to record animal behavior must make decisions, especially when observing animals mingling in a social group. Which ones should be observed? Which actions should be recorded?"

- Brainstorm with your students what kinds of organisms the class could observe in an outdoor area, such as a field or empty lot or wilderness area (whichever matches your school environment). Make predictions for what animals will be there and what these animals will do. Then move outside and generate a list of animals found in a set amount of time (at least five minutes). Make sure students add questions to the end of each entry about something they observe. Generate with the students a procedure for which animals to observe, what to observe, and when to observe these animals daily for the next several weeks.
- Create a field book for animal observations, stressing the importance of dates, drawing, and description. The American Museum of Natural History has good information about field journals here: www.amnh.org/explore/curriculum-collections/biodiversity-counts/what-is-biodiversity/doing-science-researchers-and-exhibition-staff-talk-about-their-work.-keeping-a-field-journal-1.
- Using string or Hula-Hoops or natural markers, assign students a specific section of the outdoor area to monitor with a field journal. Make sure to map the site so the students are always observing the exact same location. For the next month (or longer), have students record their observations as regularly as time permits (ideally, on a daily basis). You may even wish to have students record the GPS coordinates for their specific location.
- Divide the class into groups and have certain groups specialize in a specific organism (in addition to their field journal work).
- Create a class booklet of the questions students have written. When appropriate, have these questions guide the next day's observations. Have other students use their own observations to formulate answers or theories concerning the questions.
- These activities above may also be used by students in outdoor areas of their own choosing (and assigned as homework or extra credit). Discuss with students whether a field journal could even be done in, say, the lunchroom.
- Compare the class predictions before starting with what the class observes monthly (and at the end of the time period). What new predictions and hypotheses do the students have?

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Common Core Connection

CCSS.ELA-Literacy.W.6.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

On page 24 we read, "*Imagine being blindfolded. Three cups sit in front of you: one made of wood, one made of glass, and one made of brass. Someone taps each cup with a spoon. You can probably guess which is which by listening to the sound generated by the tapping.*"

- Test this in class. Move all the objects to various distances from the blindfolded student. How far away before it becomes too difficult to distinguish which is which?
- Do this again, but keep two items at one distance and one either closer or farther away. Have students guess which object is farther away or closer.
- Do a variation of this activity but switch the objects to items that are much more difficult to distinguish (ice, marbles, and dice, for example).
- What happens if we switch to water in identical cups but filled to different levels? Can students distinguish between different liquids? Can they tell which one is water, which one is cooking oil, which one is milk?

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

On page 35 we read, "*At the moment, I'm Janet's newest student. She explains her two most important sampling methods: the survey and the focal follow. 'The survey is like a snapshot, and the focal follow is like a movie.'*"

- Have several students take a picture of a friend (or have a friend or family member take a picture of you) at ten carefully recorded times of the day. Examine the pictures and attempt to put them in chronological order without looking at the time and dates of each picture. Have the class make predictions about what is happening in each of the ten picture sets.
- Try this in class by having the teacher take a number of pictures from the beginning of class, middle, and end of class. If the pictures are mixed up, can the class put them back in the correct order? To show the difference between the survey and focal follow, videotape the class on the same day the teacher takes the pictures. Discuss the differences, especially the limitations of using a survey method. Is there a good reason for taking survey pictures to learn about animals? Keep in mind the earlier activities designed to show the problems inherent when animals know they are being observed.

Common Core Connections

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.RI.6.7 Integrate information presented in

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different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

On page 22 we learn that the dolphin Dodger has a *"distinctively nicked and slightly tipsy dorsal fin."* Throughout the book, dorsal fins are used regularly to identify individual dolphins. Then on page 41, we read, "*Every dolphin also has a 'signature' whistle that it uses when separated from family or friends.*" This provides the scientists with two different ways to identify individual dolphins.

- Take close-up photographs of just the back of the head of each student. Make sure to identify each head with a letter or number code. Make sure to have an answer key for whom the head belongs. Make a slide show (or print out pictures) of all of the heads. Make sure the slide show is in a random order. Hand students a class list. Go through the photos and have the students assign the code letter or number for each head to one of the students in the class. Ideally, when the slide show is through, each student should have the entire class matched. Go through the slides again, but this time do the activity as a whole class activity or in groups. Then show the head that belongs to the student. Compare the results for doing the activity alone and in groups. Is this easier or harder with humans than with dolphins?
- Do this activity again, but insert heads that do NOT belong to anyone in the class.
- Do a variation of this activity but use footprints (barefoot).

Common Core Connection

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

On page 44 and 45 we see shark bites and sharks. We also read that dolphins regularly have encounters with sharks and survive. The caption on the bottom picture on page 44, for example, states, *"About three-fourths of all adult Shark Bay dolphins bear shark bite scars, a proportion twice as high as that of bottlenose dolphins living in other places."*

- Research the species of shark, in addition to tiger sharks, that live in Shark Bay. Present a poster or online show depicting each shark, showing its range, listing its diet, and evaluating the relative threat that the shark poses to the Shark Bay dolphins.
- The book lists sharks and man made threats to Shark Bay bottlenose dolphins. What are the threats facing other species of dolphin, or bottlenose dolphins living in other places? Research a dolphin species or bottlenose population. Make a poster showing possible causes of mortality. Include a bar graph or a pie chart showing what your research suggests. In groups compare your posters and prepare a group poster. Can you find any data on mortality rates, especially for deaths caused by humans? What could be done to reduce man made causes of mortality?

Common Core Connection

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Several different dolphin-hunting methods are discussed throughout the book, including sponging.

- Describe each hunting method mentioned and speculate on the reason dolphins do and do not adopt each specific method.
- Prepare skits demonstrating each hunting method to young student complete with costumes and props.
- Write Rudyard Kipling–like "Just So Stories" explaining "How the Shark Bay Dolphin Found Its Sponge."

Common Core Connection

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CCSS.ELA-Literacy.W.6.1 Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-Literacy.W.6.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

CCSS.ELA-Literacy.W.6.9a Apply grade 6 Reading standards to literature (e.g., "Compare and contrast texts in different forms or genres [e.g., stories and poems; historical novels and fantasy stories] in terms of their approaches to similar themes and topics").

Further Reading

Boysen, Sally, Dr., and Dr. Deborah Custance. *The Smartest Animals on the Planet: Extraordinary Tales of the Natural World's Cleverest Creatures*. Firefly Books, 2012.

Web Resources to Explore

Cetacean Curriculum
acsonline.org/education/curriculum
A free downloadable curriculum guide for elementary teachers. Inquiry-based activities introducing students to dolphins, whales and porpoises.

Bottlenose Dolphins
www.dolphinresearch.org.au/bottlenose.php
Information on bottlenose dolphins from the Dolphin Research Institute of Australia.

Guide created by:
Ed Spicer, Curriculum Consultant, and Lynn Rutan, retired middle school librarian, now reviewer and blogger at Bookends: the Booklist Youth Blog