



SCIENTISTS IN THE FIELD

Where Science Meets Adventure

DISCUSSION AND ACTIVITY GUIDE

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

About the Series



The Orca Scientists 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.



About the Book

Orcas, mistakenly called killer whales, still bring thousands of people to aquariums and theme parks around the world to see these mammals up close. Today, scientists have documented that orcas are family-oriented, intelligent, and very much endangered. This book documents the link between science and laws governing things like how far away boats must be from swimming orcas. Along the way, readers will learn how dogs are helping scientists locate crucial information, how wild salmon are critical for orca growth, what we learn about orcas from their dorsal fins and markings, the importance of orcas to the Samish Indian Nation, and much more!

The Orca Scientists

by Kim Perez Valice

Photographs by Andy Comins and
the Center for Whale Research
9780544898264

About the Author

Kim Perez Valice lives with her family in Michigan. This is not only her first book for the Scientists in the Field series but also her first published book!

About the Photographer

Andy Comins is a California-based photographer dedicated to bringing the wide world of scientific knowledge to children of all ages. He has worked with a number of authors, providing photos for their Scientists in the Field books.

Pre-reading Activities

Show just one piece from a jigsaw puzzle. Have students predict just what this puzzle will look like when put together. Add several more pieces and change or add to the students' predictions. Then show them the puzzle box and try to determine where exactly these pieces fit in the finished puzzle.

Review the differences between mammals and fish, whales and dolphins, and fresh water and salt water. Review straits, estuaries, isth-

Houghton Mifflin Harcourt Books for Young Readers

Visit www.sciencemeetsadventure.com for authors' Adventure Notes, teacher resources, videos, and more!

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

muses, peninsulas, sounds, bights, fjords, inlets, and oceans. What is an apex predator or keystone predator? How do these predators help regulate the health of an ecosystem?

Discuss the differences between free-range chickens (or other farm animals), caged chickens, cage-free chickens, and pasture-raised chickens. What do we mean when we speak of wild-caught fish and farm-raised fish? Review terms such as sustainability, overfishing, and organic.

Review the structure of the brain. What does “cortical thickness” mean? How is the human brain different from the animal brain? Is it really fair to say that humans are smarter than animals? Are there “animal” ways to be smart that are unique to them?

Make a list of animals that organize into family groups. Compare these families to our own families. Have students trace their own family back as far as they are able to (remembering that this can be a difficult exercise for students without a close family structure). Reminisce about favorite relatives. What has an aunt or uncle done for you? What do you love or remember with love about a grandparent? Is there a family resemblance? What benefits are there for families that share a close connection? Do animals benefit in the same ways?

Create an annotated list of all organisms (plant or animal) with a bad reputation. Include in the annotations the nature of the reputation and the predicted percentage of the truth of that reputation. Also include any interesting cultural differences.

Discussion Questions

What is the role of science in confronting our attraction to orca shows or any wild animal shows? Is there a place for the government to intervene when popularity defies science? Would an environmental plan, for example, that allowed anthropomorphic orca shows be worth considering? If so, what factors would lead to proposing such a plan? If not, why? Should marine mammal shows be allowed?

Does our infatuation with marine mammals, such as orcas, actually harm these animals?

This book shows how research has led to laws, such as how closely motorized boats may approach orcas. Discuss the scientific standards that must be satisfied before changing laws.

How do we approach people about considering the value of animals like king salmon or Chinook salmon, when most can't tell the difference between them or even know that there are different varieties?

The Endangered Species Act has led to the comeback of several endangered animals, such as the bald eagle, American alligator, and peregrine falcon. On the other hand, the news is not so good for the western black rhino, the Pinta Island tortoise, the Yangtze river dolphin, and others. What fate is likely for the orcas? What factors will cause their demise? What factors could help save them?

What do we need to do as a country to make sure that the average citizen has a better understanding of what is involved in an ongoing research project on a single animal? What steps would you take to explain to a group of non-science-oriented people why we should spend so much time researching the Southern Residents (or orcas in general)?

Applying and Extending Our Knowledge

We begin this book with a prologue featuring Mike Bigg, the scientist who led the way in documenting the number of orcas in the wild, as well as the photo identification of orcas using their dorsal fins and saddle patches, the area just under the dorsal fin.

- Using a digital camera, take pictures of just the elbows of ten or more students. Have small groups of students examine these pictures, attempting to find ways to match these pictures to the correct students. Repeat this with eyes, knees, ears, etc. Is it possible to identify people by paying close attention to just one factor?
- Is the orca on the cover the same as the one on the title page? On page 10 we see a picture of L-41 (Mega). The caption says that he “is easily spotted by his unique dorsal fin.” Is L-41 found else-

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

where in the book? Throughout this book, various whales are identified. On page 28 and elsewhere, there are pictures of whales without identification. Examine the identified whales and see if you can label any of the whales on page 28 and elsewhere that are not identified.

- Schools typically have several identifiable groups that attract different students (although there is probably some overlap). Spend time observing and documenting these groups. If you were creating a naming system, how would you do this job?
- Find a spot in your neighborhood—maybe a tree, a pond, or a meadow—and document all the different organisms that visit or live in that place. Create a shorthand for labeling the various residents and visitors.
- In this book, as in many of the Scientists in the Field books, much of the work consists of watching, dating, collecting, recording, and interpreting. Find an area that students can observe regularly. Prepare either a class or individual field journal to record information in. 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. Make sure students add questions to the end of each entry about something they observe. Generate various predictions and hypotheses with your students about what they expect to observe each day and over time.
- Prepare an online visual presentation that shows small children the differences between mammals and fish, perhaps using something similar to a Venn diagram, complete with a rubric for what it means to be a fish or a mammal.
- Do the same thing, but this time explain (both visually and in writing) the difference between land mammals and sea mammals, and then between whales and dolphins. Is there a clear-cut difference between dolphins and whales? Show this and explain why some people may still be confused about what to call an orca. For extra credit, now compare the differences between dolphins and porpoises.
- With the help of your librarian, research pilot whales, beluga whales, beaked whales, sperm whales, and narwhals. Compare these to orcas and dolphins. Research humpback whales, right whales, gray whales, fin whales, and bowhead whales. How do these compare to orcas and to the whales above? Create a report explaining the similarities and differences.
- Write a short story, song, skit, or poem to share with young students that presents the story of the orca who wants to be a whale, or of the orca who is tired of being mistaken for a whale.
- In your area, what predators are the apex predators? Does your region have a balanced predator-prey relationship?
- Your own neighborhood may not have any significant bodies of water, let alone an ocean. What animals in your neighborhood has the most in common with orcas? Explain why.
- Orcas have a complex group of vocalizations and behaviors that are used for a variety of purposes. With the help of your librarian, compile a variety of different whale sounds to play for the class. See if you can locate the same sound in two different whale dialects.
- Orcas make sounds by moving air between nasal sacs near their blowholes. Using balloons, plastic, paper, and other items, see if you can make a model that makes sounds similar to those that a whale might make.
- Orcas use echolocation to navigate. How is the orca's echolocation similar to the way a bat uses echolocation?

Common Core Connections

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

CCSS.ELA-Literacy.W.7.7 Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

Orcas have been nicknamed “killer whales,” but are they really whales? It doesn't help that there are plenty of people who think they are fish.

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

- Orcas in this book are divided into resident groups and transient groups. Make a map showing the travel patterns and diets of residents juxtaposed with the travel patterns and diets of transients. Explain any differences in behavior, diet, or movement among different resident groups.

Common Core Connections

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

CCSS.ELA-Literacy.SL.7.4 Present claims and findings, emphasizing salient points in a focused manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

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

Examine the map just before the first chapter (pages 6–7). Pay close attention to the orange color and the blue colors around the inset.

- What are the book designers/author trying to say with these colors? Write a critique or a justification for this color scheme, including an explanation for what is intended and the extent to which this map provides useful information.
- Look at just the orange areas. There are about sixteen distinct areas with this color. Label these areas. Are orcas found in these areas? Other toothed whales? Baleen whales? Create a timeline and a new map that shows when and where orcas have been found in these areas.
- The inset area is very unique. It includes several straits, a sound, islands, and more. Make flash cards that explain to young students what these various geographic terms mean. Be sure to include straits, sounds, bays, peninsulas, islands, and oceans. Some of these areas have unusual currents and weather patterns. Make cards describing the various weather patterns. Do some research and make cards showing the most common marine life: birds, mammals, etc.

Common Core Connections

CCSS.ELA-Literacy.SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner

with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

CCSS.ELA-Literacy.W.6.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

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

CCSS.ELA-Literacy.RI Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

The beginning of this book describes the naming convention as conceived by Mike Bigg and continued by Ken Balcomb and the team of orca scientists today. On page 21, we read about the affinity the Samish Indian Nation has with orcas, including J-14, named Samish in honor of this nation.

- Who are the people of the Samish Nation? What language(s) do they speak? Do an online or graphic presentation showing who the Samish people are today. If time permits, share some of their history, perhaps including their legal battles to become a federally recognized tribe.
- With the help of your librarian, research the Samish Indian Nation's relationship with the orcas. Write a paper, citing sources, on their orca naming ceremony. As with any citation, make sure that the source is a legitimate source and your information is accurate.

Common Core Connections

CCSS.ELA-Literacy.W.6.2 Write informative texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of content.

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

On page 11 we read, "Ken can identify every individual by this alphanumeric classification. He believes that the whales can identify him as well."

- Speculate on whether this claim is accurate and design ways that you could test your hypothesis.
- Write dialogue from the point of view of two (or

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

more) orcas talking about how they recognize humans using their senses.

- Orcas engage in a behavior we label as “spy hopping.” If we accept the proposition that orcas can identify humans, what sort of information would an orca be gathering when spy hopping? Is there a possibility that orcas spy-hop for aesthetic reasons? Read the last paragraph on this page in which the author mentions the “cortical thickness” of the orca’s brain.
- Read this page again and brainstorm other motivations, aside from curiosity, that are conceivable. People can be very curious, which may lead us to conclude that orcas staring at us are also curious. Are there other explanations for orcas swimming up to a boat and staring at humans? Is it likely that orcas are curious? What do scientists do to guard against anthropomorphism? Look at videos of orcas online. Read what other marine biologists have to say about their work with orcas. Write a paper describing your belief on whether curiosity is a fair way to describe orca behavior. Make sure to explain whether curiosity functions in the same way with orcas as it does with humans.
- Spend a designated amount of time observing and cataloging the gestures and body language of people your age in various settings. Does the same body language convey different meanings depending on the group of people? Speculate on whether animal behavior ever varies in meaning. Are there some gestures that almost always mean the same thing? For example, does a fluke slap always mean the same thing? If you were a scientist, how would you test to insure exactly what body language implies? Design a method for testing and justify your position.

Common Core Connections

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

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.W.6.1(a-d) Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-Literacy.RI Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

The second chapter begins with a description of J-41 teaching her son how to hunt salmon. Valice tells us that this same lesson was given to J-41 by her mother years ago. Later we learn that when the winds and temperature and currents are just right, the king salmon will embark on an epic journey, attempting to return to their first home. The salmon brain will release hormones that allow the fish to adjust to the different salt levels.

- Describe the difference between the learning orcas do versus the learning of the salmon. Is the orca smarter than the salmon? Create a presentation that supports your claim.
- Think of the traditions in your own family. Do you have lessons similar to those of the young orca learning to hunt? Do humans have anything resembling the behavior of salmon, which seem to instinctively know that it is time to return to their birthplace?
- Write a song, short story, or poem describing the behaviors of either the orcas or the salmon. Create artwork that compares your life or your education to that of orcas or salmon.
- Research ways in which learning is passed down to the young in other animals.
- The scientists studying orcas collect information, document it, interpret it, and make predictions. All this collection involves observation. Find an area in your own neighborhood that would be useful to observe on a regular basis. Create a field journal and document the area regularly. 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. Make sure students add questions to the end of each entry about something they observe.
- Compare the various types of salmon found in the

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

world today and create a presentation explaining why orcas need the king salmon.

Common Core Connections

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

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

The information starting on pages 45–47 is about an orca named Lolita.

- Have a mock trial about whether Lolita should be released or not. Select students to serve as the judge, attorneys, and witnesses. The rest of the class can be the voting jury.
- Several documentaries and videos exist that describe (with varying degrees of objectivity) orcas in captivity. There include *A Fall from Freedom*, *Blackfish*, *Inside the Tanks*, *The Dark History of Killer Whale Captures*, and more. View parts of these, and review and fact-check them for how carefully they present both sides of the argument. *Blackfish*, for example, takes SeaWorld to task, and SeaWorld considers the movie an agenda-driven piece that ignores the truth. Have students identify claims that are supported by research and which may be guided by anthropomorphic reactions.
- Observe and catalog the body language of people your age in various settings.
- Create flash cards or posters showing human behaviors in your community, with annotations describing what these behaviors suggest about the mood of the person behaving this way.
- Document behaviors of local animals, such as squirrels, hummingbirds, or blue jays with a camera or a sketch. Devote a block of time to observing, photographing, sketching, and describing the behaviors depicted. Incorporate these into your journals.

Common Core Connections

CCSS.ELA-Literacy.SL.7.4 Present claims and findings,

emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

CCSS.ELA-Literacy.W.7.7 Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

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.W.6.1(a-d) Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

The fourth chapter discusses the ways in which dogs assist scientists with their research.

- Many areas have dogs that are trained to respond to various odors. Police have drug-sniffing dogs. Some organizations have rescue dogs. Check in your area and see if you can arrange to have one of these dogs demonstrate how they use their sense of smell to find things.
- Place vials of scented and unscented liquids in identical containers around the room. Have just two vials of something like vinegar that has a very distinct odor. Have students pair up. Blindfold one of the students and have the other lead them around until they can detect the two odors that are the same. Switch the blindfold and move the liquids around until each partner has had a turn to locate the specific odor.
- This chapter goes into detail about how feces are used to determine lots of information about the health of the orcas and more. Ask students to document and summarize how orca poop is used by scientists in this book. Then have students research whether scientists studying other animals use droppings to conduct research.
- Watch these two YouTube videos to get a better idea of how and why scientists go to such effort to collect orca droppings: www.youtube.com/watch?v=qrUOIYpYmUY and www.youtube.com/watch?v=gkOeHrCjig

Common Core Connections

CCSS.ELA-Literacy.W.6.2 Write informative texts to examine a

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

topic and convey ideas, concepts, and information through the selection, organization, and analysis of content.

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

CCSS.ELA-Literacy.RI Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

In this book, scientists collected data about the effort it takes for orcas to vocalize at louder decibel levels. They collected data about the decibel levels of ships and compared that to the data collected about the decibel levels used by orcas. After years of collecting data, they concluded that ships were creating stress for orcas, which required the orcas to intake extra food, but their food supply was decreasing. They measured the decline in sizes of orcas. This led to new laws governing ships viewing orcas and how closely they can approach them.

- Is our love for marine mammals, in this case orcas, harming their population? Research this law. Does it go far enough? Would orcas be better off with a complete ban on orca-watching ships? Write a persuasive essay documenting your case.
- Do research into orca-watching cruises in the San Juan Island area. How much money does it cost to go on an orca-watching cruise? How many passengers does a ship hold? How many times per day do these ships take passengers to watch orcas? About how many ships take passengers orca watching in the San Juan Island area? How much money does a ship cost? How long will the ship stay in business? What are its annual operating costs? How many employees work on a ship? How much do the employees get paid? How many passengers does a ship need to carry to make a profit? Does the ship make money in other ways? Prepare a budget, listing sources, that give an idea of the financial health of an orca-watching ship. Write a summary of the risks and potential rewards of going into this line of work.
- Studying orcas is perceived as a worthy goal, perhaps because of their close family structure. We may buy into this research because of years of seeing advertisements about Shamu and going to shows at places like SeaWorld. Create an argument both in support of and against continuing to fund orca research. Listen to the

arguments of others in your class and decide which argument seems most persuasive.

Common Core Connections

CCSS.ELA-Literacy.W.6.2 Write informative texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of content.

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

CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-Literacy.RI Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

CCSS.ELA-Literacy.RI Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

Other Websites to Explore

This YouTube video shows Tucker, the dog featured in this book. It gives a bit more background information about how these dogs work and help the scientists. www.youtube.com/watch?v=qrUOIYpYmUY

A shorter BBC video about Tucker, the dog: www.youtube.com/watch?v=qrUOIYpYmUY

National Geographic has various resources devoted to orcas. This children's site has links, as well, to other marine mammals.

kids.nationalgeographic.com/animals/orca/#orca-jumping.jpg

Watch A Fall from Freedom: vimeo.com/140253614.

You should also be able to find online videos of the other movies about orca shows listed above.

The American Cetacean Society has a number of fact sheets for many whales, dolphins, and porpoises.

www.acsonline.org/fact-sheets

The National Oceanic and Atmospheric Administration (NOAA) site on marine mammals: www.noaa.gov/resource-collections/marine-mammals. They also have information on other animals in this region, including Chinook salmon. www.nmfs.noaa.gov/pr/species/fish/chinook-salmon.html

The Orca Scientists

BY KIM PEREZ VALICE, PHOTOGRAPHS BY ANDY COMINS AND THE CENTER FOR WHALE RESEARCH

The Marine Mammal Center in California has lots of information on orcas and other marine mammals. www.marinemammalcenter.org/education/marine-mammal-information

The Samish Indian Nation has a very interesting and useful website. www.samishtribe.nsn.us

The Burke Museum has several articles that tell the geologic history of the Pacific Northwest. www.burkemuseum.org/geo_history_wa/Dance%20of%20the%20Giant%20Continents.htm

Further Reading

In addition to the books listed in the bibliography on pages 74–75:

Hargrove, John, and Howard Chua-Eoan. *Beneath the Surface: Killer Whales, SeaWorld, and the Truth Beyond Blackfish*. New York: St. Martin's Griffin, 2016.

Miller, Debbie, S., and John H. Eiler. *A King Salmon Journey*. Fairbanks, AK: University of Alaska Press, 2014.

Neiwert, David. *Of Orcas and Men: What Killer Whales Can Teach Us*. New York: Overlook Press, 2016.

Guide created by:
Ed Spicer, curriculum consultant, retired educator,
and blogger at spicyreads.org. You can find him on
[@spicyreads](https://twitter.com/spicyreads).