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# Special Sections

There are five classes of special sections indicated with icons and colored bars throughout the text. They perform order of magnitude estimates, explore biological problems using computation, examine the experimental underpinnings of topics, and elaborate on mathematical details.



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# Map of the Maps

**Part 1:** Map of Alfred Russel Wallace's voyage with the black lines denoting Wallace's travel route and the red lines indicating chains of volcanoes. From *The Malay Archipelago* (1869) by Alfred Russel Wallace.

**Chapter 1:** Map of the world according to Eratosthenes (220 B.C.E.). Eratosthenes is known for, among many other things, his measurement of the circumference of the Earth, and is considered one of the founders of the subject of geography. From *Report on the Scientific Results of the Voyage of the H.M.S. Challenger During the Years 1872–76*, prepared under the superintendence of C. Wyville Thompson and John Murray (1895).

**Chapter 2:** Population density in Los Angeles County, as determined in the 2000 census. Darker colors represent denser populations (up to 100,000 people per square mile). From the United States Census Bureau.

**Chapter 3:** Sedimentary rock layers in the Grand Canyon. Geology and cross section by Peter J. Conley, artwork by Dick Beasley. From the United States National Park Service (1985).

**Chapter 4:** *Carta marina*, a map of Scandinavia, by Olaus Magnus. A translation of the Latin caption reads: *A Marine map and Description of the Northern Lands and of their Marvels, most carefully drawn up at Venice in the year 1539 through the generous assistance of the Most Honourable Lord Hieronymo Quirino*. This detail shows the sea monsters in the ocean between Norway and Iceland.

**Part 2:** Tourist map of Père Lachaise cemetery, Paris, France.

**Chapter 5:** Airplane routes around the nearly spherical Earth. Courtesy of OpenFlights.com.

**Chapter 6:** Josiah Willard Gibbs articulated the variational principle that shows how to find the equilibrium state of a system by maximizing the entropy. Gibbs spent his entire career in New Haven, Connecticut at Yale University. This 1886 map shows the university buildings during Gibbs' time. Source: Yale University Map Collection. Courtesy of the Yale University Map Collection.

**Chapter 7:** County map of Virginia and West Virginia, drawn by Samuel Augustus Mitchell Jr. in 1864, after the American Civil War.

**Chapter 8:** Aerial view of the hedge maze at Longleat Safari and Adventure Park, near Warminster, United Kingdom. Courtesy of Atlaspix/Alamy.

**Chapter 9:** Topographic map of the Great Salt Lake (Utah, United States) and surrounding region. From the United States Geological Survey (1970).

**Chapter 10:** Blueprint diagram of the Golden Gate Bridge, San Francisco, California, United States. Courtesy of EngineeringArtwork.com

**Chapter 11:** Digital elevation map of Mount Cotopaxi in the Andes Mountains, near Quito, Ecuador. Blue and green correspond to the lowest elevations in the image, while beige, orange, red, and white represent increasing elevations. Courtesy of the NASA Earth Observatory (2000).

**Part 3:** Migration tracks of the sooty shearwater, a small seabird, tracked with geolocating tags from two breeding colonies in New Zealand. Breeding season is shown in blue, northward migration in yellow, and wintering season and southward migration in orange. Over about 260 days, an individual animal travels about 64,000 km in a figure-8 pattern across the entire Pacific Ocean. From S. A. Shaffer et al., "Migratory shearwaters integrate oceanic resources across the Pacific Ocean in an endless summer," *Proceedings of the*

*National Academy of Sciences USA*, **103**: 12799–12802, 2006.

**Chapter 12:** Worldwide distribution of ocean currents (warm in red, cold in green). Arrows indicate the direction of drift; the number of strokes on the arrow shafts denote the magnitude of the drift per hour. Sea ice is shown in purple. Prepared by the American Geographical Society for the United States Department of State in 1943.

**Chapter 13:** Temperature map of the sun's corona, recorded by the Extreme Ultraviolet Imaging Telescope at the Solar and Heliospheric Observatory on June 21, 2001. Courtesy of ESA/NASA.

**Chapter 14:** John Snow's map of the 1854 cholera outbreak in the Soho neighborhood of London. By interviewing residents of the neighborhood where nearly 500 people died of cholera in a ten-day period, Snow found that nearly all of the deaths occurred in homes close to the water pump in Broad Street, which he hypothesized was the source of the epidemic. Reproduced from *On the Mode of Communication of Cholera*, 2<sup>nd</sup> Edition, John Snow (1855).

**Chapter 15:** Positron emission tomography (PET scan) map of a healthy human brain, showing the rate of glucose utilization in various parts of the right hemisphere. Warmer colors indicate faster glucose uptake. Courtesy of Alzheimer's Disease Education and Referral Center, a service of the National Institute on Aging (United States National Institutes of Health).

**Chapter 16:** High speed train routes of France, mapped as a transit diagram. Courtesy of Cameron Booth.

**Chapter 17:** Nile River delta at night, as photographed by the crew in Expedition 25 on the International Space Station on October 28, 2010. Courtesy of Image Science & Analysis Laboratory, Johnson Space Center, Earth Observatory, NASA/GSFC SeaWiFS Project.

**Chapter 18:** Single-celled photosynthetic organisms such as the coccolithophore *Emiliana huxleyi* can form gigantic oceanic blooms visible from space. In this April 1998 image, the Aleutian Islands and the state of Alaska are visible next to the Bering Sea that harbors the algal bloom. Courtesy of NASA/GSFC SeaWiFS Project.

**Part 4:** A map of the infant universe, revealed by seven years of data from the Wilkinson Microwave Anisotropy Probe (WMAP). The image reveals 13.7 billion year old temperature fluctuations (the range of  $\pm 200$  microKelvin is shown as color differences) that correspond to the seeds that grew to become the galaxies. Courtesy of NASA/WMAP Science Team.

**Chapter 19:** Map of the Internet, as of September, 1998, created by Bill Cheswick. *Courtesy of Lumeta Corporation* 2000–2011. Published in *Wired Magazine*, December 1998 (issue 6.12).

**Chapter 20:** The Sloan Great Wall measured by J. Richard Gott and Mario Juric shows a wall of galaxies spanning 1.37 billion light years. It stands in the Guinness Book of Records as the largest structure in the universe. Courtesy of Michael Blanton and the Sloan Digital Sky Survey Collaboration, [www.sdss.org](http://www.sdss.org).

**Chapter 21:** This map shows the patterns of human migration as inferred from modern geographical distributions of marker sequences in the Y chromosome (blue), indicating patrilineal inheritance, and in the mitochondrial DNA (orange), indicating matrilineal inheritance. Courtesy of National Geographic Maps, Atlas of the Human Journey.

**Chapter 22:** "The Lands Beyond" drawn by Jules Feiffer for the Phantom Tollbooth (1961) by Norton Juster. Courtesy of Knopf Books for Young Readers, a division of Random House, Inc.