



Illustrations for Health Assessment Techniques of the Atlantic Horseshoe Crab, *Limulus polyphemus*

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Abstract

Horseshoe crab blood cells detect extremely small amounts of bacteria allowing them to be used in medicine to test the sterilization of medical devices, vaccines, and implants. This is a worldwide standard test called Limulus Amebocyte Lysate. The National Aquarium in Baltimore, MD, has developed guidelines for health examinations that are aimed to improve health maintenance and conservation strategies for horseshoe crabs. Illustrations were created to accompany this specific literature to ensure the overall effectiveness of the material. A total of 28 color illustrations were created to help educate veterinarians and veterinarian technicians, aquarists, and biologists.

Introduction

The Atlantic horseshoe crab, *Limulus polyphemus*, is very important for conservation and medical research.

Conservation

- Eggs provide food for migratory birds
- Food source for fish, crustaceans, birds, marine reptiles (specifically the loggerhead turtle)

Research & Human Medicine

- Model organism
- Blood cells detect minute amounts of bacteria
- Sterility of drugs, vaccines, and medical devices
- Limulus amebocyte lysate (LAL) assay

With the increasing demands for LAL production, the overall population is declining. Veterinarians and researchers need to know how to properly examine the health of the horseshoe crab and monitor health to keep the species thriving.



Fig. 1: External anatomy showing dorsal and ventral views

Objectives

- Create accurate comprehensive anatomical illustrations
- Create an easy to follow, realistic necropsy series

Materials & Methods

Concept Development and Research Strategy:

- Meetings discussed project objectives, intended audience, and anticipated outcomes
- Literature review completed to gain sufficient knowledge of anatomy and physiology of horseshoe crabs
- Illustration outline created described all intended illustrations and it was approved by all content experts and faculty advisor
- Week-long study trip for continued learning and concentrated dissection to the Marine Biological Laboratory in Woods Hole, MA

Illustration Technique:

1. Thumbnail sketches were used to plan and organize initial ideas
2. Storyboards were then created to finalize layouts, text, and base art
3. Final sketches were created from direct observation and photographs of living and dissected specimens
4. All illustrations were created using multiple layers and masks in Photoshop

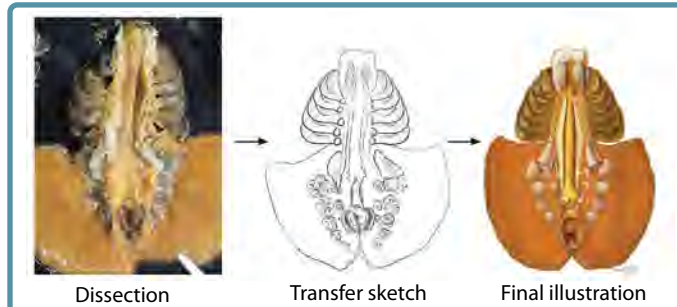


Fig. 2: Illustration Workflow: From dissection photograph to transfer sketch to final illustration

Results

A total of 28 detailed illustrations were created in the following subject matter:

- Internal and external anatomy
- Common disease states
- Anatomical sex comparison
- Inhabiting organisms
- Hemolymph extraction techniques
- Book gill anatomy
- Circulatory system diagram
- Necropsy technique guide

There has never been a standardized guideline for necropsy techniques on horseshoe crabs. The series created in this project describes the procedure in a comprehensive, anatomically faithful, and sequential manner. These illustrations will help create a better overall understanding of horseshoe crab anatomy and health leading to proper diagnosis of a disease, thus contributing to proper health maintenance and better conservation strategies.

Results (cont.)

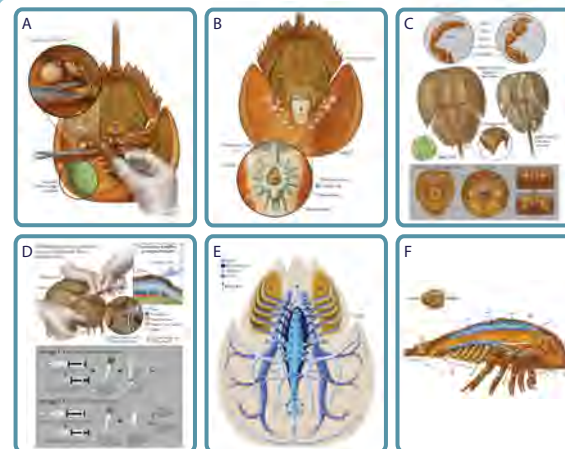


Fig. 3: Examples: A) Necropsy series, step 5; B) Necropsy series, step 8; C) Sex comparison; D) Hemolymph extraction technique; E) Blood circulation diagram; F) Cross section

Discussion & Conclusions

The main objective was to create illustrations to accompany guidelines created by the National Aquarium aimed to educate veterinarians, veterinarian technicians, aquarists, and biologists.

Expected benefits of these didactic illustrations are:

- Improved understanding of anatomy and health
- Reduced gaps in knowledge
- Properly performed health assessments and necropsies

By understanding normal biology of a horseshoe crab, proper diagnoses of an abnormality can occur, contributing to better conservation strategies and proper health maintenance.

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