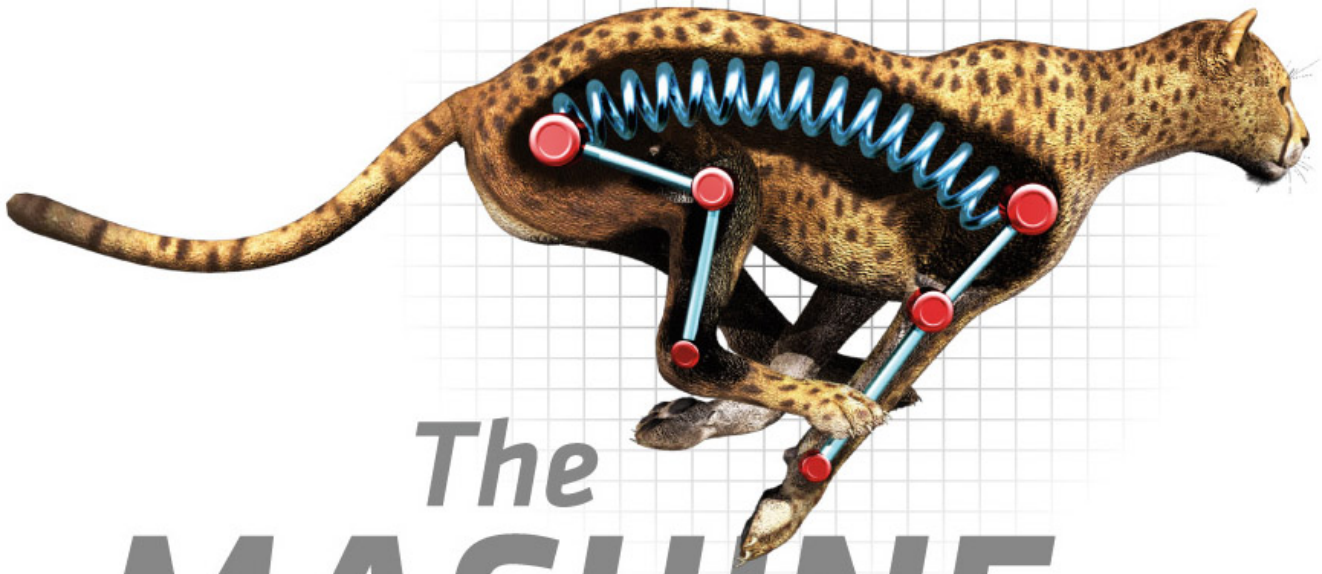

The MACHINE INSIDE

BIOMECHANICS

FIELD MUSEUM

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THE BIG IDEA

Biomechanics is a way of looking at living organisms: as machines built by evolution.

This exhibition takes visitors past the familiar surface of nature, and deep inside its remarkable workings. It's a story of survival, of using devices finely-tuned to every imaginable situation.

Visitors will be invited to observe, compare, role-play, and explore. In doing so, they will learn something that applies to far more than the subject at hand. Visitors will leave the exhibition with a different perspective on the world around them.

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WHY BIOMECHANICS?

RELEVANT.

- Timely topic and emerging, vibrant research area
- Strong alignment with Next Generation Science Standards and STEM learning goals

APPEALING.

- 70 museums (8 countries): Biomechanics ranked #1 of 8 topics
- 400 museum-goers (50% with children under 18): Ranked #2 of 11 topics
- 200 Field Museum visitors: 87% would make a special trip to see the exhibition

HOW WE TELL THE STORY

- To present cutting-edge science through compelling experiences: a consortium of scientists and museum partners
- To illustrate the great diversity of biological "designs":
  80 specimens and 12 replications and touchable models
- To reveal "how it works" and "how we know":
  7 large media elements, 13 live footage videos, and 3 digital interactives
- To put forces and features in the hands of visitors:
  7 mechanical interactives
- To demonstrate the power of nature to inspire scientists and designers:
  7 biomimicry innovations
- To immerse visitors: 7500 square feet of custom exhibitry, lighting design, and original sound

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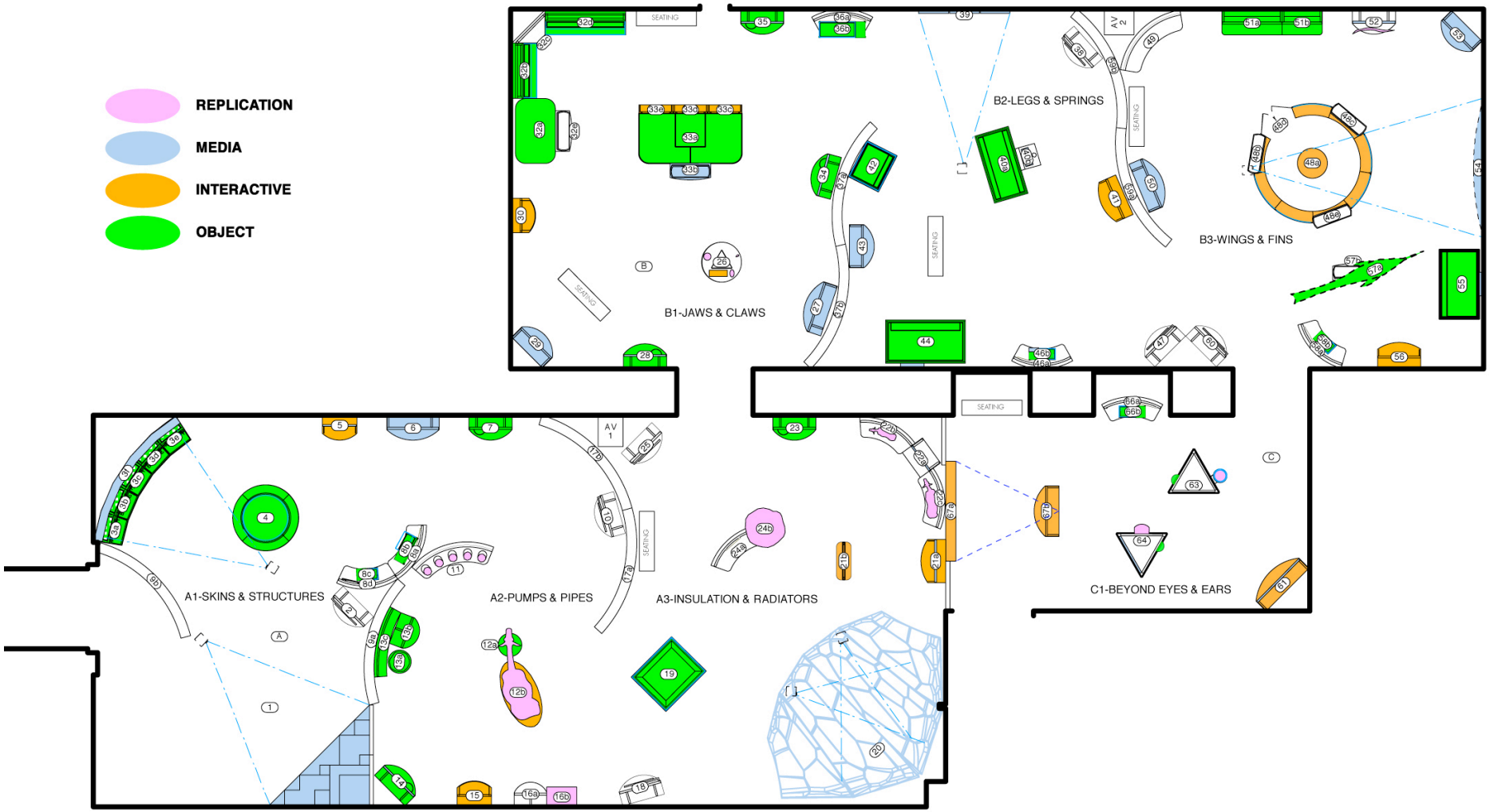
EXPERIENCE MAP

A rich variety of experiences are laid out in a thoughtful pacing and designed for modularity.



DESIGNERS' STATEMENT

The exhibition design is inspired by the science of biomechanics. The visual quality of the high-tech imagery that scientists use is luminescent and vibrant. It translates into display elements that are metallic, reflective, and colorful, and that express the combination of the mechanical and the organic. As the visitor moves through the space they feel a sense of unfolding and revealing. Gallery sections are softly delineated through translucent scrim walls that allow filtered vistas into adjoining spaces, creating anticipation and wonder. Colorful lighting and large video projections activate spaces.

GRAPHICS STRATEGY:

- Embedded 3D lenticular images and videos create movement
- Strong text hierarchy makes content easily accessible
- Original illustrations paired with specimens offer close examination
- Bilingual layout and flexible graphics system increases access
- Unique color palette for each section orients visitors and creates dynamic path

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MAIN CONTENT MESSAGES

Amputees have new levels of mobility with carbon prosthetic limbs inspired by the natural design of the Achilles tendon.

- All living things respond to the forces of the physical world.
- Evolution is Earth's greatest tinkerer.
- Scientists reveal how biological designs really work.
- Nature's ingenuity inspires.

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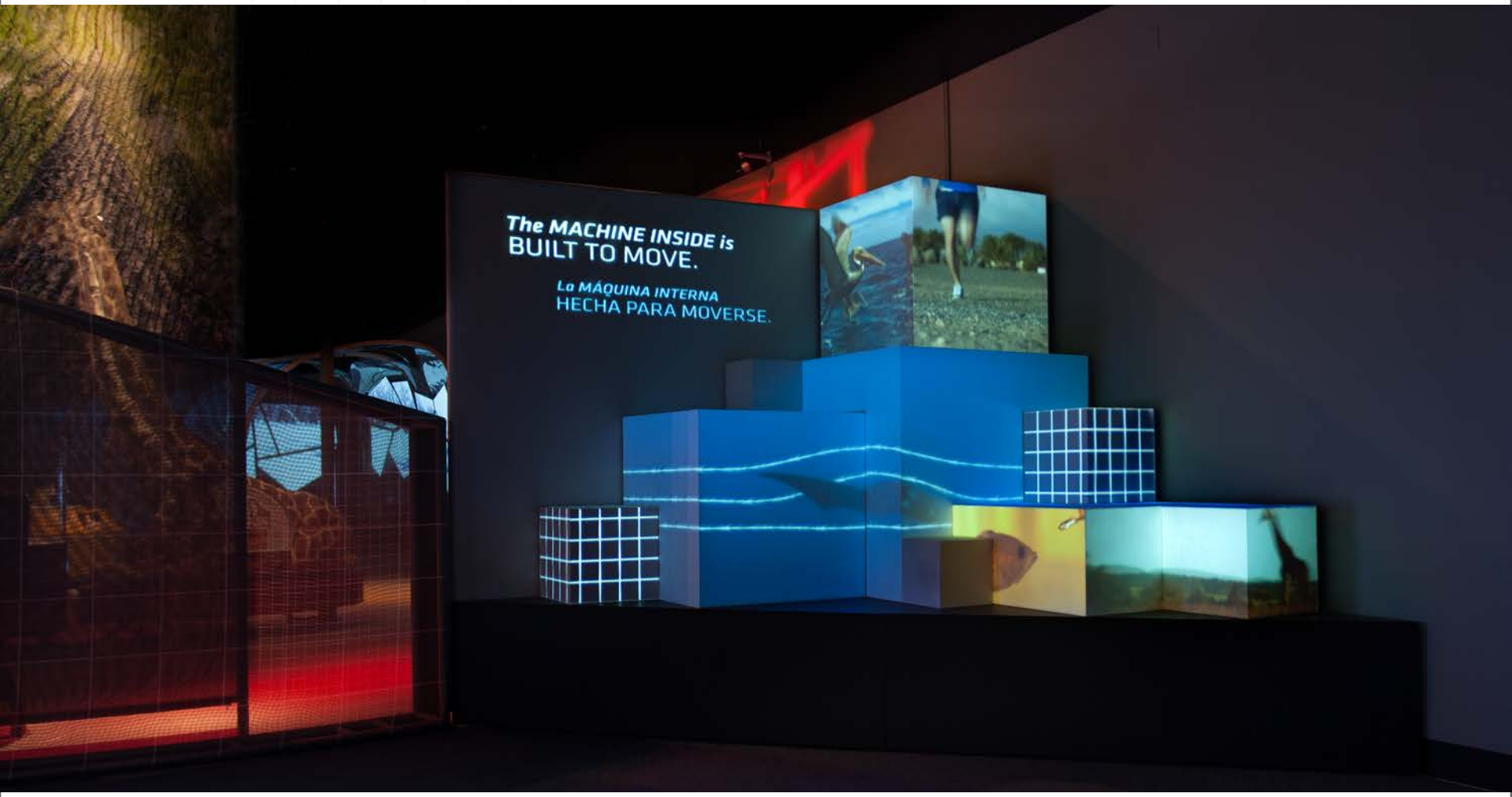
FLOORPLAN

The exhibition narrative moves outward from an organism's inner workings to the way it moves and experiences the world.

INTRODUCTION



Introductory Projection: A looping video program mapped onto a series of interlocking, large cubes introduces the themes of the exhibition. Using minimal text, vivid video, animation, and an accompanying soundscape, this installation helps visitors anticipate the broad reaching scope of the exhibition.

STAYING IN ONE PIECE:
STRUCTURES AND MATERIALS

A woodpecker's unique skull allows it to peck wood at a rate of 20 pecks per second, without injuring its brain.

SECTION THEME:

How do plants and animals manage to stay in one piece in a world where the crushing force of gravity, the pressure of water and wind, and the blows of other creatures are all working to tear them apart?

SECTION CONTENTS:

Large Media Experience:
There are many high-stake forces in the world (ie. collision with other animals). The projection includes live-action video of organisms compressing, bending, pulling, deforming, and/or shearing.

Digital Interactive:
Strength in one material property (ie. compressibility) involves a tradeoff in another (ie. bendability). Visitors will model organisms and explore these tradeoffs on a large touchscreen.

Replications and Models:
- Human kneecap

Nonnarrative Video:
Leaves twisting in wind

Specimens:
- Array of natural materials including hemp, spider web, lobed cactus coral
- Array of dome-shaped organisms, including skulls and a trilobite

Biomimicry Displays:
- Resilin (protein) and spinal disc replacements
- Burrs and Velcro

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STAYING IN ONE PIECE:
STRUCTURES AND MATERIALS

IN THIS IMAGE: “Forces” projection, object array cases, custom gobo design (included), “Materials” digital interactive.

GOING WITH THE FLOW:
PUMPS AND PIPES

A redwood tree pumps 160 gallons of water to a height of 250 feet—silently, using no electricity, and without breaking a sweat.

SECTION THEME:

Inside every living thing, fluids like blood circulate with a precise pressure, speed, and volume in order to sustain life. How—without metal, motors, or electricity—do they manage to drain, pressurize, push, and recirculate these vital fluids?

SECTION CONTENTS:

Mechanical Interactives:

- Feel the pressure and effort required to pump blood to the top of a giraffe's head. Raising fluid a great height requires high pressure, so a giraffe has blood pressure much higher than a human. Relate blood pressure to literal fluid pressure.
- Spiders force fluid into their legs to extend them, rather than use muscles. Feel the fluid pressure change as the limbs extend and then curl up.

Nonnarrative Video:

Breathing beetles

Specimens:

- Fossil insects in amber
- Giraffe heart (wet specimen)
- Cross section of a tree stump

Replications and Models:

- Hearts: human, fish, turtle, frog, eagle
- Full-scale giraffe
- Australian worm (diorama)

FIELD MUSEUM

GOING WITH THE FLOW:
PUMPS AND PIPES

IN THIS IMAGE: Custom light gobo, giraffe model (heart-pumping interactive on backside), worm diorama, tree circulation, hearts array.

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SURVIVING THE ELEMENTS:
INSULATION AND RADIATORS

Blood vessels on the surface of the Fennec fox's outsized ears release heat, saving it from heat stroke in the searing Sahara Desert.

SECTION THEME:

Life on earth must endure the planet's extreme temperatures. What strategies and mechanisms do plants and animals use to keep warm in icy seas—or keep their cool in broiling deserts?

SECTION CONTENTS:

Large Media Experiences:
Heat is always moving, so living things need a strategy for managing it. In this immersive theater, visitors will watch multiple projections (animated and live action film) and "feel" hot or cold to empathize with the starring organisms.

Specimens:
- Array of animal "radiators" such as a regal horned lizard
- Alpine butterfly

Replications and Models:
- Deer (large and small)
- Termite mound

Digital Interactives:
Under a heat sensor camera, visitors can see how insulated areas emit less heat.

Biomimicry Display:
Termite mounds and passive design in architecture.

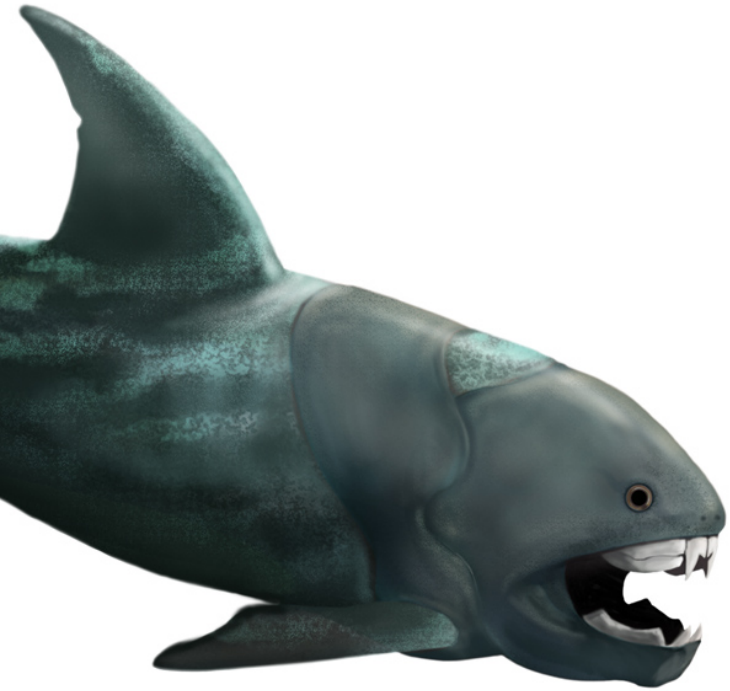
FIELD MUSEUM

SURVIVING THE ELEMENTS:

INSULATION AND RADIATORS

IN THIS IMAGE: Biomimicry of termite mounds, display case of nature's radiators, "heat" theater, "Insulation" digital interactive

GRABBING A BITE:
JAWS AND CLAWS



Dunkleosteus stalked the seas 380 million years ago and had a bite force of 8,000 pounds per square inch. (Ours is around 290 pounds per square inch.)

SECTION THEME:

Everything has to eat. But food can be scarce and competition, fierce. How do animals use their inner machines—their muscles, levers and linkages to grab on and take a bite?

SECTION CONTENTS:

Mechanical Interactives:

- Compare your grip to that of a chimp using a dynamometer.
- Moving a skeleton with muscles involves levers. Test the change in power when you modify where muscles attach.
- Linkages transmit force from one place to another. Tinker with those in fish jaws to create different "bites".

Narrative Video:
How Muscles Work

Nonnarrative Videos:

- Sling-jaw wrasse feeding
- Trap-jaw ants feeding

Specimens:

- Squid tentacle
- Sling-jaw wrasse
- Trap-jaw ants
- Skulls of fast biters (ie. wood stork) and hard biters (ie. *T. rex* cast)

Biomimicry Display:
Timber beetle jaws and chainsaw

Manmade Innovation:
Dunkleosteus metal sculpture

Replications and Models:
Hands and claws for grip display (ie. chimp, stone crab, harpy eagle)

FIELD MUSEUM

GRABBING A BITE:
JAWS AND CLAWS

Designer's Rendering

IN THIS IMAGE: "Hard" and "Fast" biters case, "Muscles" video, *Dunkleosteus* model, fish jaws interactives, grip force interactive.

FIELD MUSEUM

CROSSING THE LANDSCAPE:
LEGS AND SPRINGS

Why is the cheetah the fastest land animal? The aerodynamic snout, the long, skinny tail for balance, claws that never retract provide extra traction, and a spine that curls under for extra reach.

SECTION THEME:

Whether you are an ant or an antelope, the world is a big place: how do living things overcome the forces that hold them in place in order to crawl or gallop across earth's surface?

SECTION CONTENTS:

Large Media Experience:
Animals have myriad ways of moving on land. In this projection, visitors will see a panoramic motion of creatures, comparing their gaits and footfall patterns.

Biomimicry Display:
Cheetahs and prosthetic legs

Narrative Videos:
- Being Big on Land
- Human Locomotion

Nonnarrative Videos:
- Prosthetic leg in action
- The world's fastest animal: the cheetah
- Walking robots

Manmade Innovations:
- 2 legged robots
- Prosthetic leg

Specimens:
- Cheetah taxidermy
- Skeletons to show sprawl stature: cat, iguana, salamander

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CROSSING THE LANDSCAPE:
LEGS AND SPRINGS

IN THIS IMAGE: “Gaits” projection, sprawling array case, cheetah case and research video.

LAUNCHING INTO THE BLUE:
WINGS AND FINS

Fish larvae swimming through ocean water feel the resistance that humans would if we were to front crawl through honey.

SECTION THEME:

Only a small fraction of the earth is dry land. Over millions of years living things have adapted to the dizzying heights of the open skies and the crushing pressure of the deepest seas. How do creatures manage to propel themselves through air and water? How did flight evolve?

SECTION CONTENTS:

Mechanical Interactives:

- Scale matters when swimming. See how size and viscosity relate by manipulating tubes with fluid and objects representing different animals.
- What's it like to fly with short or long wings? Visitors flap different wings, causing rotation at varying speeds.

Large Media Experience:
A projection with footage of various animals swimming and flying provides a moving backdrop.

Specimens:
Array of short and long bird wings.

Narrative Videos:

- Fish Fin Patterns and Swimming
- Humans and Flight

Nonnarrative Videos:

- "Clap and fling" technique in insects
- Flying snakes

Biomimicry Display:
Whale fins and turbine blade

Manmade Innovations:

- 2 swimming robots
- Flying robot
- Model turbine blade

Replications and Models:
Flying snake and Marlin

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LAUNCHING INTO THE BLUE:
WINGS AND FINS

IN THIS IMAGE: Flight interactive, atmospheric projection, legged robots case, video on humans and flight, flying snake object display

FIELD MUSEUM

GATHERING INTELLIGENCE:
EYES, EARS, AND BEYOND

Sharks—thanks to electricity-conducting salt water—can sense the twitching muscles of prey hundreds of meters away.

SECTION THEME:

Eyes are among evolution's most elegant gadgets. Look into how yours are an engineering marvel and then go beyond the five familiar senses to explore "seeing" devices that need no light: brain tissue that detects Earth's magnetic field and antennae that smell.

SECTION CONTENTS:

Nonnarrative Video:
The manakin's "buzzing" wings

Digital Interactive:
Eyes Array: The eye has evolved multiple independent times, with different mechanical configurations. In this large multitouch screen, visitors will be awed by the complexity of eyes as they explore beautiful eye imagery and their inner workings.

Specimens:
- Northern Saw-whet Owl
- Luna moth

Replications and Models
- Venus fly trap
- Sea turtles

Manmade Innovation:
Bat cane

Biomimicry Display:
Bat echolocation and the "bat" cane for the blind

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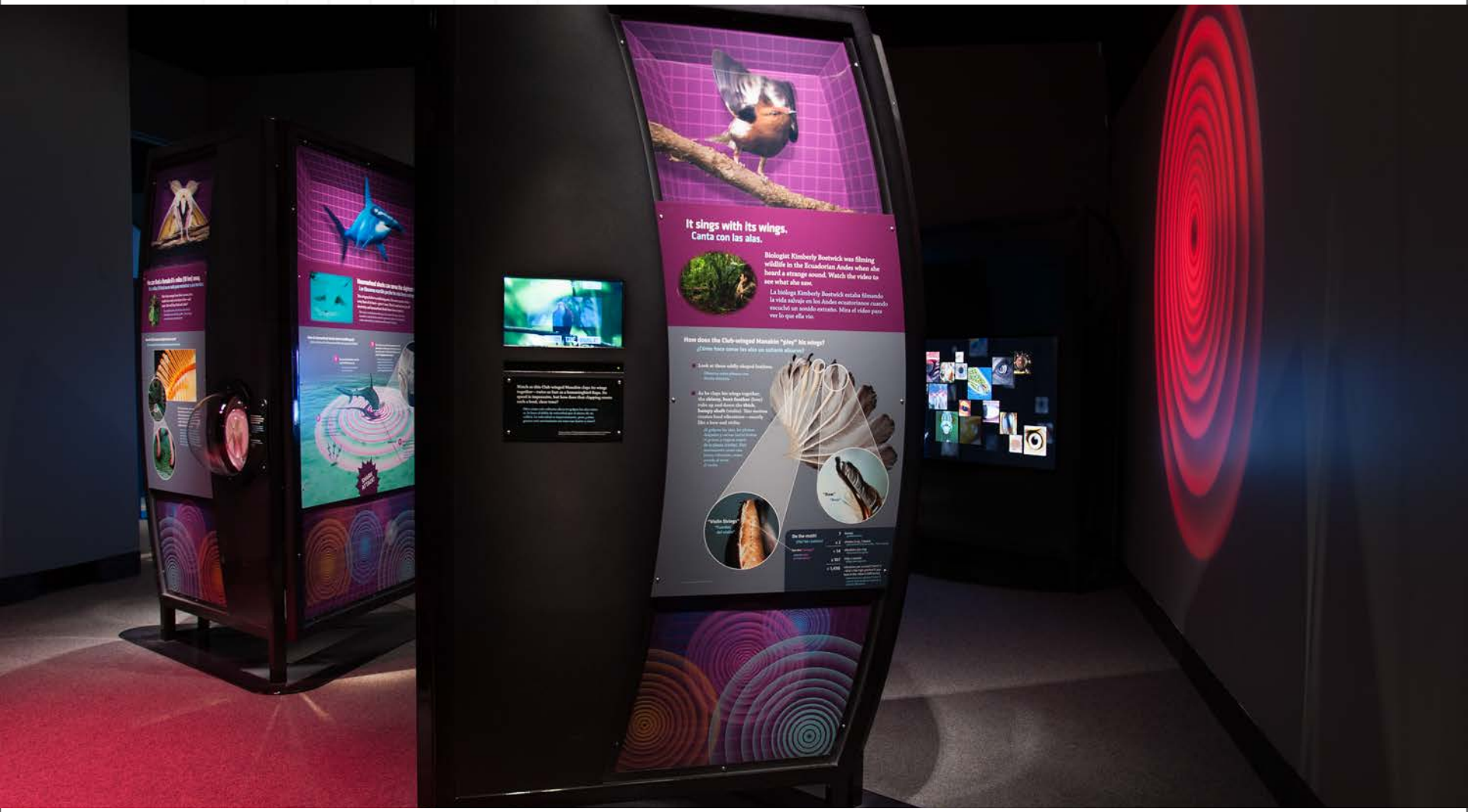
GATHERING INTELLIGENCE:
EYES, EARS, AND BEYOND



IN THIS IMAGE: Eye digital interactive, Manakin object display, animal senses displays.

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TOUR SCHEDULE

March 15, 2014-January 4, 2015	The Field Museum, Chicago
June 6-September 7, 2015	Perot Museum of Nature & Science, Dallas
January 30-April 24, 2016	Museum of Science, Boston
October 8, 2016-January 1, 2017	San Diego Museum of Natural History
February 4-May 7, 2017	Ontario Science Centre, Toronto
June 8, 2017-January 7, 2018	Denver Museum of Nature & Science
February 12-September 3, 2018	Natural History Museum of Utah
September 29, 2018-April 20, 2019	Cleveland Museum of Natural History