THE FRANKLIN INSTITUTE

YOUR BRAIN

K-12 EDUCATOR'S GUIDE

YOUR BRAIN IS ALWAYS CHANGING.

Find out how and why as you explore the exhibit.

How does the human brain make sense of the world?

Why is it so hard for scientists to understand how the brain works?

How will society change as science advances?

The *Your Brain* exhibit invites you and your students to consider these questions as you discover what's happening inside your head.

During your visit, students will:

- Discover foundational brain science concepts.
- Interact with devices and displays that are designed to change their brains as they learn.

After your visit, students will:

- Think about how the human brain makes sense of the world.
- Understand that science still have much to discover about how the human brain works.

Quick Tips

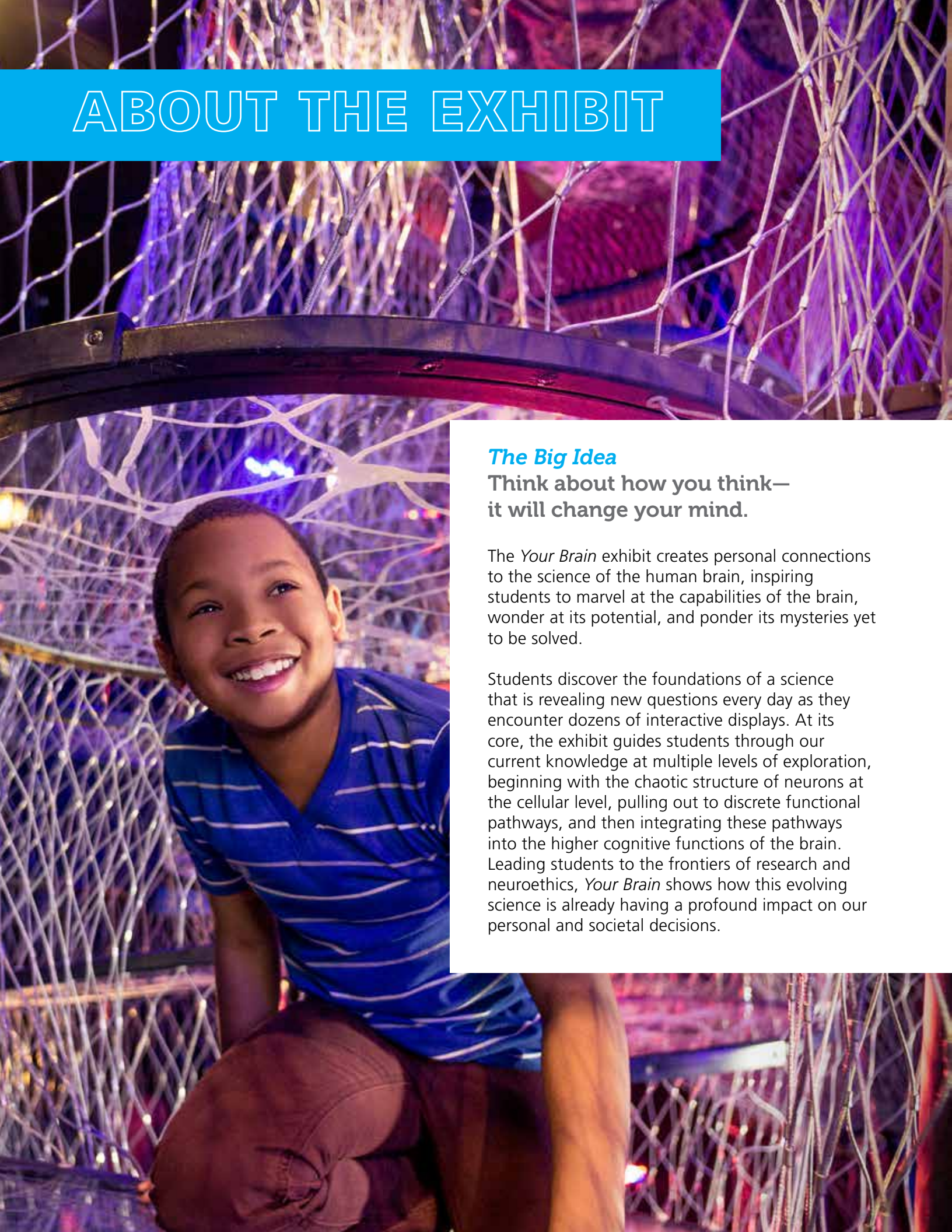
- The exhibit is located in the Frank Baldino, Jr. Gallery on the main level of the Nicholas and Athena Karabots Pavilion. Enter the exhibit via Wisdom Hall which is alongside the Benjamin Franklin National Memorial and also accessible from the main Bartol Atrium.

- On average, most groups will spend about 60 minutes in the exhibit, if carefully examining all of the displays. Restrooms are located near the exhibit entrance in Wisdom Hall. There are no restrooms inside the exhibit.

- No food or beverages are allowed in any of the exhibit galleries.

- Running through the exhibit is not allowed. Designate a meeting location within the exhibit when you arrive in case someone gets separated. Please do not congregate at the entrance/exit, however, so as to enable other guests to enter and exit easily.

ABOUT THE EXHIBIT



The Big Idea

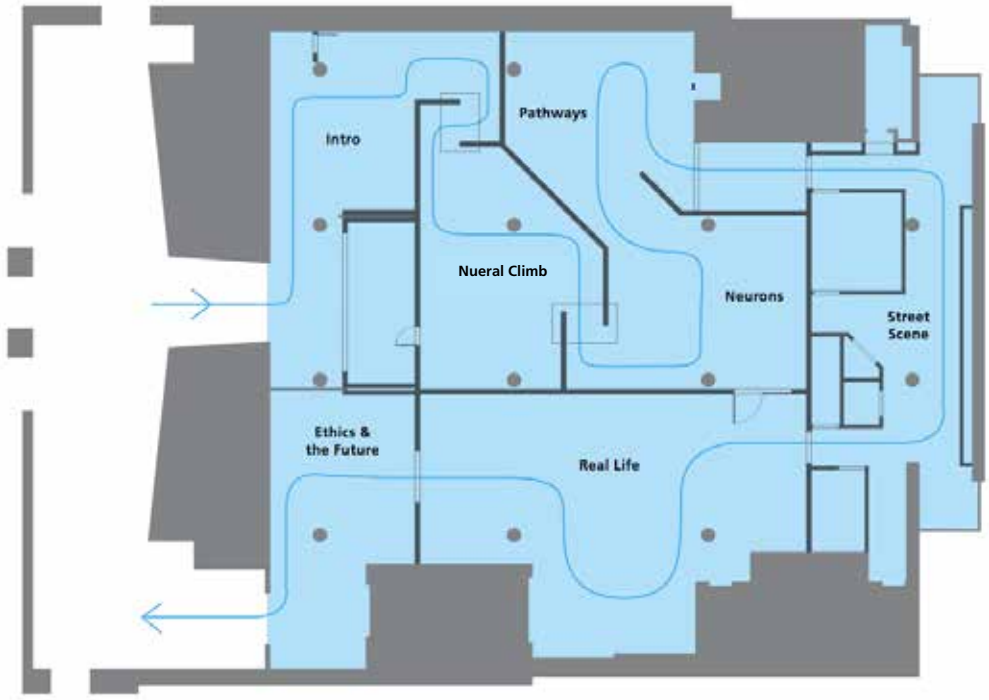
Think about how you think—it will change your mind.

The *Your Brain* exhibit creates personal connections to the science of the human brain, inspiring students to marvel at the capabilities of the brain, wonder at its potential, and ponder its mysteries yet to be solved.

Students discover the foundations of a science that is revealing new questions every day as they encounter dozens of interactive displays. At its core, the exhibit guides students through our current knowledge at multiple levels of exploration, beginning with the chaotic structure of neurons at the cellular level, pulling out to discrete functional pathways, and then integrating these pathways into the higher cognitive functions of the brain. Leading students to the frontiers of research and neuroethics, *Your Brain* shows how this evolving science is already having a profound impact on our personal and societal decisions.

EXHIBIT OVERVIEW

The *Your Brain* exhibit is organized into six areas: Introduction, Neurons, Pathways, Street Scene, Real Life, and Ethics & Future. Each area builds on concepts presented in the previous area. In general, the intent is that you and your students will follow the path through the exhibit from the Introduction area through to the end. It is not impossible to reverse course, but the experience is stronger if you follow the intended pathway.



Introduction

The key message for the introductory section of the exhibit is that your brain creates your world. The experiences and devices in this area provoke curiosity as students begin to think about thinking.

HIGHLIGHTS

- Visualize your central nervous system.
- See a plastinated human brain.
- Feel a simulation of a real human brain.
- Look at brain scan images, including functional MRIs.
- Learn about neurons signaling.

EXHIBIT OVERVIEW

Neural Climb

The Neural Climb is a distinct experience that is also the transition space from the Introduction area into the Neurons area. Your students leave the brightly lit entry experience and move into a large darkened room as they now go "inside" the brain to learn about its structure and function. The Neural Climb is a full-body, immersive experience that invites students to become part of the complex swarm of signaling that happens within the neural network. It features an 18-foot-tall web of dynamic lighting and sound effects with climbing platforms. As students climb on the structure or walk on the panels in the floor, lights shoot off into the network creating a dynamic and beautiful representation of neural communication. In the same way that a walk through the Giant Heart has become a field-trip tradition for many educators, we hope that a climb through the Neural Climb becomes another field-trip tradition.

Neurons

Understanding neurons is essential to understanding brain science. This area invites students to spend time exploring this fundamental concept.

HIGHLIGHTS

- Connect axon terminals to dendrites and create a digital neuron network.
- Fire a model neuron and release neurotransmitters.
- Test your own neural network's speed.
- Look at a collage of images and video of brain visualizations. Compare techniques and see which are most effective.
- Learn how much (and how little) scientists now know about functional areas of the brain.

EXHIBIT OVERVIEW

Pathways

Students explore the different brain pathways that are currently understood, especially the vision, touch, and fear pathways.

HIGHLIGHTS

- Notice the amazing sculpture (which was produced using a 3D printer) which visualizes a diffusion MRI scan which shows connected pathways.
- Test your visual pathway and then try to confuse it.
- Make a face and see how the human brain seeks faces in everyday scenes.
- Test your touch sensitivity and then try to confuse your touch pathway.
- Make your homunculus—an image that represents your body parts based on how much brain activity control them.
- Test your fear pathway and then try to confuse it.

Street Scene

This simulated block of a busy neighborhood invites students to make sense of their world, even while that world is trying to confuse them with a series of optical illusions.

HIGHLIGHTS

- Look at optical illusions that make you see the same thing in different ways.
- Turn shapes into words as you try to make sense of negative space.
- Turn off different perceptions and see how the brain adjusts.
- See what happens when everything in a room is just slightly tilted.
- Turn your world upside down. (Note: This experience is limited to four people at a time.)

EXHIBIT OVERVIEW

Real Life

Every day, your brain is always changing as it makes sense of the world around you. Explore how real life is constructed by your brain.

HIGHLIGHTS

- Challenge your expectations as your brain encounters unexpected feedback.
- Test your auditory processing as you attempt to locate a moving sound.
- Prove once and for all that multitasking is a myth—your brain actually switches from one task to another.
- Focus on counting and discover that your brain overlooked extraneous information in order to achieve the task at hand.
- Test your short-term memory—how many numbers can you remember?
- Test your auditory processing and hear how your brain can sometimes make sense of gibberish.
- Read body language and see how your brain can be the best lie detector.

Ethics & Future

Students are invited to pause and reflect on what they've learned and consider what they still want to know.

HIGHLIGHTS

- Join a conversation about ethical challenges related to brain science including "smart pills," memory modification, and brain reading.
- Hear some of the big questions that are still waiting to be answered.
- Tell us what you want to know about your brain.

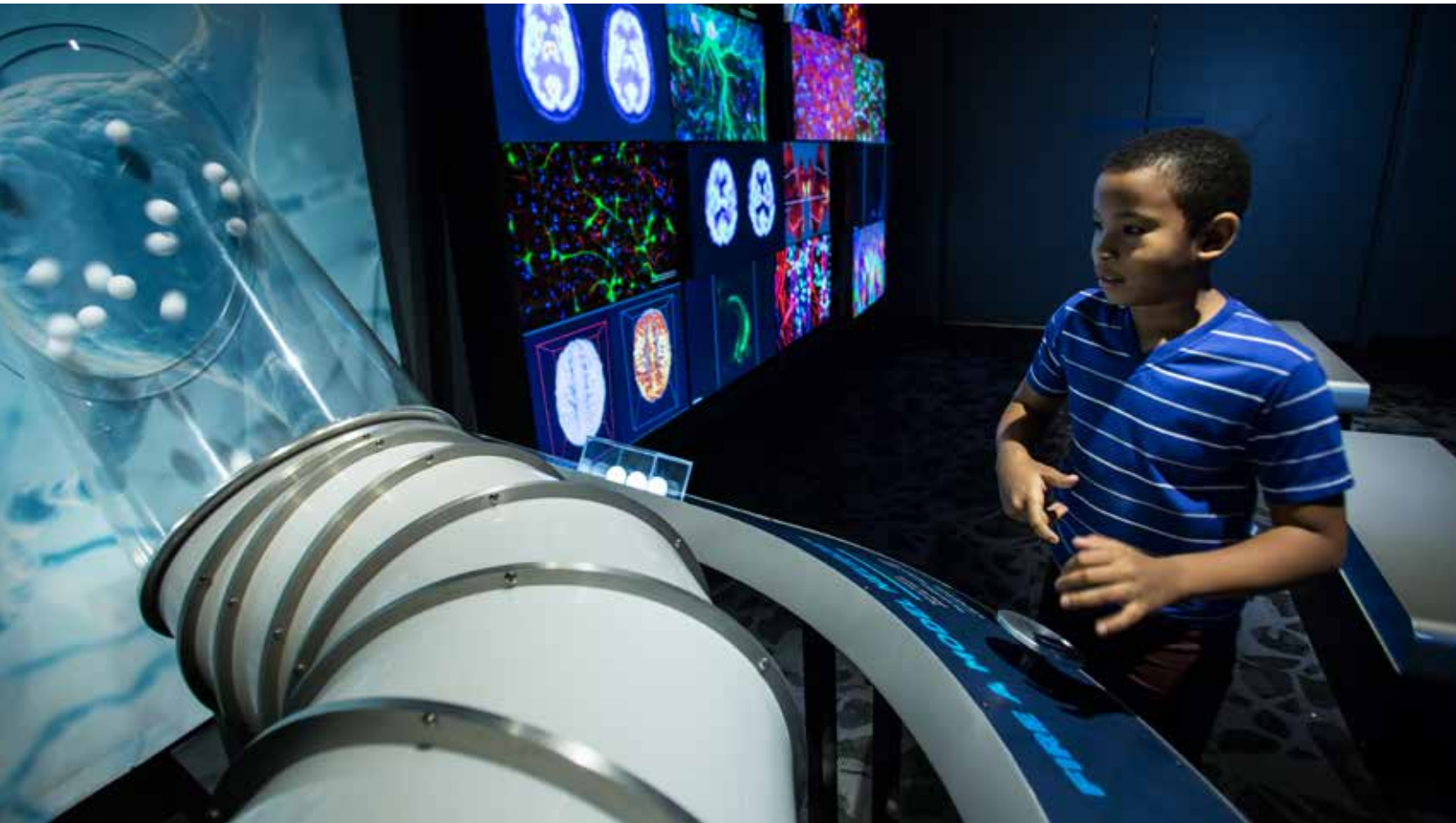
TRY THIS!

Brainstorming

Before your field-trip, ask your students to do some brainstorming.

- Post chart paper or designate an area of the board that won't need to be erased.
- Invite students to list all of the body functions that the brain controls.
- Possible answers include breathing, thinking, walking, talking, remembering, seeing, feeling, hearing, etc.
- When you return to your classroom after your field-trip, ask your students to reflect on the list. **Do they have anything else to add to the list now?**

The brain controls just about every body function. The brain processes so much information at once that if you were aware of every single little detail that the brain processed you would go into an information overload. You may think you have a lot of control over your body, but really your brain does a lot without you realizing it. Imagine if you constantly had to remind yourself to breathe! But you don't have to do that because the brain stem takes care of that for you. The brain is the most important and one of the most complex organs in the body and it is not even completely understood yet. It's pretty amazing that an organ weighing about three pounds controls everything that goes on in the body.



TRY THIS!

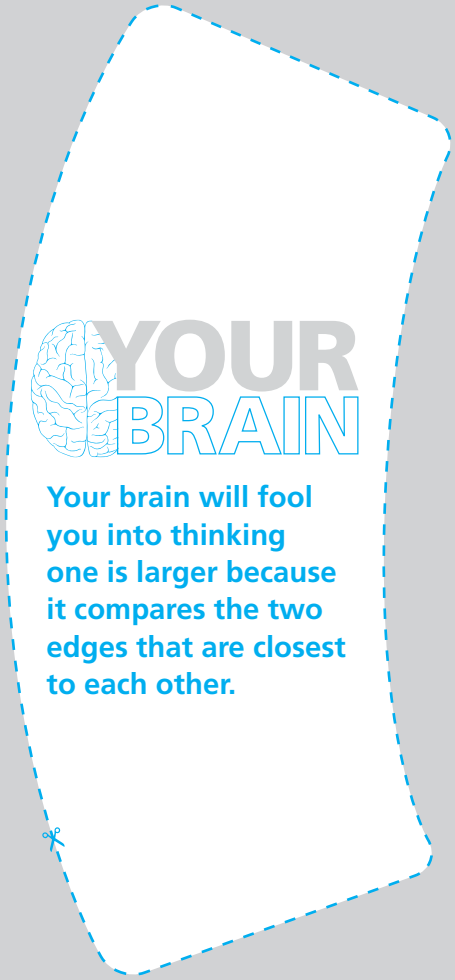
Brain Teaser

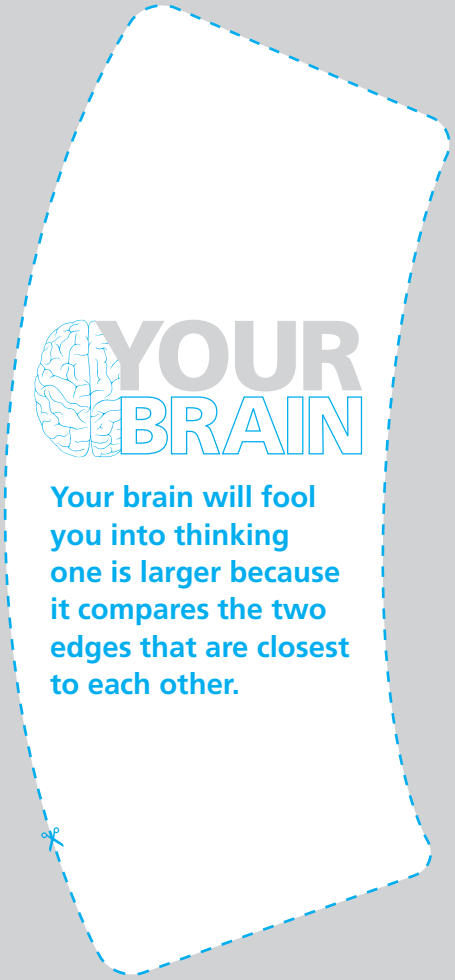
Cut out these two identical shapes.

After cutting them, stack them to prove they are the same size.

Place them side by side on a flat surface. Which one is bigger?

Take them home and fool your friends and family! Show them side by side on a table before stacking them to prove they are the same.

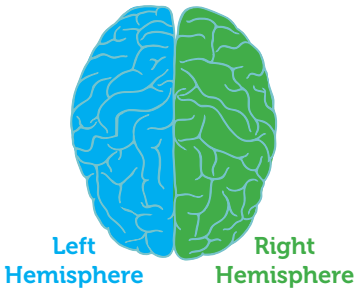


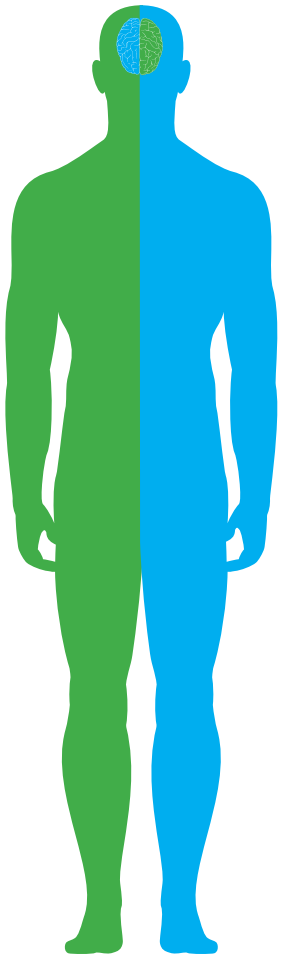


TRY THIS!

Mixed Signals

The brain's right hemisphere controls the left side of the body. The left hemisphere controls the right side of the body. Signals from the brain cross to the opposite side of the body on their way to and from the brain.





Certain tasks can be difficult at first as the brain processes the conflicting signals.

Try to pat your head and rub your stomach at the same time.

Why is this difficult? It's because your brain is trying to do two different activities with both halves of the brain at the same time. This may cause some mixed messages. Why is this hard at first? Why does it get easier? Practice really does make perfect as your brain quickly rewires itself for a new skill!

1. **Cross your arms, outstretched, with palms facing each other.**
2. **Clasp your hands together with fingers intertwined.**
3. **Bend your elbows and bring your clasped hands inward and up.**
4. **Ask a partner to point to, but not touch, one of your fingers.**
5. **Try to wiggle that finger.**

It's important that someone else decides which finger to wiggle for you. It's easier if you select your own finger, although still more difficult than you might expect!

RESOURCES & STANDARDS

Your Brain

Suggested Resources for K-12 Classrooms and Libraries

ELEMENTARY SCHOOL

Dr. Frankenstein's Human Body Book by Richard Walker ISBN 0756640911

Eyes and Ears by Seymour Simon ISBN 0060733020

My Bodyworks by Jane Schoenberg ISBN 1566565839

The Brain by Seymour Simon ISBN 0060877197

MIDDLE SCHOOL

All About Sleep from A to Zzzz by Elaine Scott ISBN 0670061883

Phineas Gage: A Gruesome but True Story about Brain Science by John Fleischman ISBN 0618494782

The Complete Human Body by Alice Roberts ISBN 075666733X

The Great Brain Book by HP Newquist ISBN 0439458951

HIGH SCHOOL

Medical Ethics: Life and Death Issues by Karen Judson ISBN 0766015858

The Human Brain Book by Rita Carter ISBN 0756654416

RECOMMENDED WEBSITES

BioInteractive at Howard Hughes Medical Institute
Select "Brain" on the topic list
www.hhmi.org/biointeractive

NIH Curriculum Supplements for K-12 Teachers
science.education.nih.gov

Resources for Educators at The Dana Foundation
www.dana.org/educators

Curricular Standards

An exploration of the *Your Brain* exhibit can help students achieve learning objectives as called for by the national standards.

NEXT GENERATION SCIENCE STANDARDS

1: Structure, Function, & Information Processing
3: Inheritance and Variation of Traits: Life Cycles and Traits
4: Structure, Function, & Information Processing
MS: Structure, Function, & Information Processing
HS: Structure & Function

NATIONAL SCIENCE EDUCATION STANDARDS

K-4 C: Life Science
5-8 C: Life Science
9-12 C: Life Science
9-12 F: Science in Personal & Social Perspectives

BENCHMARKS FOR SCIENCE LITERACY

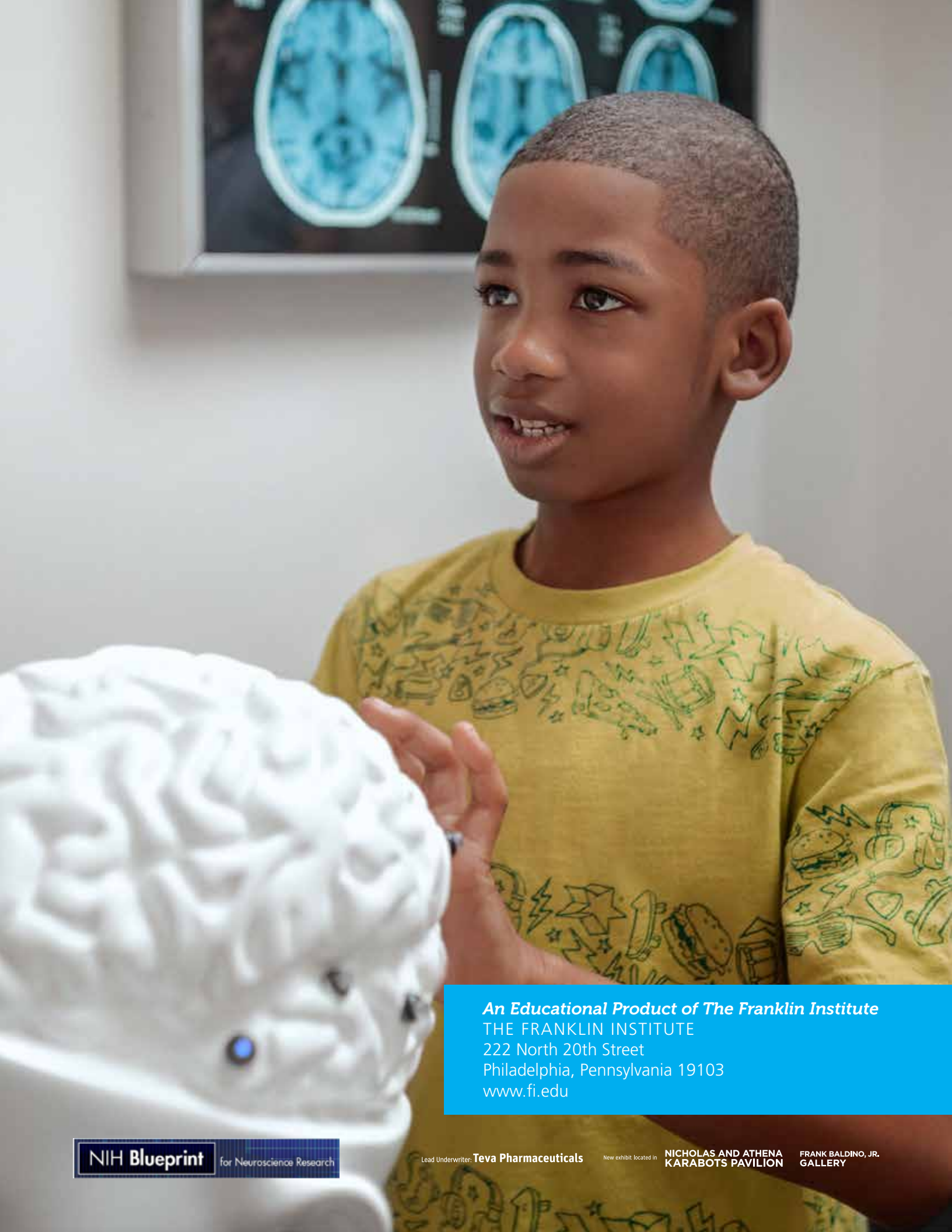
6. The Human Organism
6a. Human Identity
6b. Human Development
6c. Basic Functions
6d. Learning

COMMON CORE ENGLISH LANGUAGE ARTS

K-5: Reading Informational Text
6-12: Literacy in Science & Technical Subjects

COMMON CORE MATHEMATICS

K-12: Measurement & Data



An Educational Product of The Franklin Institute

THE FRANKLIN INSTITUTE
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NIH Blueprint for Neuroscience Research

Lead Underwriter: **Teva Pharmaceuticals**

New exhibit located in **NICHOLAS AND ATHENA KARABOTS PAVILION** **FRANK BALDINO, JR. GALLERY**