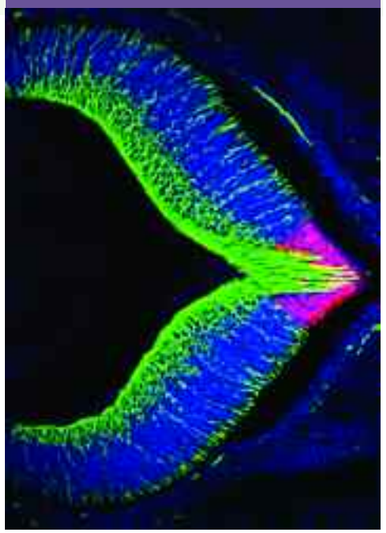
an artistic perspective on life

A



B

Life not only imitates art ... sometimes life *is* art. A collection of images produced by members of the U-M Center for Organogenesis, created using light and electron microscopes, shows the abstract and artistically captivating side of incredibly tiny biological elements. While mouse skin, a zebrafish retina, a marine flatworm ovary and the muscles of a snake may not sound like classic photographic subjects, the 50 images, 11 of which are shown here, demonstrate the beauty of microscopic photographic art.

"People aren't used to looking at biological specimens as art, but they have natural symmetries — the same things you'd see in a nature photograph," says Deborah Gumucio, Ph.D., professor of cell and developmental biology, co-director of the Center for Organogenesis, and one of the organizers of the project. "Every time scientists take a picture under the microscope … we think about image composition, balancing the field, and color," Gumucio adds. "These photographs have tremendous depth. When you put that together with the underlying biology, it takes on yet another dimension." Gumucio's colleagues on the project are K. Sue O'Shea, Ph.D., professor of cell and developmental biology; Kim-Chew Lim, research assistant professor of cell and developmental biology; and Rebecca Pintar, administrative specialist in the Center for Organogenesis. The scientists-turned-artists responsible for the images include graduate and undergraduate students, professors, staff members and house officers.

The photographs are being sold to raise funds for graduate and postgraduate training and were first made available for purchase to the public via a booth at the 2005 Ann Arbor Street Art Fair. They will also be on display in the soon-to-be-completed Biomedical Science Research Building and in the Life Sciences Institute. For information on purchasing images from the collection, e-mail bioartography@umich.edu, or visit www.bioartography.com.

—MF

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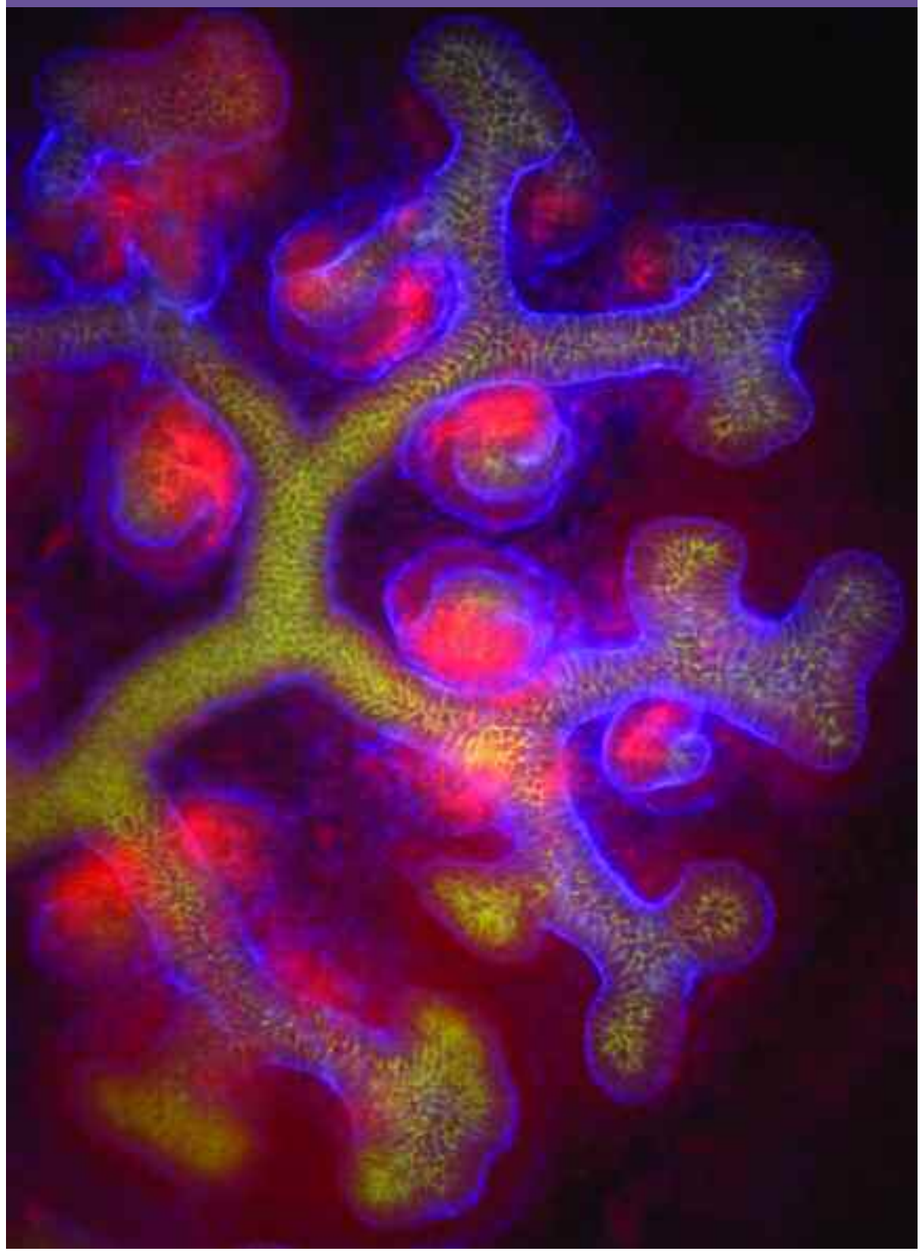


A **Seeing the Point** *(Amanda Evans, graduate student, Cell and Developmental Biology)*

This section of a developing mouse eye shows the retina (blue); the individual extensions (axons) from the retinal neurons that connect the eye to the brain (green), and the future optic nerve region (red). Mouse models like this one are used to study glaucoma, a common eye disease that can be caused by death of neurons in the retina.

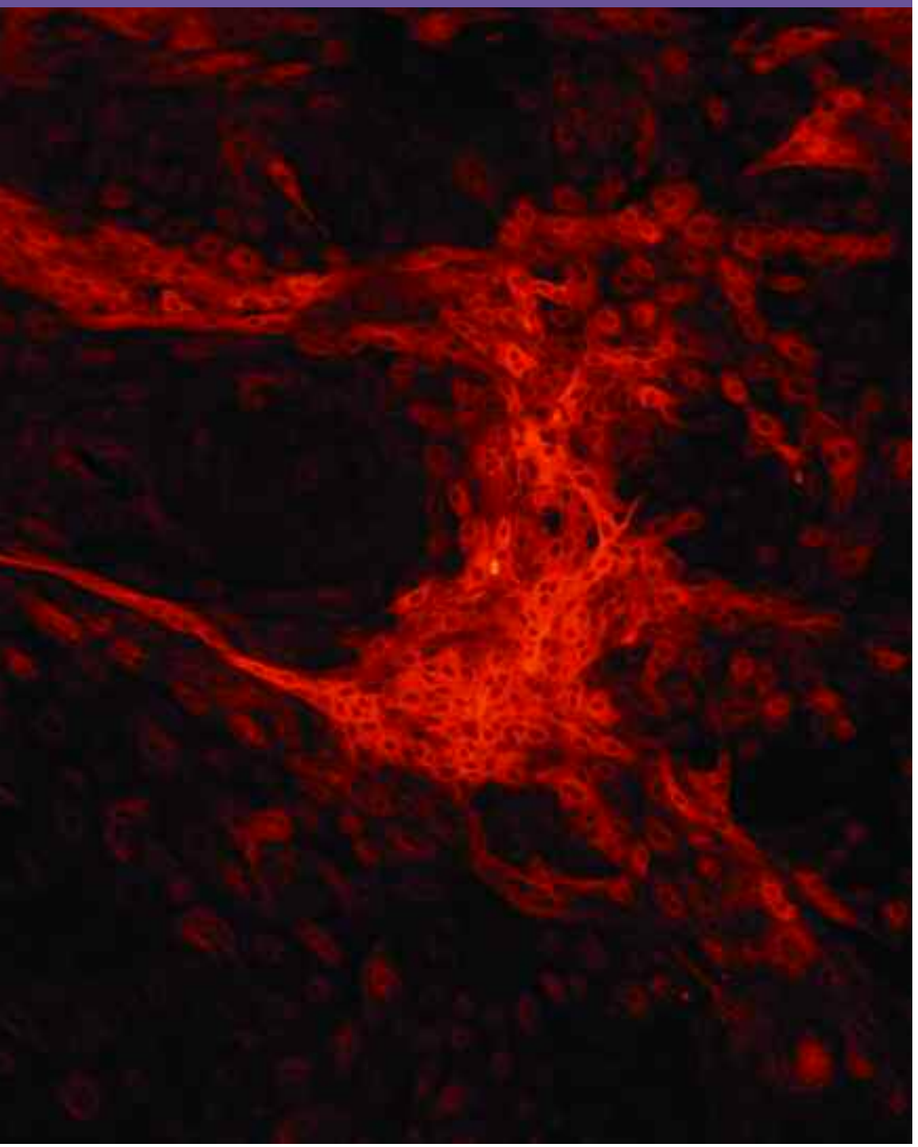
B **Something Fishy** *(Matt Veldman, graduate student, Neuroscience Program)*

This image shows a zebrafish embryo approximately nine hours after fertilization. The yolk (white) is almost completely surrounded by cells destined to become a baby zebrafish (green). The zebrafish develops rapidly, with all major organ systems present three days after fertilization. Because the early embryo is transparent, it is a good system for the study of organ development. The formation of many organs, including heart, kidney, gut and muscle, is very similar in humans and zebrafish. Therefore, information gained in the study of zebrafish development can be highly relevant to human health and disease.

C **Rosebud Kidney** *(Greg Dressler, Ph.D., associate professor, Pathology)*

This image of a mouse kidney at an early stage of embryonic development illustrates the intimate relationships between cells of the nephron (red) and the branching collecting ducts (green). The purple/blue dye marks the boundary of each tubule and each new nephron from the surrounding space. Studying mouse kidney development can help us learn more about human kidney diseases such as Wilm's tumor and polycystic kidney disease.

D



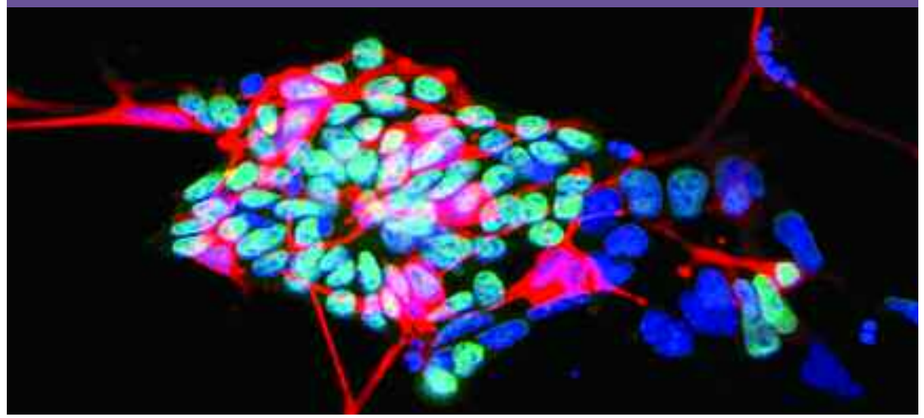
D Potential *(The Human Embryonic Stem Cell Center)*

The goal of this work is to coax human embryonic stem (ES) cells to form neuronal cells of the brain and spinal cord. These ES cells were exposed to a growth factor called noggin that encourages them to differentiate into neuronal cells. The cells were then stained to determine if they express typical neuronal proteins (red). Using these cells, we can study the growth and development of primitive cells of the nervous system in a culture dish. Ultimately these studies should help us learn how to use similar cells to re-engineer damaged brains and spinal cords.

E Potency *(Matt Velkey, graduate student, Cell and Developmental Biology)*

These mouse embryonic stem (ES) cells express a gene called Neurogenin1, which is normally present in the developing brain. Under direction of this gene, some of the ES cells have become mature neurons and now express neuron-specific proteins (red). Other cells are not fully differentiated, but their nuclei contain proteins (turquoise) characteristic of the primitive cells of the nervous system. Using ES cells as a model system to understand the signals that control how cells decide to become neurons of the brain will be useful not only as we seek to unravel the remaining mysteries of embryonic development, but also in our efforts to develop cell replacement therapies to treat neural degenerative diseases and injuries.

E



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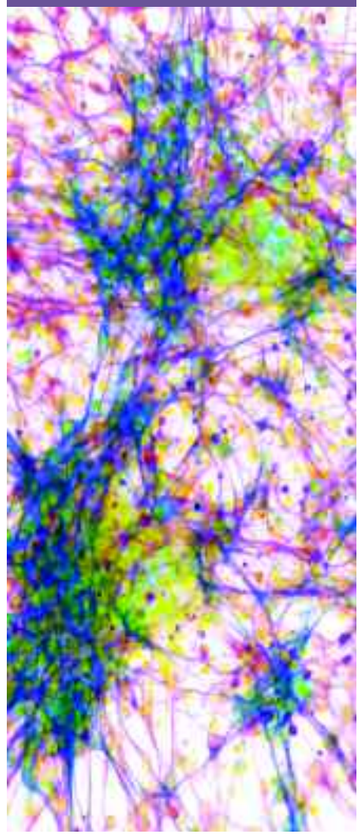

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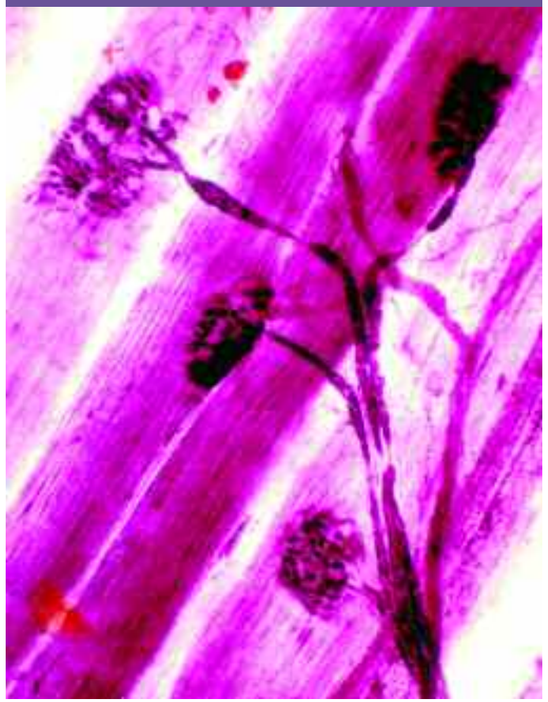


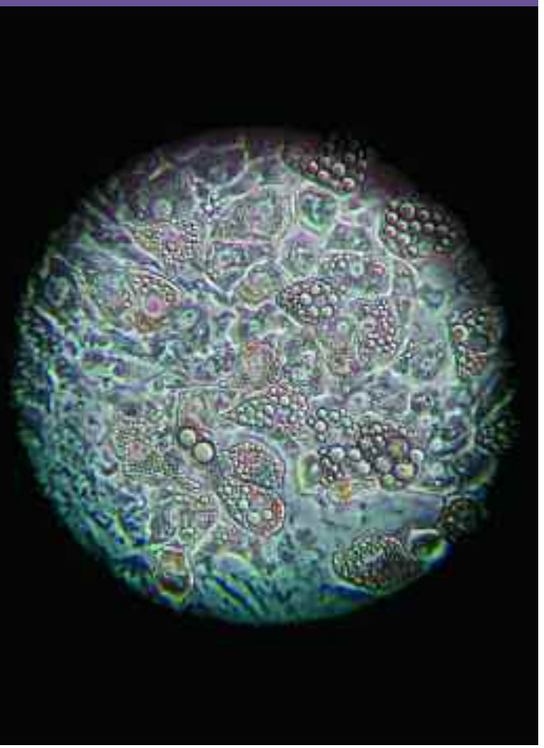
F Twins *(Matt Lorincz, M.D., Ph.D., assistant professor, Neurology)*

Degeneration of neurons in the brain causes severe conditions such as Parkinson's and Huntington's diseases. Even though in some cases (such as Huntington's disease) we know the genetic mutations involved, we do not understand how these mutations cause degeneration of neurons. Fortunately, it is possible to simulate these diseases in the lab using embryonic stem (ES) cells. The Huntington's mutation can be incorporated into ES cells and these ES cells can be differentiated into neurons in a culture dish, providing a valuable model to study the biology of this disease and to test drugs that might prevent degeneration. These embryonic stem cells have formed neurons, each with long fibrous processes. The color of the image has been manipulated.

G Motoring *(A. Kent Christensen, Ph.D., professor emeritus, Cell and Developmental Biology)*

Each movement of the body begins when muscles receive chemical signals from the nerves that contact them. The actual connection between the nerve and the muscle (a synapse) takes place at a specialized region (the synaptic bouton) at the end of a long extension of the nerve cell. In this photograph, the long red diagonal stripes are muscles of a snake. Long extensions from the nerves branch and connect to the muscle at swollen nerve endings that resemble flowers.

H



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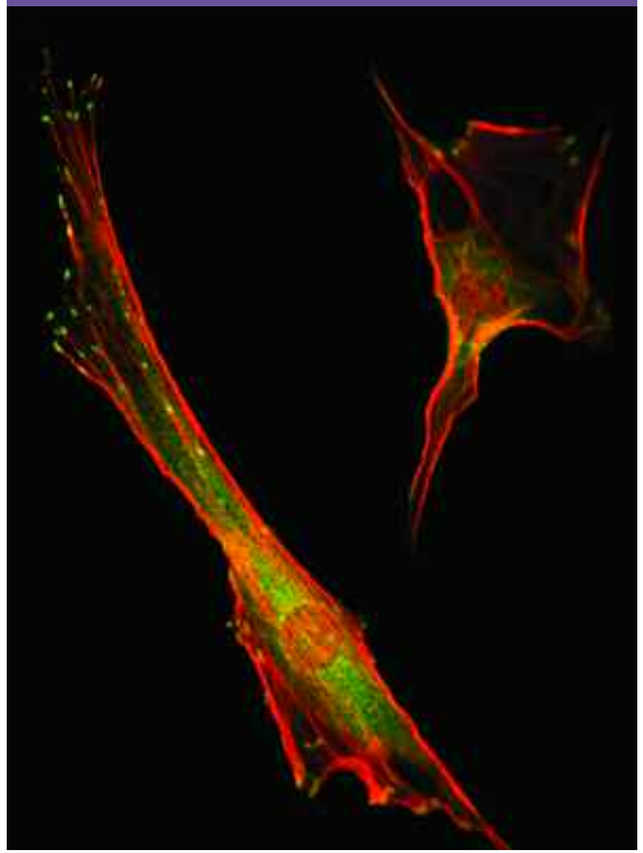

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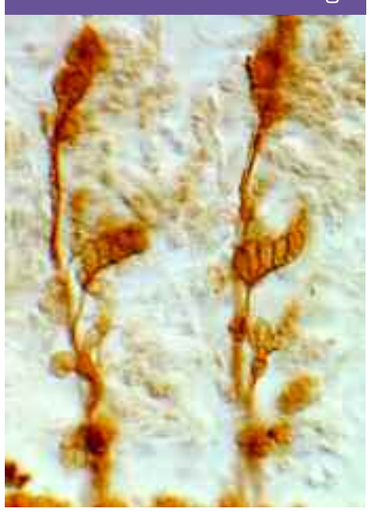


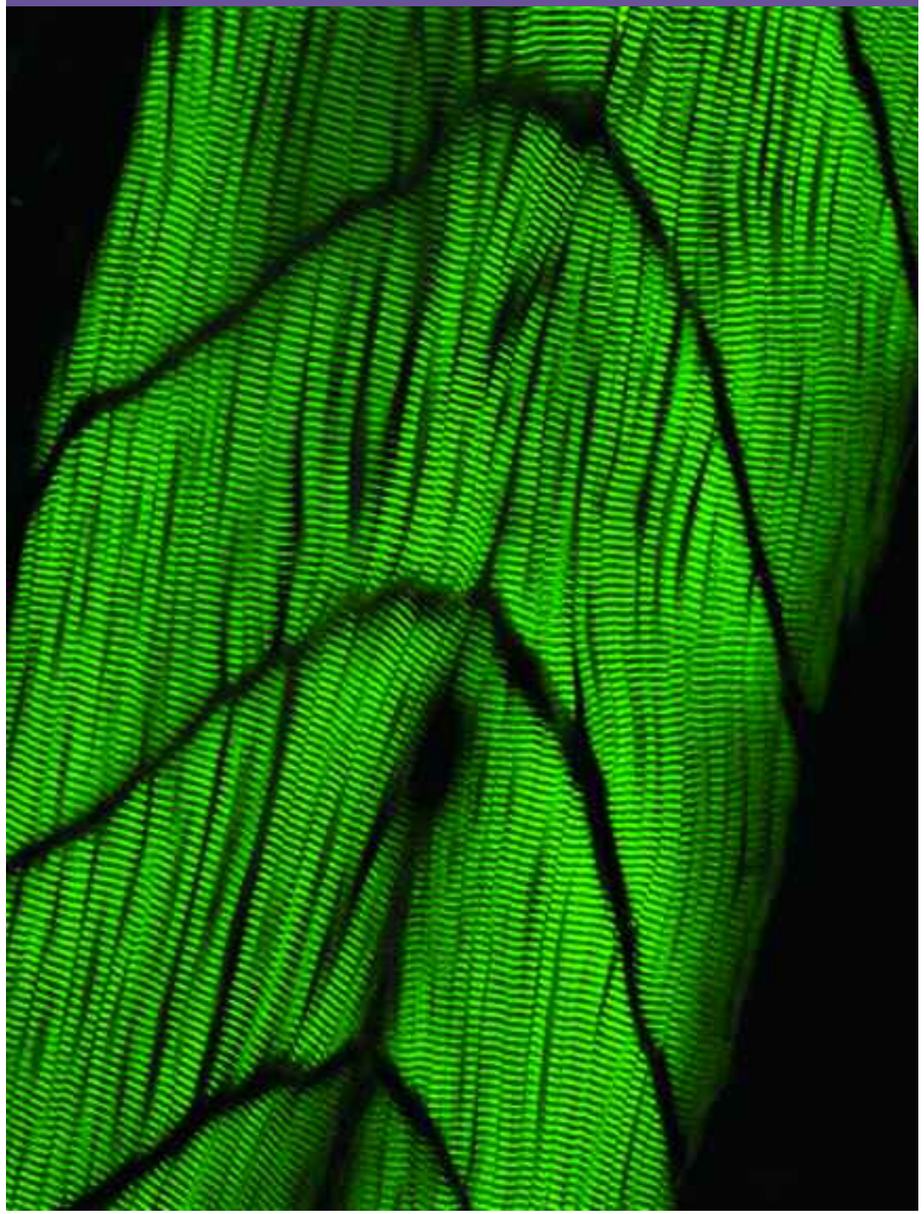
H World of Fat *(Brian Cha, graduate student, Molecular and Integrative Physiology)*

Pictured is a microscope image of cells that express a gene (C/EBPa) that directs them to become fat cells. Many of the cells contain spherical lipid/fat droplets. Because of the growing problem of obesity and diabetes, how fat cells form has become an increasingly important subject for research. Although the general perception is that fat cells are just depots for caloric excess, in fact they are essential for the regulation of energy balance.

I Locomotion *(Nikolas Kazmers, undergraduate student, Engineering)*

These mouse bone cells are wandering along the glass surface of a tissue culture dish. The cells are stained for structural proteins called vinculin (green) and actin (red). Vinculin is a protein present in specialized regions of the cell that allow it to attach to a surface. These transient suction cups (green patches) allow a cell to generate the force needed to move. Inside the cell, these focal adhesions are connected to the actin, which forms long cables that act like supporting guy wires to give the cell its shape and provide structural integrity.

K



J Brain Flowers *(Michael Hortsch, Ph.D., associate professor, Cell and Developmental Biology)*

These structures are sensory neurons and their extensions in the body wall of a fruit fly *(Drosophila)* embryo. Some of the genes that are important for the development and function of these structures in the fly are also crucial for the formation of similar structures in the human brain, making the fruit fly a valuable model for the study of how the nervous system forms.

K Superman *(Mark Russell, M.D., assistant professor, Pediatric Cardiology)*

Skeletal muscles are designed to permit strong, quick and usually voluntary contractions to allow a wide range of movement of many body parts. Skeletal muscle consists of bundles of muscle fibers composed of thousands of individual muscle cells. This example is from a zebrafish, but human skeletal muscle would be nearly indistinguishable from this. The contraction force is provided by the unique structure of muscle cells, seen here as bands. When athletes train, there is an increase in the number of individual muscle cells, as well as an increase in the size of muscle fibers such as this one.