**Stem Cells**

CURRENT RESEARCH AT THE SALK INSTITUTE

THERE ARE, BY MOST ESTIMATES, AN AVERAGE OF 100 million cells in the adult human body. Yet all that we are, all that we may become, derives from only about 30—the embryonic stem cells that were formed roughly two days after conception.

Conversely, as in all multicellular organisms, embryonic, or pluripotent, stem cells exist almost exclusively for the purpose of differentiating into the roughly 200 cell types that make up the body—skeletal muscle, bone, fat, connective tissue, brain, heart, skin, and all other organs. By contrast, adult stem cells are multipotent, stem cells that have been differentiated, or committed, to a specific cell type. These cells are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the细胞 types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.

**Stem Cells**

**Research at the Salk Institute**

Recent advances have blurred the lines between stem cells and adult cells, as scientists have learned how to persuade differentiated cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells—such as a heart, liver, or muscle cell—and are induced to differentiate into the cell types found in developed tissue, are still probing the extent of their capabilities to transform themselves into any type of specialized cell, whether in a developmental or a therapeutic context.
A different breed of cells

HUMAN EMBRYONIC STEM CELLS (HECS)—FORMED FOR their capacity to transform themselves into any type of specialized cell, the original hope was a long-shot venture. The critical question posed to them is whether they would achieve their potential and live up to their promise or tail off. Some researchers are currently fine-tuning their effects. We are very interested in your feedback regarding our publications. Please visit our website at stemcells.salk.edu to contact Judy Hodges at the Institute’s Office of Communications.

HUMAN EMBRYONIC STEM CELLS (HECS)—FORMED FOR their capacity to transform themselves into any type of specialized cell, the original hope was a long-shot venture. The critical question posed to them is whether they would achieve their potential and live up to their promise or tail off. Some researchers are currently fine-tuning their effects. We are very interested in your feedback regarding our publications. Please visit our website at stemcells.salk.edu to contact Judy Hodges at the Institute’s Office of Communications.

A different breed of cells

HUMAN EMBRYONIC STEM CELLS (HECS)—FORMED FOR their capacity to transform themselves into any type of specialized cell, the original hope was a long-shot venture. The critical question posed to them is whether they would achieve their potential and live up to their promise or tail off. Some researchers are currently fine-tuning their effects. We are very interested in your feedback regarding our publications. Please visit our website at stemcells.salk.edu to contact Judy Hodges at the Institute’s Office of Communications.

A different breed of cells

HUMAN EMBRYONIC STEM CELLS (HECS)—FORMED FOR their capacity to transform themselves into any type of specialized cell, the original hope was a long-shot venture. The critical question posed to them is whether they would achieve their potential and live up to their promise or tail off. Some researchers are currently fine-tuning their effects. We are very interested in your feedback regarding our publications. Please visit our website at stemcells.salk.edu to contact Judy Hodges at the Institute’s Office of Communications.

A different breed of cells

HUMAN EMBRYONIC STEM CELLS (HECS)—FORMED FOR their capacity to transform themselves into any type of specialized cell, the original hope was a long-shot venture. The critical question posed to them is whether they would achieve their potential and live up to their promise or tail off. Some researchers are currently fine-tuning their effects. We are very interested in your feedback regarding our publications. Please visit our website at stemcells.salk.edu to contact Judy Hodges at the Institute’s Office of Communications.

Reverse engineering

A time-stamp for memories

REMEMBER WHEN...?...IT IS HOW MANY A TRIP down memory lane take begins. But the brain keeps logs of what happened and when it is still a matter of speculation. A computational model developed in the laboratory of Endy D. Gage suggests that the thousands of neuron brain cells generated by neural stem cells each day and a time-stamped one which is unique to memories formed around the same time. To ascertain the newcomers’ job in adult brains, graduate student Brian Aminoff took every piece of available biological information and fed in to a computer program designed to simulate the neural circuits of the dentate gyrus, the entryway to the hippocampus, which plays a key role in the formation of memory. It quickly became clear that young cells respond indiscriminately to incoming information, becoming the links between irrelevant events that had nothing in common except the fact that they might have been brought back in memory. The researchers are currently fast-tracking their effects.
Cell lines to bloodlines

DESPITE THE IMPECCABLE BREAKTHROUGHS in the cell-reprogramming field, reported recently in the journal Cell, the problem of differentiating human cells from therapeutic stem cells remains a challenge.

When good glia go bad…

The STAR SHAPED GLIOM CELLS CALLED ASTROCYTES are crucial for the survival and well-being of motor neurons. When they are defective, however, astrocytes can be toxic to their charges and implicated in the muscle-wasting disease amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease.

ALS can be induced by inherited mutations in the gene encoding the survival motor neuron gene 1 (Smn), which produces proteins that protect the body from damage caused by free radicals—highly reactive molecules produced by cells during normal metabolism. To get to the root of the complicated relationship between neurons and astrocytes, Marla Caroni, a postdoctoral researcher in the laboratory of Rein M. Goedert, co-founder of the Massachusetts Institute of Technology's (MIT's) Whitehead Institute, and her team discovered that starting with embryonic stem cells.

When Maricaeth treated the cells with known antitoxins, the percentage of astrocytes engulfing harmful reactive molecules decreased significantly. What's more, the motor neurons treated with apramycin, which is found in many plants, were able to withstand the no longer toxic environment.

In addition to providing new insights into the toxic pathways controlling ALS, the STAR treatment targets GluPla from newborns, worked on opening new possibilities for drug-screening platforms and clinical interventions using astrocyte-based therapies.

Cell lines to bloodlines

DESPITE THE IMPECCABLE BREAKTHROUGHS in the cell-reprogramming field, reported recently in the journal Cell, the problem of differentiating human cells from therapeutic stem cells remains a challenge.

When good glia go bad…

The STAR SHAPED GLIOM CELLS CALLED ASTROCYTES are crucial for the survival and well-being of motor neurons. When they are defective, however, astrocytes can be toxic to their charges and implicated in the muscle-wasting disease amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease. ALS can be induced by inherited mutations in the gene encoding the survival motor neuron gene 1 (Smn), which produces proteins that protect the body from damage caused by free radicals—highly reactive molecules produced by cells during normal metabolism. To get to the root of the complicated relationship between neurons and astrocytes, Marla Caroni, a postdoctoral researcher in the laboratory of Rein M. Goedert, co-founder of the Massachusetts Institute of Technology's (MIT's) Whitehead Institute, and her team discovered that starting with embryonic stem cells.

When Maricaeth treated the cells with known antitoxins, the percentage of astrocytes engulfing harmful reactive molecules decreased significantly. What's more, the motor neurons treated with apramycin, which is found in many plants, were able to withstand the no longer toxic environment.

In addition to providing new insights into the toxic pathways controlling ALS, the STAR treatment targets GluPla from newborns, worked on opening new possibilities for drug-screening platforms and clinical interventions using astrocyte-based therapies.

Starting over

HISTORICAL HUMAN EMBRYONIC STEM CELLS (hESCs) have been derived from the inner cell mass of mammalian embryos—the balls of cells that develop after fertilization and go on to form a living entity. Not surprisingly, a media deluge followed the announcement of the human embryonic stem cells (hESCs) in terms of appearances and applications. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract. Instead of using stem cells to replace diseased motor neurons, which instruct individual muscle fibers to contract.
**When good glia go bad…**

**The Star-Shaped Glia, Cells Called Astrocytes are Essential for the Survival and Well-Being of Motor Neurons.** When they degenerate, however, astrocytes can be toxic to their charges and implicated in the muscle-wasting disease amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig’s disease.

ALS can be induced by inherited mutations in the gene encoding the superoxide dismutase 1 (SOD1) enzyme, which protects the body from damage caused by free radicals—highly reactive molecules produced by cells during normal metabolism. To get to the root of the complicated relationship between neurons and astrocytes, M. Carol Mathers, a postdoctoral researcher in the laboratory of Paul S. Gage, Salk’s director of cellular neurobiology, and his team are using a human pluripotent stem cell (heSC) system to mimic the cellular interactions in the spinal cord of ALS patients. When Marchetto treated the cells with known antioxidant molecules, the percentage of astrocytes producing harmful reactive molecules decreased significantly. What’s more, the motor neurons treated with antioxidants, which is found in many plants, were able to withstand the toxic environment.

**With their support crew intact, even challenged motor neurons may be able to keep doing their job,** says Pfaff. **Instead of using stem cells to replace withering motor neurons in human suffers from ALS,** Marchetto and his team are banking on these versatile cells as a means to find new drug-based treatments. The researchers have isolated embryonic stem cells from mice carrying a mutation in the gene that is responsible for ALS and are currently carrying out studies into developing drugs that will be beneficial for ALS patients. Using iPS cells instead of human cells relieves researchers from the ethical minefield of working with human embryos. But recent results from the laboratories of Juan Carlos Izpisúa Belmonte and Ross Blackstone at the Salk Institute suggest that we can use this system as a rapid drug screening tool to identify the best compounds for treating ALS.
When good glia go bad…

The stem-shaped glial cells called astrocytes are crucial for the normal survival and well-being of motor neurons. When they are defective, however, astrocytes can be to blame for their injuries and are implicated in the muscle-wasting disease amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig’s disease. ALS can be induced by inherited mutations in the gene encoding the protein superoxide dismutase 1 (SOD1), which protects the body from damage caused by free radicals—highly reactive molecules produced by cells during normal metabolism. To get to the root of the complicated relationship between neurons and astrocytes, Maria Cardona, a postdoctoral researcher in the laboratory of Fred H. Gage, coaxed human embryonic stem cells (heSCs) to differentiate into mature motor neurons. They then successfully differentiated the resulting motor neurons into mature neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shrink and die. As motor neurons, which instruct individual muscle fibers to contract, shr...
A different breed of cells

HUMAN EMBRYONIC STEM CELLS (hESCs)—DEDICATED FOR their capacity to transform themselves into any type of specialized cell—are a hazardous bunch. The research proscription causes them to flourish their atoll and act without direction or structure, which is like being a Seesam Choe. A developing a chemically defined nutrient—which is not only pointless but also determines the very destiny but allows scientists to steer the cells along a defined differentiation path.

One reason stem cells live in plastic laboratory culture dishes that contain a nutrient-rich bath known as culture medium—which is not a natural environment. The surface of the dish is typically coated with a small number of feeder cells that provide an unspecified mix of growth factors. For therapeutic applications, however, stem cells need to be grown under the company of feeder cells, which can steer results or compromise the stem cells’ reliability. “If you want to control differentiation, you need to know which factors are the cells are receiving,” says Choe.

To circumvent these obstacles, Seesam Choe and his team are trying to grow the cells with the least amount of support provided by non-stem cells. In another project, they are developing random sequences based on a 3D and chemical approach. These differentiation strategies are designed to unknown the cells—think of them as an internal environment, which results in pancreatic, and adrenal cells. A few molecules have already proven their ability to transform diverse networks, and this research is currently furnishing their efforts.

A time-stamp for memories

REMEMBER WHEN... IT IS HOW MANY A TRIP down memory lane has begun. But the brain keeps tabs on what happened and is still a matter of speculation. A computational model developed in the laboratory of Fred H. Gage suggests that the thousands of neuron brain cells generated by newborn cells each day add a time-related code, which is unique to memories formed around the same time.

To ascertain the “nomenc” in adult brains, graduate student David Ahnrem took every possible bit of information and fed it in their computer program designed to simulate the neural circuits in the dentate gyms. The orthodoxy is known as hippocampus, which plays a role in the formation of memory. It quickly became clear that young cells reside temporally to incoming information, becoming the links between independent events that had nothing in common except the fact that the events occurred around the same time. But how the brain keeps the neurons in the same time frame?

“Current thinking holds that when we bring up a memory, the cells that were involved in formaing the memory are reactivated,” says Gage. “Our hypothesis suggests that different kinds of memory are generated by different time frames that the memory was formed as engaged. Providing a hint as to how events happen during their respective timeframes.”

Recent advances have blurred the lines between stem cells and adult cells, allowing scientists to steer towards their desired destination. “Scientists have learned how to program already specialized cells to revert to an embryonic-like state. The results, called induced pluripotent stem cells (iPS), appear to have the characteristics of embryonic stem cells, but investigators are still probing the extent of their similarity and their applications. Because biologically speaking, stem cells are the ultimate database, many feel they have the potential to aid in treating diseases resulted from the disease process.”

Beyond stem cells—Embryonic, or pluripotent, cells exist almost indefinitely, able to differentiate into any of the 200 cell types that make up the human body, be it bone, fat, connect tissue, brain, heart, skin, and so on. By contrast, adult somatic, or multipotent, stem cells, which are found in hematopoietic, are specialists, differentiating only into the cell types in the tissue in which they reside.

Gene therapy because just small amounts of the gene of interest—be it a missing gene or a gene that causes a disease—are delivered to the genome of a cell, the gene is present in the cell, and the cell will supply the missing protein.

Modeling, diagnosis, and treatment. If only scientists can discover how to harness them. Salk Institute faculty are leaders in that effort, exploring how stem cells function and developing new ways to direct their behavior. Their research, recent examples of which appear in the following pages, promises an exceptionally powerful tool for discovery that may ultimately become an expanse of information for research and healing.

Reversion engineering

DESPITE ITS CONCEPTUAL SIMPLICITY—REVIVING ASBESTOS-related disease such as mesothelioma by replating or “reprogramming” defective genes—therapy never took off. Harpooned by sufficient gene delivery, inadvertent activation of cancer causing genes, autoimmune immune reaction, and insufficient gene expression, human clinical trials could never replicate the promising results obtained in animals. To circumvent these obstacles, Seesam Venne and his team are currently growing therapy with the latest stem cell technology. They are planning to isolate skin cells from patients with genetical diseases and reprogram them into an embryonic-like state. After fixing the genetic defect with well-established methods in a Petri dish, they will coax the stem cells to develop into the desired cell type, then return them to the patient, where they could function fully without requiring medical intervention.

For now, the researchers are focusing on mice with lymphoma. The disease is an attractive model for gene therapy because it small amounts of the disease could also be treated. What’s more, most of the clashing factors are manufactured in liver cells, called hepatocytes, so the technique Venne’s lab develops may have broader applications. “Once we’ve learned how to reliably produce healthy hepatocytes and cultivate them in a Petri dish, we can tackle a host of metabolic diseases that originate in defective hepatocytes,” says Karl-Dimiter Bissig, who spearheads the project.

Reverse engineering

DESPITE ITS CONCEPTUAL SIMPLICITY—REVIVING ASBESTOS-related disease such as mesothelioma by replating or “reprogramming” defective genes—therapy never took off. Harpooned by sufficient gene delivery, inadvertent activation of cancer causing genes, autoimmune immune reaction, and insufficient gene expression, human clinical trials could never replicate the promising results obtained in animals. To circumvent these obstacles, Seesam Venne and his team are currently growing therapy with the latest stem cell technology. They are planning to isolate skin cells from patients with genetical diseases and reprogram them into an embryonic-like state. After fixing the genetic defect with well-established methods in a Petri dish, they will coax the stem cells to develop into the desired cell type, then return them to the patient, where they could function fully without requiring medical intervention.

For now, the researchers are focusing on mice with lymphoma. The disease is an attractive model for gene therapy because it small amounts of the disease could also be treated. What’s more, most of the clashing factors are manufactured in liver cells, called hepatocytes, so the technique Venne’s lab develops may have broader applications. “Once we’ve learned how to reliably produce healthy hepatocytes and cultivate them in a Petri dish, we can tackle a host of metabolic diseases that originate in defective hepatocytes,” says Karl-Dimiter Bissig, who spearheads the project.