

### ❖ Could a Special Diet Replace Chemotherapy?

- ❖ For patients with blood cancer or in need of a bone marrow transplant, the amino acid valine could hold answers to new treatments.
- ❖ Blood cancer treatments may one day include special dietary restrictions: researchers have found that an essential amino acid plays a crucial role in the creation of blood stem cells—a discovery the scientists say could lead to a potential alternative to chemotherapy and radiation.
- ❖ Valine is one of 10 essential amino acids—protein building blocks that are crucial to life but cannot be made by the human body.
- ❖ It must therefore be obtained through diet and is found in protein-rich foods such as meat, dairy and legumes.

❖ Valine is involved in metabolism and tissue repair, and now it also seems key to the formation of blood stem cells.

- ❖ As reported in Science, researchers at the University of Tokyo and Stanford University found that human blood stem cells failed to proliferate when cultured in petri dishes without valine.
- ❖ Mice deprived of the amino acid for two to four weeks also stopped making new red and white blood cells.
- ❖ Based on these results, senior author Hiromitsu Nakauchi and his colleagues think that depriving blood cancer patients of dietary valine before a bone marrow transplant might spare them the necessity of chemotherapy or radiation—both of which destroy cancer causing blood stem cells to make room for transplanted ones but carry health risks.

❖ In a followup experiment, Nakauchi and his colleagues put the idea to the test in valine restricted mice and were able to successfully transplant bone marrow without needing radiation or chemotherapy.

- ❖ But half of the mice died from a lack of valine shortly after the four week trial ended.
- ❖ Nakauchi says it will take much more research to determine how long people can tolerate a valine free diet (which would likely be supplied intravenously).
- ❖ But if the deprivation works in humans, it could open up the possibility of bone marrow transplants for some patients who are usually not considered candidates for chemotherapy or radiation,

❖ He suspects that this approach will need to be combined with other therapies or smaller doses of chemo and radiation to be effective, though.

- ❖ Removing valine from the diet of certain leukemia patients could also potentially eliminate the cells that are the cause of their cancers in the first place.
- ❖ Nakauchi says: “If such a simple and relatively less harmful therapy could be used to treat leukemias, that would be great.”

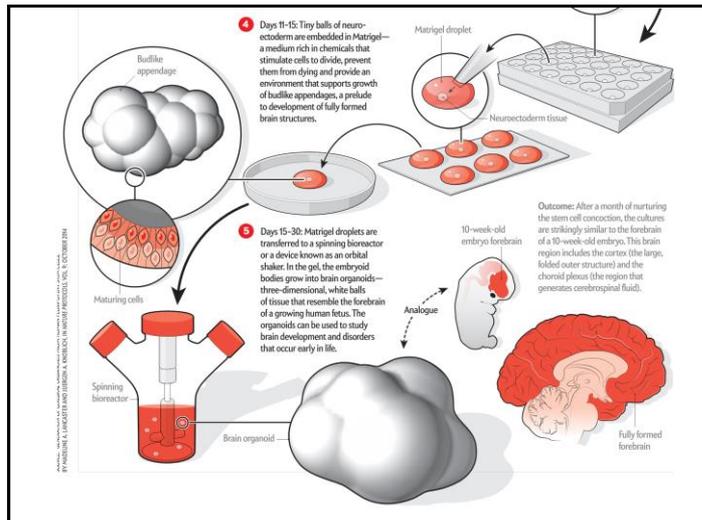
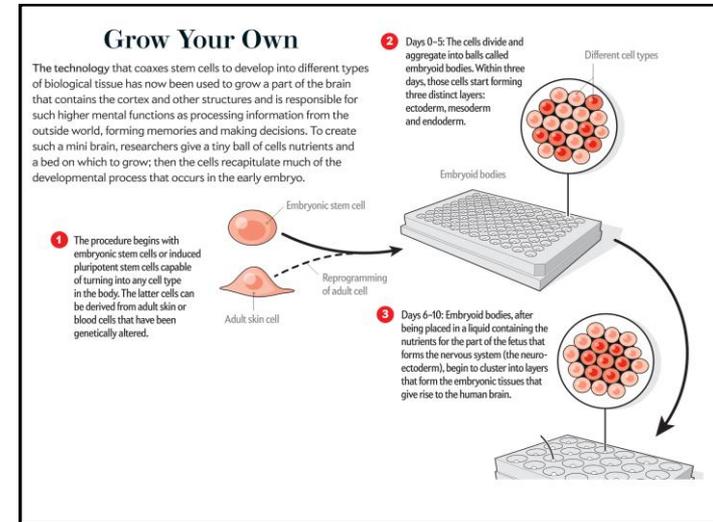
- ❖ Lab-built brains.
- ❖ Scientists copy nature's most complex organ in the hope of solving the mysteries of brain disorders, from autism to Alzheimer's.
- ❖ Everything that makes us human is located within tissue composing the human brain.
- ❖ It is here that our thoughts develop, here that we feel love or hate, and where the most creative and most evil ideas of humankind arise.
- ❖ This walnut-shaped structure is also the most complex organ nature has generated.
- ❖ The brain harbors about 86 billion neurons, or nerve cells, that have to be born at the right time, migrate to the right place, and wire up in the right way if we are to survive and thrive.

- ❖ Understanding exactly how the human brain develops and functions is the greatest challenge of modern biology.
- ❖ Most of what we have learned about the organ since the birth of neuroscience more than 100 years ago derives from experiments done on animals—frequently mice or rats.
- ❖ Scientists could justify this approach because mice and humans share a common brain architecture: they harbor many of the same types of nerve cells and rely on essentially the same parts of the brain to carry out shared mental processes.
- ❖ But humans and rodents differ in one key way. Whereas the mouse brain has a smooth surface, the human brain is highly folded.

- ❖ To nonscientists, this difference might seem trivial.
- ❖ But neurobiologists believe that the folding makes a world of difference to human brain function.
- ❖ It allows for many more neurons to be placed within the same volume and is also a prominent feature of all "intelligent" animals, such as monkeys, cats, dogs and whales.
- ❖ Evolutionary biologists have shown that folding arose from another difference between mice and people: neurons in many parts of the brain arise from a specific set of precursor cells that exist only in minute numbers in mice.
- ❖ Such differences may explain why many common genetic mutations responsible for severe neurological disorders in humans have little effect when bred into mice by researchers trying to study the mechanisms of human diseases.

- ❖ If the mutations affect the development or maintenance of proper human brain architecture or the functioning of cell types that are common only in humans, then the studies would be doomed to failure.
- ❖ In fact, the unique characteristics of the human brain may be one of the reasons that rodent studies have yielded no effective therapies for such brain disorders as schizophrenia, epilepsy and autism.
- ❖ Recognition of the differences between mouse and human brains has spurred a hunt for more informative ways to conduct neuroscience experiments.
- ❖ Recently my laboratory has come up with an exciting approach: growing the largest part of the developing brain in miniature in a lab dish.

- ❖ These brain structures, called organoids, give neuroscientists a model of the human brain that should provide information they cannot obtain by running studies in mice.
- ❖ Researchers can observe what happens when the brain-in-a-dish, or mini brain, is exposed, for example, to the Zika virus, which can disrupt brain development in fetuses of infected women, or when an organoid is genetically engineered to mimic a brain afflicted with a neurological disease.



- ❖ The idea of growing a human brain in a dish is sure to make some people squeamish.
- ❖ Movies such as The Matrix come to mind that evoke fantasies about lab-grown brains developing thoughts or even personalities.
- ❖ These are needless fears.
- ❖ The probability that a lab-grown brain will develop a mind of its own is nil.
- ❖ An organoid is not a “humanoid” in a jar and will not be one even in the far future.
- ❖ Any conscious being needs to be able to process information from the senses to develop an internal mental model of reality.

- ❖ Organoids are neither able to see nor hear and lack any sensory input.
- ❖ Even if we were to connect them to a camera and a microphone, the incoming visual and auditory information would still need to be translated into a form that could be understood by these brain cells in a dish— and, as things stand, providing that translation is an insurmountable technical challenge.
- ❖ Organoids are not functional brains, only lumps of tissue that imitate the molecular and cellular functioning of the organ at spectacular levels of detail.
- ❖ They are similar to pieces of tissue removed during brain surgery, not conscious beings.
- ❖ Still, growing an organoid does raise certain ethical and legal issues.

- ❖ The benefits of this cellular technology outweigh any possible downside.
- ❖ Cerebral organoids have laid the foundation for performing realistic medical and toxicology experiments in human tissue, without the need for animal experiments.
- ❖ Even so, I and others would like to improve them. For instance, the current generation lacks blood vessels.
- ❖ That absence is not a problem during the early stages of organoid development, but over time cells start dying from lack of oxygen and nutrients.
- ❖ In theory, it should be possible to provide blood vessels, either through new 3-D-printing techniques or by growing them from stem cells.