Mind Over Disease: A Personal Experience
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ADVANCES IN SCIENCE

Answering the big questions

World's scientists predict what's next in coming 25 years

By Ronald Kotulak
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To celebrate the 125th anniversary of its founding by Thomas Edison, the journal Science asked more than 100 of the world's top scientists what they thought were the 25 most important scientific questions likely to be answered in the next 25 years.

The 25 big questions range from what is consciousness (the mysterious interplay of brain cells and neurotransmitters that conjures up awareness and the ability to ask questions) to what is the universe made of.

What distinguishes humans from all other species is that capacity to formulate questions--and to find answers that lead to more questions.

Children start asking "why" almost as soon as they learn to talk. Why is the sky blue? Do mosquitoes go to the bathroom?

Asking the right question is the driving force behind science's amazing run of successes in explaining how the world works.

"Children ask the most natural and the most difficult questions because they really do want explanations in which they can understand relationships between cause and effect," said Donald Kennedy, executive editor in chief of Science.

"Scientists proceed in much the same way," he said. "They see some complicated outcome and they say, What produced this? I'm not going to be satisfied with just describing that it happened; I want to know what put it in motion."

Whereas a frustrated parent may answer a child's inquisitiveness with "because I told you so," scientists must frame a question in such a way that it poses a hypothesis--a theory that tries to explain how something works--that can be tested to determine if it is true or not.

Questions are more important than answers in shaping the future of science, Kennedy wrote in an editorial in Science, adding that science is about questions while research is about answers.

"The essential feature of a good question is that it is ultimately testable or answerable," he wrote. "The big question that can never be wrestled with isn't worth much."

In 1943 Erwin Schrodinger posed one of the most famous questions ever recorded when he asked, "What is life?" Enough tantalizing clues are known, he postulated, to begin looking for the molecules of life.

Schrodinger's question, and slim book by the same title, inspired a generation of young scientists, including James Watson and Francis Crick, who won the race to decipher the chemical structure of DNA.

But Watson and Crick's achievement was only the start of a cascade of new questions: What are genes? Are there disease genes? Why do humans have so many fewer genes than previously thought? That last question opened a new field of epigenetics, which studies the role the environment plays in determining how genes are expressed.

Scientists ask questions because they have an overwhelming urge to know why things are the way they are. The knowledge learned scrapes away the crust of ignorance that limits human progress.

"In many cases, the answers are going to have a big impact on human well-being, and not just in the medical sense," Kennedy said. "People who explore the cosmos try to put our solar system, Earth and everybody on it in some kind of grander context in terms of our universe."

Some answers seem to have no immediate relevance at the time of discovery, but later turn out to have a major impact on society.

When Michael Faraday was demonstrating his equipment for generating the newly discovered phenomenon of electricity in the early 1800s, British chancellor of the exchequer William Gladstone, said: "It is very interesting, Mr. Faraday; But what practical worth is it?" Faraday replied: "One day, sir, you may tax it."

The ancient Greeks were masters at asking questions and coming up with philosophical answers that were intellectually satisfying but usually not testable. It wasn't until the Age of Enlightenment starting in the 1600s that the scientific method--observe, form a hypothesis, test it--took hold.

The flood of discoveries that followed changed the world. Every now and then, particularly after a surge of great discoveries, someone, often a scientist, would say that science has learned all there is to learn.

"The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote," Albert A. Michelson, who measured the speed of light, said in a speech dedicating the Ryerson Physics Lab at the University of Chicago in 1894.