Biology 3201 STSE CASE STUDY Debating Science Gillam Holy Heart Name: _____

"When I consider healthy discussions that take place in the scientific world, vigorous debate (or at least consideration) of opposing alternatives is critical for the successful development of ideas and identification of promising new areas of research. The ideas that withstand critical challenges from colleagues end up being the most robust and strongest theories."

—Brent Edwards, PhD,
Starkey Hearing Research Centre

Science is a process of constructing, refining, and revising knowledge and understanding. Individuals or small groups of scientists start the process. However, the result of their work—a new discovery, a rejected hypothesis, or a modified theory—is a collaborative process that requires feedback, discussion, and the eventual consensus of others in the scientific community.

The role of scientific review

Science requires, and is founded on, the practice of peer review. The first scientific organization was founded in 1560. Its purpose was to present scientific ideas for review and discussion. Since then, countless societies, associations, journals, symposia, conferences, and Internet resources have been set up to give scientists a place to communicate ideas and findings for evaluation by their peers.

Peer reviewers compare assumptions with their own knowledge, attempt to replicate or verify findings, and frequently challenge their colleagues' conclusions. This is why it is so important to document all procedures and carefully record the resulting data.

The review process has uncovered faulty experimental designs, incorrect conclusions, and—at times—deliberately fraudulent data. In many cases, however, the process of peer review and scientific debate has led to the development, refinement, and acceptance of scientific laws and theories that help shape our understanding of the world around us. The process is not foolproof. The sheer volume of material being published today in a variety of increasingly specialized journals makes it very difficult for the field to police itself effectively. Individual publications must have strict guidelines for submissions to ensure that legitimate research is being presented for review.

In Darwin's day, 1858, he publicly reported on the studies he and Alfred Russel Wallace had done related to the origin and diversity of life to the Linnean Society in London. *On the Origin of Species* was published the next year as a book, and scientific colleagues used it to review the evidence presented and the conclusions. That review continues as more evidence is found and more conclusions are reached, published, and debated.

Science and society

Scientific debates are not always confined to the topics of scientific evidence and conclusions. Scientists do not exist in a vacuum; they are part of society. Their discoveries have led to inventions that have transformed the ways in which we live our lives. Some scientific discoveries go beyond practical applications to challenge assumptions that sustain social institutions.

For example, since the days of Aristotle, people in Western society had believed that Earth was the centre of the universe. Theologians and political authorities had based their justification of social order on this understanding. In 1543, Nicolaus Copernicus, a Polish astronomer, challenged this Earth-centred view by publishing a new theory about Earth orbiting the Sun. In the 1600s, the astronomer and physicist Galileo Galilei (1564–1642) was imprisoned and threatened with torture for supporting Copernicus's theory. Representatives of the state felt that a Sun-centred universe was a dangerous idea that would undermine social structures and authority.

This photo from July 20, 1925, shows defence attorney Clarence Darrow (standing at right) questioning prosecution witness William Jennings Bryan. The trial took place outdoors that day due to the extreme Dayton, Tennessee, heat.

When Darwin published his book in 1859, those debating his theories and conclusions were not just scientists. Many non-scientists were alarmed by the implications of Darwin's conclusions, which were thought to challenge the idea that humans were created intentionally by God for a special purpose and that, again, this would undermine the social order.

The social debate over evolution was still raging in 1925 when the state of Tennessee passed legislation that made it "unlawful" for any teacher there to "teach any theory that denies the story of the Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals." A high school biology teacher named John Thomas Scopes was soon charged with the offence. His trial, which became known through the media as "The Scopes Monkey Trial," was held in a packed courthouse and followed by national newspapers in the U.S. (It also was the first trial to be broadcast on national radio.)

The arguments for and against the indictment largely revolved around preserving the separation of church and state, the validity of various interpretations of the Bible, and whether a conviction created a special status for one faith. The actual science related to the theory of evolution was not the focus of the debate; the concern was about its social impact.

Some of the current debates among scientists—for example, about climate change and the importance of preserving biodiversity—have also moved beyond the sphere of science and entered the public forum. Once again, scientific conclusions are under fire, not because the science is thought to be wrong, but because there are concerns that the implications will somehow undermine social (and economic) principles and practices.

Research and Analyze

1.) You and your colleagues at the university have discovered a protein that you believe is a major trigger for certain types of heart disease. You've rerun your tests many times and gotten consistent results. Now it's time to publish them. What is the name of a scientific journal that you could publish your research in? Use google

_____

_____

2.) Describe the readership (how many people read this journal)? Use google

_____

_____

3.) What is the process for submitting research for review with this journal? Use google

_____

_____

_____

_____

4.) How is the journal funded? Use google

_____

_____

5.) Does this journal cover the types of research that you and your team did on proteins? (aka, does it cover information on the human body and heart disease)

_____

6.) The peppered moth, *Biston betularia,* has been the subject of scientific study since 1848, when it was noted that the numbers of individuals of flecked and dark moth populations fluctuated over relatively short periods that corresponded to the amount of air pollution in the moth's habitat. Numerous studies confirm the hypothesis that natural selection is driving these population changes. However, this hypothesis has been challenged, mainly in the popular media, rather than in scientific journals. **Do research, and in point form summarize the evidence that has been cited to challenge the hypothesis. Use google**

7.) When and why do you think members of the general public should get involved in discussions about scientific findings? Where do you think these discussions should take place? (for example, schools, courts, newspapers, radio, television, public meetings, or the Internet) and why you think it is the most effective.

8.) *The Journal of Negative Results in Biomedicine* is one of a handful of scientific journals devoted to communicating the negative results of failed investigations and disproved hypotheses. Some scientists suggest that all scientific journals should do a better job of providing such information. Do you agree? Justify your reasoning.