TEACH[R]

The mechanics of Intelligent Design—good enough to teach?

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Abstract

Considerable debate has taken place in the last two years over whether or not Intelligent Design (ID) should be taught to high school students. This paper examines some of the basic features of ID as set out by its major proponents. It also outlines the arguments of detractors who would argue that ID is not science, but religion or creationism in disguise. These suggest that ID is a type of 'god of the gaps' argument which then languishes when mechanisms accounting for the appearance of complex objects or systems having the hallmarks of design are elucidated by further scientific research. It is also noted that while the complexity, functionality and apparent purpose of biological systems may have the appearance of being designed, other explanations exist. Further, it is noted that design theory is unable to speculate on the mechanism(s) leading to their formation. It is also observed that the design discussion has some general concepts which go beyond the specific ID framework and with which many more Christians in science resonate. Internationally, ID has not featured in school science curricula and attempts to integrate it into Australian school curricula should be very carefully evaluated with respect to the experiences of the global educational and scientific community.

Introduction

Judging by the rapid accumulation of books, articles and websites over the last ten years or so the Intelligent Design (ID) argument has certainly made its mark on the scientific community. As will be made evident later, discussion has spilled over into the public arena and is used by a variety of conservative Christian groups as an argument against evolutionary theory. In addition to debates raging in the USA on the teaching of ID in schools, in 2005 the then Australian Federal Minister for Education, Brendan Nelson publicly stated that he had no problem with the teaching of ID alongside evolutionary theory in schools.[1] He further added that it should not replace evolutionary theory but be offered as an alternative.

> *"While ID describes complexity, it offers no explanation for the development of the systems it studies"*

This sparked lively discussion among several groups in Australia including scientists, educators and school administrators. Professor Michael Archer (Dean of the Faculty of Science, University of New South Wales) instigated a public letter on behalf of scientists and school teachers denouncing the proposal. This letter appeared in many Australian newspapers on October 20, 2005 further fuelling the controversy.[2] A common major objection to ID in this context is that it is not science but simply religion (or creationism) in another guise and has no place in the science class. Three years later, how should we approach the controversial topic of teaching ID in schools?

Core features of the contemporary intelligent design argument

ID, as a way of looking at the complexity of living organisms and their components, was developed and championed by Michael Behe, a professor of biochemistry well known for his landmark book, *Darwin's black box*.[3] ID examines the detailed complexity observed in biochemical systems and structures. Coupled with recent advances in biochemistry and molecular biology, ID proponents use this staggering complexity to challenge naturalistic evolution as an explanation for the existence of these systems and structures. On the other hand, many ID adherents believe in conventional scientific time scales and in evolution as the major player in producing the current diversity of life forms. It is worth noting that while ID describes complexity, it offers no explanation for the development of the systems it studies.

ID has been used by various groups and in a variety of ways to argue for an intelligence behind the universe. In some spheres this is the Christian God of the Bible, but many religions and other groups such as the New Age movement could also be sympathetic to ID. Yet for many ID purists, the existence of a designer is not inferred, evidence of design is the goal of all investigations.

Arguments from design are not new. In the early

1800s, Anglican clergyman William Paley presented a now well known illustration that still encapsulates the basic essence of the design argument:

> In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came to be there, I might possibly answer, that for anything I knew to the contrary, it had lain there for ever. But suppose I had found a watch on the ground, and it should be inquired how the watch happened to be in that place…that when we come to inspect the watch, we perceive—what we could not discover in the stone—that its several parts are framed together for a purpose, e.g. that they are so formed and adjusted as to produce motion, and that motion so regulated as to point out the hour of the day; that if the different parts had been differently shaped from what they are or placed in any other manner or in any other order other than that in which they are placed…no motion at all would have been carried out in the machine…[4]

Paley envisioned design as the purposeful arrangement of parts to achieve a particular objective or function. He noted that changing the arrangement of such parts results in loss of function. Continuing this line of reasoning, Behe argues that the hallmark of ID is the concept of 'irreducible complexity' which is readily observed in

> A single system which is composed of several interacting parts that contribute to the basic function, and where the removal of any one of the parts causes the system to effectively cease functioning.[5]

Behe illustrates the basis of irreducible complexity using the common household mousetrap. A mousetrap consists of five parts—a wooden base, a spring, a hammer (to break the mouse's back), a sensitive catch (releases when slight pressure is applied) and a metal bar (connects to the catch and holds the hammer back when the trap is charged).[6] He argues that it is irreducibly complex because all the components are essential if it is to function as designed. If the hammer was removed the mouse could not be pinned to the wooden platform. If there was no spring, the hammer and catch would sit loosely and the trap would fail to function. In fact, if any single part was not present the trap would be completely ineffective in catching mice.

Using this simple model as an illustration of design, Behe attempts to demonstrate his concept of irreducible complexity in a host of biochemical systems and structures ranging from the molecular machinery of bacterial flagella to the biochemistry of blood clotting mechanisms.[7]

Behe argues that his concept of irreducible complexity in biochemical systems challenges naturalistic Darwinian evolution:

> An irreducibly complex system cannot be produced directly (that is, by continuously improving the initial function, which continues to work by the same mechanism) by slight, successive modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a part is by definition non-functional. An irreducibly complex biological system, if there is such a thing, would be a powerful challenge to Darwinian evolution. Since natural selection can only choose systems that are already working, then if a biological system cannot be produced gradually it would have to arise as an integrated unit, in one fell swoop, for natural selection to have anything to act on.[8]

However in recent years, as judged by most scientists, including many sincere Christians, this central element of ID has been successfully challenged. As will be discussed later, mechanisms accounting for the evolution of so called irreducibly complex systems such as bacterial flagella have been described.

The detection of design

The work of Bradley and Thaxton

In the years just preceding the publication of Behe's work, Bradley and Thaxton noted that some classic design arguments used to argue for the existence of an intelligence behind the universe can also be explained by natural causes. The complex organisation observed when snowflakes are examined microscopically is often used as one such example. These authors observe that

> The snowflake's structure is nothing mysterious or supernatural. It arises by the natural process of dendritic growth that accompanies the phase change of H2O from liquid (water) to solid (snow).[9]

From this, it is apparent that at least for some parts of the natural world the appearance of design can clearly be explained by natural processes.

These authors also suggest another type of observed order on the basis of information theory. Information theory was first developed during the 1940s at the Bell Telephone Laboratories. It describes the science of message transmission using either a real language or symbolic one such as Morse code or for the biochemist, even the genetic code found in the DNA molecule.[10] While the first type of order (for example, snowflakes) can be explained by natural physical and chemical laws, the second type

> Is not a result of anything within the matter itself. It is in principle opposed to anything we see forming naturally. This kind of order does provide evidence for intelligent causes.[11]

"Behe argues that his concept of irreducible complexity in biochemical systems challenges naturalistic Darwinian evolution"

These authors use Mt Rushmore (where the faces of four American presidents are carved into a cliff face) as an example to illustrate this second kind of order. When one observes the formation from many different angles the conclusion can be reached that they are indeed modelled on human faces, and completely foreign to naturally occurring rock formations. Because of the nature of the carving, one can conclude that an intelligence was the cause rather than some sort of natural process.[12]

Bradley and Thaxton suggest that complex structures are specified by large amounts of information.[13] In order to produce complex structures like Mt Rushmore a lot of organised instructions are required which contrast with the random activities of erosion. This type of reasoning was a basic forerunner of many ID arguments and was then extended to include biological complexity.

The illusion of design

Understandably, many have reasoned that the biological sphere shows complexity of structures that in principle resemble Mt Rushmore. However, critics of ID have pointed out that even though living organisms and their various components may look like they are designed, there is no scientific way of determining whether they are the result of intelligent causes. Examining an existing functioning biochemical, anatomical or physiological system that may have arisen through a naturalistic (or even theistic) evolutionary process or resulting from an act of special creation will still appear to be designed simply because it functions and fulfils a purpose. In other words one is not able to tell from examining the inferred design detail of a system or structure how that particular system or structure came to be. Even atheistic evolutionists who have serious objections to the design movement in general insist that nature resulting from the pressure of natural selection will appear to be designed. Richard Dawkins states in his book, *The blind watchmaker*, that: "Biology is the study of complicated things that give the appearance of having been designed for a purpose"[14] and

> Natural selection is the blind watchmaker, blind because it does not see ahead, does not plan consequences, has no purpose in view. Yet the living results of natural selection overwhelmingly impress us with the appearance of design as if by a master watchmaker, [they] impress us with the illusion of design and planning.[15]

"One is not able to tell from examining the inferred design detail of a system or structure, how it came to be"

The work of Dembski

Another well known pioneer of the ID movement, William Dembski, has proposed an analytical method for detecting design. He claims that design is actually empirically detectable.[16] In other words, there are well-defined methods that, on the basis of observational data, are capable of reliably distinguishing intelligent from undirected natural causation of a given system or object. Dembski has postulated a three stage explanatory filter for detecting intelligent design (Figure 1).[17]

According to Dembski, if an event or observation is affirmed at the final layer of the filter then one can be justified in inferring that the event involved design. The explanatory filter asks questions of that event or object in the following order: Does a natural law explain it? Does chance explain it? Does design explain it?

According to Dembski, if there is a high probability of explaining the existence or operation of a given system then natural law is the best explanation (for example, there is a high probability that when a suspended object is released, it will fall to the earth according to the law of gravity). If the answer to this first question is no, then one can move comfortably to the second test question. If there is a good probability of chance explaining the system under study, then let it be so. But if the probability of law and chance fail to offer an explanation then one can assume the best explanation is one of design. This is especially true of specified, small probability events, for example producing an information rich molecule like DNA, with a specific base sequence, from a random pool of nucleotides.

Dembski has further developed this model and argues that an intelligent cause is responsible for an effect (or object) if it can be demonstrated that the effect (or object) is both complex and specified. Using written language as an illustration, he indicates that a single letter is specified but not complex. A long sentence of randomly jumbled letters is complex, but not specified while a Shakespearean sonnet is both complex and specified.[19] In other words, a meaningful sentence and one composed of jumbled letters are both complex, but they differ in that the meaningful sentence is composed of letters deliberately arranged in such a way that a pattern corresponding to intelligible English is recognised. He argues that specification implies purpose, and this is the product of intelligent design. One could easily apply such an analogy to the conversion of substrate to product molecules in a series of dependent enzyme-mediated reactions; the pattern of components in the sequence is deliberately arranged for a given purpose and thus exhibits both complexity and specification. In other words, the sequence makes biochemical sense. In fact, such an analysis could be applied to a sequence of nucleotide bases in DNA, a sequence of amino acids in a protein, or a host of other examples in biochemistry or molecular

biology. While design is inferred according to Dembski's criteria, the mechanisms accounting for the development of such systems cannot be determined.

Dembski has since refined his arguments and suggests that in addition to complexity and specification, contingency needs to be established.

> Contingency ensures that the object in question is not the result of an automatic and therefore unintelligent process in its production. Complexity ensures that the object is not so simple that it can be explained by chance. Finally, specification ensures that the object exhibits the type of pattern characteristic of intelligence.[20]

One could consider such automatic or unintelligent processes as being the physical or chemical laws of nature leading to snowflakes (the first type of order observed in design suggested by Bradley and Thaxton). This is also reflected in the first stage of Dembski's explanatory filter, where law may best explain the occurrence of a given event. Dembski makes the point that in his application of the term complexity, it also describes a form of probability. He suggests a relationship between complexity and probability:

> Complexity and probability therefore vary inversely: the greater the complexity, the smaller the probability. Thus to determine whether something is sufficiently complex to warrant a design inference is to determine whether it has sufficiently small probability.[21]

Thus increasing complexity can be equated with decreasing probability, so that highly complex and ordered events become increasingly improbable. Dembski derives another explanatory filter where the three levels of the filter are contingency, complexity and specification (Figure 2).[22]

When an event or object is analysed using this new filter, the first question concerns contingency. Is the event contingent? Can a natural law or other event be excluded from its explanation? If no, then the event can be attributed to necessity. If yes (natural explanations or laws can be excluded) then it passes to the next level of the filter—the question of complexity. If no is the answer at this level, the event may best be explained by chance, an event that happens spontaneously. If yes is the answer, the event is complex, it passes to the question of specification. If the event is not specified, it can be attributed to chance. If the event is specified its cause is best explained in terms of design.

According to Dembski, naturalism operates on the fact that nothing outside of nature can explain

Figure 1: Dembski's original explanatory filter.[18]

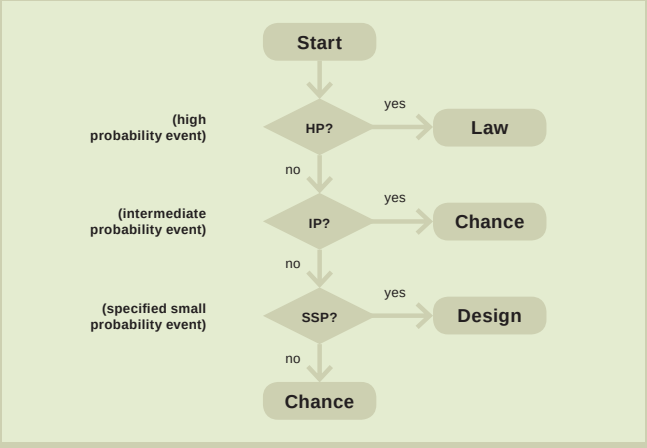
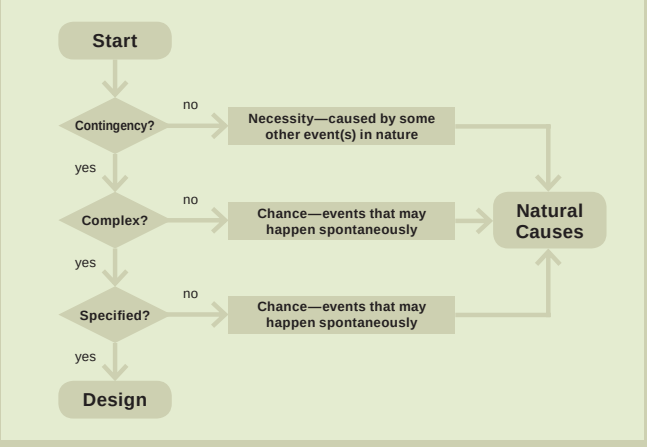


Figure 2: Dembski's modified explanatory filter.[19]



natural events. Things happen by chance or necessity:

> Events therefore happen either because they were caused by other events or because they happened spontaneously. The first of these is called "necessity", the second "chance". For the naturalist, chance and necessity are the fundamental modes of causation. Together they constitute what are called "natural causes". Naturalism therefore seeks to account for intelligent agency in terms of natural causes.[24]

Dembski makes a credible attempt at adding rigour to design arguments. In conjunction with

> ***Dembski's explanatory filters offer a significant attempt at establishing evidence of design in biological systems***

Behe's concept of irreducible complexity, his explanatory filters offer a significant attempt at establishing evidence of design in biological systems. Biochemical systems are highly complex and information rich. In other words they are highly specified and according to Dembski, they have a very low probability of occurring naturally. However, as credible as the attempt may be in establishing evidence of design it sheds little light on how the system under study came to be.

Is ID an alternative scientific option to naturalistic evolutionary theory?

For many scientists (both theist and atheist), ID's failure to offer explanations of mechanism means that it is a less than viable alternative to naturalistic evolutionary theory when it comes to explaining the origin and development of life on earth. Arguments raised by the ID movement generally tend to be from the negative: "Things are just so complex I can't imagine natural evolutionary mechanisms accounting for this". This type of reasoning comes close to a 'god of the gaps' type of argument where unknown steps in a process are ascribed to God's activity. Such positions can then become untenable if advances in scientific knowledge offer explanations. As science develops and new theories and explanations fill in the knowledge gaps, God is squeezed out of the picture. Further, many ID purists do not have a problem with concepts related to directed or theistic evolutionary processes producing complex biochemical systems that then may be analysed for design.

Evolutionary convergence

Evolutionary convergence is an example of how developing scientific thought may fill in the gaps in scientific knowledge and suggest an answer to ID's challenge to evolution being unable to produce complicated biological systems and structures. Palaeobiologist and 2005 Boyle lecturer, Simon Conway Morris has considered and further developed the concept of evolutionary convergence in considerable detail.[25] In evolutionary terms, homology refers to the situation where a particular biochemical, anatomical or physiological feature is observed in different species with common ancestral descent. However, where the same or very similar feature is found in quite unrelated species the term used is evolutionary convergence. Evolutionary convergence suggests that evolutionary mechanisms seek the same solution to similar biological needs resulting in the evolution of the eye, ability to smell, echolocation and even intelligence.

Morris' book *Life's solution: Inevitable humans in a lonely universe* is full of detailed examples of evolutionary convergence.[26] According to Morris, this convergence may be the result of a type of molecular programming in molecules leading to complicated biochemical structures exhibiting a tendency to combine in converging ways. For Morris these restricted pathways of evolutionary development supplement what he sees as the insufficiency of natural selection alone. Driven by a type of molecular pre-programming, anatomical and physiological structures develop, with intelligent life as the inevitable end result. These restricted converging pathways give rise to many of the recurrent biological themes found in many diverse species. He is convinced of the

> Uncanny ability of evolution to navigate to the appropriate solution through immense hyperspaces of biological possibility.[27]

The anthropic principle

It is interesting to note that Morris' views on evolutionary convergence resonate with the anthropic principle which suggests that the universe appears fine tuned for life in terms of such diverse features as gravitational attraction, strong and weak nuclear forces, the existence of atoms, the properties of the water molecule, and the nature of the earth's atmosphere. The universe appears just the way it should in order to arrive at the development of life. For further contemplation of the anthropic principle the reader is directed to books such as *The Goldilocks enigma*[28] by Paul Davies or Michael Denton's *Nature's destiny: How biology reveals purpose in the universe*[29].

Denton, author of *Evolution: A theory in crisis*[30] (a major challenge to naturalistic evolutionary processes) examines the fitness of a wide variety of essential factors for life as we know it on this planet. These factors range from the carbon atom to the very interesting idea that humans are uniquely adapted for the use of fire, argued by Denton as the essential ingredient for the development and advancement of technology. Denton suggests that given the complexity of the cell and its constituents, organic evolution would have to be the result of some kind of directed program rather than a consequence of random undirected processes. He posits that the complexity of organs such as eyes and lungs argues against current undirected Darwinian evolutionary mechanisms. Denton concludes that the entire universe, from molecules to galaxies, is uniquely tuned and perhaps programmed for one purpose, the development of carbon-based life with humankind as its eventual climax.

ID and Christians

Francis Collins, author of *The language of God*[31], a devout Christian and long-time head of the Human Genome Project, is not surprised by the readiness of some evangelical Christians to embrace ID. He sees this as a backlash against those outspoken evolutionists who insist only on an atheistic platform with respect to evolutionary processes.[32] However, he warns that those who do readily accept ID may find their faith jeopardised as ID arguments crumble:

> If believers have attached their last vestiges of hope that God could find a place in human existence through ID theory, and that theory collapses, what then happens to faith?[33]

ID and scientific method

Collins shares the concern of many thoughtful Christian scientists with respect to the scientific validity of ID. Unfortunately, ID lacks a fundamental characteristic of sound scientific theories—the ability to predict other findings and hence the ability to prompt further experimentation.[34]

As mentioned, ID describes complexity of existing systems and structures but does not speculate on mechanisms that bring them into existence. Science as a discipline is based on observation, experimentation and the development of theories, which are in turn tested and modified where necessary after further testing and experimentation. Thus science may be considered a self correcting endeavour. However, ID, while being essentially descriptive of complexity, can't really be tested in a scientifically rigorous manner. It is simply not possible to do 'design experiments' as one would perform 'science experiments'.

The core of ID, irreducible complexity, has also come under scrutiny and the irreducible complexity of many biological structures is now being questioned as science fills in the mystery surrounding them, "suggesting that ID proponents have made the mistake of confusing the unknown with the unknowable, or the unsolved with the unsolvable."[35] Bacterial flagella have been used as a prime example of irreducible complexity. But considerable homology exists between the structural components of bacterial flagella and those of bacterial type-III secretory systems.[36] Flagella secrete the protein flagellin in order to construct the flagellum using the same components and mechanisms by which type-III secretory systems secrete proteins (the rod and ring complex) that allow bacteria to comprise eukaryotic targets. Rather than being uniquely irreducibly complex, flagella may be thought of as specialised type-III secretory systems.[37]

A further challenge to faith results from the use of ID by some as a type of proof of an intelligence behind the universe. While, as noted earlier, many ID advocates stop short of speculation on an intelligence behind the universe, many do not. If one puts a lot of weight on ID being an argument for a creative intelligence in terms of the Christian Scriptures which describe a loving creator God, then one is also obliged to consider and accommodate the design seen in tooth and claw (this includes the predators and parasites of the natural world).[38] One can't help but admire the unique apparent design of predators such as the great white shark or the cheetah that equip them for hunting and catching prey. This is an area that seems to have attracted little attention and where little has been written at present. Yet if we take ID seriously, we must address the application of this type of design in a Christian world view.

> ***Collins warns that those who do readily accept ID may find their faith jeopardised as ID arguements crumble***

ID in school curricula

Internationally, there has been considerable debate concerning the teaching of ID in schools. Perhaps for the reasons noted above, ID does not currently appear in either science or religion school curricula in Australia or overseas. In 2004 Dembski lamented the fact that even if ID were allowed in schools there was a lack of a suitable curriculum and he urged the development of such.[39] As yet an ID curriculum has not appeared. Development of an ID curriculum would be difficult as topics in science curricula (as in the case of individual topics within any scientific discipline) develop from a scaffolding of scientific facts and theories built upon over many years of thoughtful research. Currently, the general consensus of the scientific community would indicate that ID is not science and thus would not have a part in a science curriculum. At present, ID seems to be disconnected from the main body of science and while it applies itself mainly to descriptive biochemistry it still awaits adoption by the wider scientific community. This situation seems to be unlikely to change in the near future with the prospect of ID remaining an orphan for some considerable time.

In Australia there is no mention of ID in either science or religion school curricula. Furthermore, as in most other countries, senior school curricula are already bursting at the seams and there would be a significant challenge to find a place where ID might be legitimately included. Recent international developments would indicate that senior school syllabi might do well to distance themselves from including ID as any part of a formal science class in schools.

"The experience of the international community suggests a high degree of caution be exercised with respect to integrating ID into school science or religion curricula"

Perhaps the most controversial public debate concerning the teaching of ID in schools took place in the District Court for the Middle District of Pennsylvania, December, 2005. A law suit was filed by parents of students against the Dover Area School District that required ninth-grade biology students to be read a statement that indicated that ID offered an alternative explanation for the origin of life when compared with Darwin's view.[40] Expert witnesses in the area of science and religion, such as Professor John Haught, successfully argued that ID is not science and that advocates of ID share

> A kind of theological confusion of science with religious ideas, and they tend together to propose that this should be wedged into the science classroom.[41]

The court ruled against the Dover School Board on the grounds that ID was not science and

> Cannot uncouple itself from its creationist, and thus religious, antecedents…as stated, our conclusion today is that it is unconstitutional to teach ID as an alternative to evolution in a public school science classroom.[42]

In the United Kingdom the interaction between science and religion is taken seriously in school curricula. The *Science and Religion in Schools Project* (funded by a John Templeton Foundation Grant) was launched in April 2002 and the first materials were published in 2006.[43] A particular strength of this project is that the importance of dialogue in curriculum development is well recognised:

> Any successful work in this area must involve cooperation and discussion between university experts and experienced school teachers.[44]

In the UK science and religion is taught from primary school through to high school and curriculum materials are being well developed[45], but it is noteworthy that ID does not appear to feature in the curriculum materials developed by this innovative group. Advice is offered by the *Science and Religion in Schools Project* with respect to the inclusion of ID in school science curricula:

> In 2007 the Department for Children, Schools and Families issued guidance on the place of creationism and intelligent design in Science lessons. This was clearly in response to the concern of some in the world of Science that creationism and intelligent design were being presented as scientific theories; as opposed to philosophical or theological positions in their own right. The DCSF guidance states that there is no place for teaching about intelligent design or creationism in Science but that these theories would be covered in Religious Education, Citizenship and History, with a clear emphasis on RE as the main place for such discussions.[46]

And further, with respect to the teaching of ID in religious education classes:

> If it is not possible to present intelligent design or creationism as scientific theories in Science then teachers should not present them as scientific theories in religious education.[47]

The experience of the international community of educationalists and scientists would suggest a high degree of caution be exercised with respect to notions of integrating ID into school science or even religion curricula.

Conclusions

In keeping with present international trends it would be inadvisable to include ID in school science curricula on the basis that ID has been deemed to be unscientific. Caution should also be exercised concerning the introduction of ID into school religion curricula if it is being presented as a type of scientific theory.

Given the global interest in ID in recent years as a way to point to an intelligence behind the universe, there may be a sense of disappointment that ID has not measured up to expectations. Yet there are other more rigorous avenues that may be explored. The anthropic principle (the fine tuning of the universe for life) may be used as a vehicle for the investigation and teaching of complex scientific phenomenon to students. For example, students may be guided in a problem based learning approach when studying the fine tuning of physical and chemical constants, gravity, nuclear forces, the structure of the carbon atom, the water molecule, or the make up of the atmosphere. All have a long history of scientific investigation and rigour, and even the study of the history of their investigation and elucidation teaches a student as much about how science developed historically as it does about the phenomenon being studied. The anthropic principle seems a much more persuasive argument for those looking for evidence of the work of an intelligent cause behind the universe. TEACH[R]

The next volume of TEACH *will include an article discussing a form of the design arguement which is more widely accepted by Christians.*

Endnotes

[1] David Wroe, 'Intelligent design' an option: Nelson. *The Age*, August 11, 2005.

[2] The full text of this letter may be found at: http://www.science.unsw.edu.au/news/2005/intelligent.html

[3] Michael Behe, *Darwin's black box*. (New York: Simon and

Schuster, 1996).

[4] Frederick Le Gros, *Paley's natural theology.* (London: The Christian Evidence Committee of The Society for Promoting Christian Knowledge, 1885), 9-10.

[5] Behe, *Darwin's black box*, 39.

[6] Ibid., 42-44.

[7] Ibid., 69-73 and 74-97.

[8] Ibid., 39.

[9] Walter L. Bradley and Charles B. Thaxton, "Information and the origin of life," in James P. Moreland, ed., *The creation hypothesis*. (Downers Grove, Illinois: IVP, 1994), 203.

[10] Ibid., 205.

[11] Ibid., 203.

[12] Ibid., 204.

[13] Ibid., 206.

[14] Richard Dawkins, *The blind watchmaker.* (New York: Norton, 1986), 1.

[15] Ibid., 21.

[16] For an earlier discussion, see Ewan Ward and Marty Hancock, "Intelligent design: The biochemical challenge to Darwinian evolution," *Christian Science and Spirituality*, *2* (2001): 7-24.

[17] William A. Dembski, "Redesigning science" in William A. Dembski, ed., *Mere creation: Science, faith and intelligent design*. (Downers Grove, Illinois: IVP, 1998), 98-108

[18] Adapted from: William A. Dembski, "Redesigning science" in William A. Dembski, ed., *Mere creation: Science, faith and intelligent design*. 99.

[19] William A. Dembski, *Intelligent design: The bridge between science and theology.* (Downers Grove, Illinois: IVP, 1999), 47.

[20] Ibid., 128.

[21] Ibid., 130.

[22] Ibid., 133-134.

[23] Adapted from: William A. Dembski, *Intelligent design: The bridge between science and theology.* (Downers Grove, Illinois: IVP, 1999), 47.

[24] Ibid., 214.

[25] Simon Conway Morris, *Darwin's compass: How evolution discovers the song of creation*. (2005 Boyle Lecture) (www document: http://www.stmarylebow.co.uk/?Boyle_Lecture:2005) August 16, 2007.

[26] Simon Conway Morris, *Life's solution: Inevitable humans in a lonely universe.* (Cambridge: Cambridge University Press, 2003, 2006).

[27] Ibid., 327.

[28] Paul Davies, *The Goldilocks enigma: Why is the universe just right for life?* (London: Penguin, 2006).

[29] Michael Denton, *Nature's destiny: How the laws of biology reveal purpose in the universe.* (New York: Free Press, 1998).

[30] Michael Denton, *Evolution: A theory in crisis*. (Bethesda, Md.: Adler & Adler, 1986).

[31] Francis S. Collins, *The language of God.* (New York: Free Press, 2006).

[32] Ibid., 195.

[33] Ibid.

[34] Ibid., 187.

[35] Ibid., 188.

[36] Ian Musgrave, "Evolution of the bacterial flagellum," in Matt Young and Taner Edis, eds., *Why intelligent design fails: A scientific critique of the new creationism.* (New Jersey: Rutgers University Press, 2005), 72-84.

[37] Robert M. Macnab, "The bacterial flagellum: Reversible rotary propeller and type-III export apparatus." *Journal of Bacteriology*, *181* (1999): 7149-7153.

[38] Ward and Hancock, "Intelligent design: The biochemical challenge to Darwinian evolution," 21.

[39] William A. Dembski, *The design revolution: Answering the toughest questions about intelligent design*. (Downers Grove, Illinois: IVP, 2004), 321.

[40] *Dover Area School District School Board press release for biology curricula*, November 2004. (www document: http://www2.ncseweb.org/kvd/exhibits/DASD/2004-11-19_DASD_press_release_Biology_Curriculum.pdf) July 29, 2008.

[41] John Haught and Adam Shapiro, *Conversation with John Haught on evolution, intelligent design and the recent Dover trial.* (www document: http://www.metanexus.net/magazine/ArticleDetail/tabid/68/id/9482/Default.aspx) July 29, 2008.

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[43] *Science and Religion in Schools Project*. http://www.srsp.net/

[44] Martin Rogers, *The science and religion debate in schools across the world.* (www document: http://www.metanexus.net/magazine/tabid/68/id/10327/Default.aspx) July 29, 2008.

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[46] Science and Religion in Schools Project. *Some guidance on the teaching of creationism and ID in schools*. (www document: http://www.srsp.net/new/guidanceid.html) July 29, 2008.

[47] Ibid.