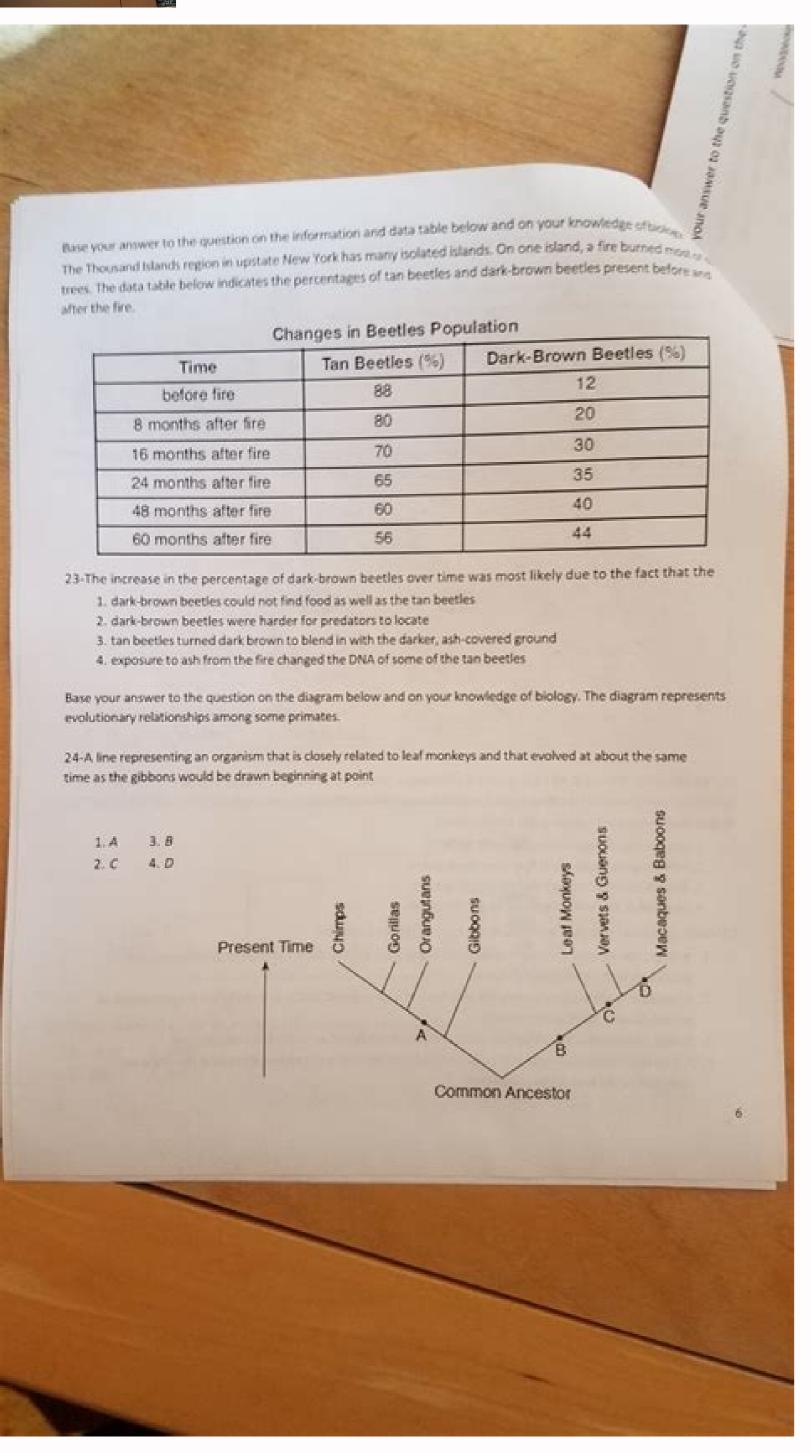
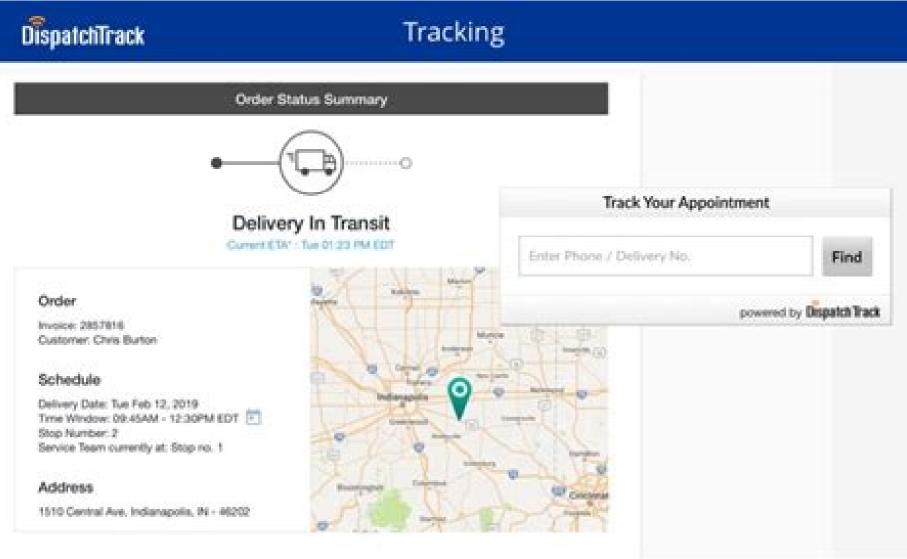
Evidence of evolution lab 38 answers

I'm not robot!











This article is about the concept in intelligent design. For the concept in systems theory, see Emergence. Argument by proponents of intelligent design Part of a series on Intelligent design Part of a series on Intelligent design Part of a series on Intelligent design. Timeline Wedge strategy Politics Kitzmiller v. Dover Campaigns Discovery Institute Centre for Intelligent Design and Evolution Awareness Center Physicians and Surgeons for Scientific Integrity Truth in Science Reactions Jewish Roman Catholic Scientific bodies that explicitly reject intelligent design Creationism Categoryvte Irreducible complexity (IC) is the argument that certain biological systems cannot have evolved by successive small modifications to pre-existing functional systems through natural selection, because no less complex system would function. Irreducible complexity has become central to the creationist concept of intelligent design as pseudoscience and rejects the concept of irreducible complexity. [2] Irreducible complexity is one of two main arguments used by intelligent design proponents, alongside specified complexity. [3] Creation science presented the theological argument from design with assertions that evolution could not explain complex molecular mechanisms, and in 1993 Michael Behe, a professor of biochemistry at Lehigh University, presented these arguments in a revised version of the school textbook Of Pandas and People.[4] In his 1996 book Darwin's Black Box he called this concept irreducible complexity and said it made evolution that evolution that evolution relies on improvement of existing functions, ignoring how complex adaptations originate from changes in function, and disregarding published research.[4] Evolutionary biologists have published research formed by the addition of components as revealed by different temporal origins of their proteins.[8][9] In the 2005 Kitzmiller v. Dover Area School District trial, Behe gave testimony on the subject of irreducible complexity has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large."[1] Definitions Michael Behe defined irreducible complexity in natural selection in terms of well-matched, 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.[10] A second definition given by Behe in 2000 (his "evolutionary definition") states: An irreducible complex evolutionary pathway is one that contains one or more unselected steps in the pathway.[11] Intelligent-design advocate William A. Dembski assumed an "original function" in his 2002 definition: A system performing a given basic function is irreducibly complex if it includes a set of well-matched, mutually interacting, nonarbitrarily individuated parts such that each part in the set is indispensable to maintaining the system's basic, and therefore original, function. The set of these indispensable parts is known as the irreducible complexity is a descendant of the teleological argument from design or from complexity). This states that complex functionality in the natural world which looks designed is evidence of an intelligent creator. William Paley famously argued, in his 1802 watchmaker analogy, that complexity in nature implies the existence of a watchmaker.[13] This argument has a long history, and one can trace it back at least as far as Cicero's De Natura Deorum ii.34,[14][15] written in 45 BC. Up to the 18th century Galen (1st and 2nd centuries AD) wrote about the large number of parts of the body and their relationships, which observation was cited as evidence for creation.[16] The idea that the interdependence between parts would have implications for the origins of living things was raised by writers starting with Pierre Gassendi in the mid-17th century[17] and by John Wilkins (1614-1672), who wrote (citing Galen), "Now to imagine, that all these things, according to their several kinds, could be brought into this regular frame and order, to which such an infinite number of Intentions are required, without the contrivance of some wise Agent, must needs be irrational in the highest degree."[18] [19] In the late 17th-century, Thomas Burnet referred to "a multitude of pieces aptly joyn'd" to argue against the eternity of life.[20] In the early 18th century, Nicolas Malebranche[21] wrote "An organized body contains an infinity of parts that mutually depend upon one another in relation to particular ends, all of which must be actually formed in order to work as a whole", arguing in favor of preformation, rather than epigenesis, of the individual was made by other 18th-century students of natural history. [23] In his 1790 book, The Critique of Judgment, Kant is said by Guyer to argue that "we cannot conceive how a whole that comes into being only gradually from its parts can nevertheless be the cause of the properties of those parts".[24][25] 19th century Chapter XV of Paley's Natural Theology discusses at length what he called "relations" of parts of living things as an indication of their design.[13] Georges Cuvier applied his principle of the correlation of parts to describe an animal from fragmentary remains. For Cuvier, this related to another principle of his, the conditions of existence, which excluded the possibility of transmutation of species. [26] While he did not originate the term, Charles Darwin identified the argument as a possible way to falsify a prediction of the theory of evolution at the outset. In The Origin of Species (1859), he wrote, "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. But I can find out no such case." [27] Darwin's theory of evolution challenges the teleological argument by postulating an alternative explanation to that of an intelligent designer—namely, evolution by natural selection. By showing how simple unintelligent forces can ratchet up designs of extraordinary complexity without invoking outside design, Darwin showed that an intelligent designer was not the necessary conclusion to draw from complexity in nature. The argument from irreducible complexity attempts to demonstrate that certain biological features cannot be purely the product of Darwinian evolution. [28] In the late 19th century, in a dispute between supporters of the adequacy of natural selection and those who held for inheritance of acquired characteristics, one of the arguments made repeatedly by Herbert Spencer, and followed by others, depended on what Spencer referred to as co-adaptation of co-operative parts. It is thirty years since this was set forth in 'The Principles of Biology.' In §166, I instanced the enormous horns of the extinct Irish elk, and contended that in this and in kindred cases, where for the efficient use of some one enlarged part many other parts have to be simultaneously enlarged, it is out of the question to suppose that they can have all spontaneously varied in the required proportions."[29][30] Darwin responded to Spencer's objections in chapter XXV of The Variation of Animals and Plants Under Domestication (1868).[31] The history of this concept in the dispute has been characterized: "An older and more religious tradition of idealist thinkers were committed to the explanation of complex adaptive contrivances by intelligent design. ... Another line of thinkers, unified by the recurrent publications of Herbert Spencer, also saw co-adaptation as a composed, irreducible whole, but sought to explain it by the inheritance of acquired characteristics."[32] St. George Jackson Mivart raised the objection to natural selection that "Complex and simultaneous co-ordinations ... until so far developed as to effect the requisite junctions, are useless"[33] which "amounts to the concept of 'irreducible complexity' as defined by ... Michael Behe".[34] 20th century Hermann Muller, in the early 20th century, discussed a concept similar to irreducible complexity. However, far from seeing this as a problem for evolution, he described the "interlocking" of biological features as a consequence to be expected of evolution, which would lead to irreversibility of some evolutionary changes, [35] He wrote, "Being thus finally woven, as it were, into the most intimate fabric of the organism, the once novel character can no longer be withdrawn with impunity, and may have become vitally necessary."[36] In 1974 the young Earth creationist Henry M. Morris introduced a similar concept in his book Scientific Creationism, in which he wrote; "This issue can actually be attacked quantitatively, using simple principles of mathematical probability. The problem is simply whether a complex system, in which many components function unitedly together, and in which each component is uniquely necessary to the efficient functioning of the whole, could ever arise by random processes."[37] In 1975 Thomas H. Frazzetta published a book-length study of a concept similar to irreducible complexity, explained by gradual, step-wise, non-teleological evolution. Frazzetta wrote: "A complex adaptation is one constructed of several components that must blend together operationally to make the adaptation work." It is analogous to a machine whose performance depends upon careful cooperation among its parts. In the case of the machine, no single part can greatly be altered without changing the performance of the entire machine." The machine that he chose as an analog is the Peaucellier-Lipkin linkage, and one biological system given extended description was the jaw apparatus of a python. The conclusion of this investigation, rather than that evolution of a complex adaptation was impossible, "awed by the adaptations of living things, to be stunned by their complexity and suitability", was "to accept the inescapable but not humiliating fact that much of mankind can be seen in a tree or a lizard." [38] In 1981, Ariel Roth, in defense of the creation-science position in the trial McLean v. Arkansas, said of "complex integrated structures": "This system would not be functional until all the parts were there ... How did these parts survive during evolution ...?"[39] In 1985 Cairns-Smith wrote of "interlocking": "How can a complex collaboration between components evolve in small steps?" and used the analogy of the scaffolding called centering - used to build an arch then removed afterwards: "Surely there was 'scaffolding'. Before the multitudinous components of present biochemistry could come to lean together they had to lean on something else."[40][41] However, neither Muller or Cairns-Smith claimed their ideas as evidence of something supernatural.[42] An essay in support of creationism published in 1994 referred to bacterial flagella as showing "multiple, integrated" in the standard of the components", where "nothing about them works unless every one of their complexly fashioned and integrated components are in place". The author asked the reader to "imagine the effects of natural selection on those organisms that fortuitously evolved the flagella ... without the concommitant [sic] control mechanisms".[43][4] An early concept of

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irreducibly complex systems comes from Ludwig von Bertalanffy (1901-1972), an Austrian biologist. [44] He believed that complex systems must be examined as complete, irreducible systems in a book titled General Systems
Theory. After James Watson and Francis Crick published the structure of DNA in the early 1950s, General Systems Theory remained popular in the physical and biological sciences. [45] However, systems theory remained popular in the physical and biological sciences.
his ideas on the concept around 1992, in the early days of the 'wedge movement', and first presented his ideas about "irreducible complexity" in June 1993 when the "Johnson-Behe cadre of scholars" met at Pajaro Dunes in California.[46] He set out his ideas in the second edition of Of Pandas and People published in 1993, extensively revising Chapter
6 Biochemical Similarities with new sections on the complex mechanism of blood clotting and on the origin of proteins.[47] He first used the term "irreducible complex biochemical cellular systems. He posits that evolutionary mechanisms cannot explain the development of such
"irreducibly complex" systems. Notably, Behe credits philosopher William Paley for the original concept (alone among the predecessors) and suggests that his application of the concept to biological systems is entirely original. Intelligent design advocates argue that irreducibly complex systems must have been deliberately engineered by some form of
intelligence. In 2001, Michael Behe wrote: "[T]here is an asymmetry between my current definition of irreducible complexity and the task facing natural selection. I hope to repair this defect in future work." Behe specifically explained that the "current definition puts the focus on removing a part from an already functioning system", but the "difficult
task facing Darwinian evolution, however, would not be to remove parts from sophisticated pre-existing systems; it would be to bring together components to make a new system in the first place".[48] In the 2005 Kitzmiller v. Dover Area School District trial, Behe testified under oath that he "did not judge [the asymmetry] serious enough to [have
revised the book] yet."[49] Behe additionally testified that the presence of irreducible complexity in organisms would not rule out the involvement of evolutionary mechanisms in the development of organic life. He further testified that he knew of no earlier "peer reviewed articles in scientific journals discussing the intelligent design of the blood
clotting cascade," but that there were "probably a large number of peer reviewed articles in science journals that demonstrate that the blood clotting system is indeed a purposeful arrangement of peer reviewed articles in science and is essentially religious in nature".)[51]
According to the theory of evolution, genetic variations occur without specific design or intent. The environment "selects" the variants that have the highest fitness, which are then passed on to the next generation of organisms. Change occurs by the gradual operation of natural forces over time, perhaps more quickly (see punctuated
equilibrium). This process is able to adapt complex structures from one function and natural selection at the "micro level", such as changing the relative frequency of various beak lengths
in finches, but assert that it cannot account for irreducible complexity, because none of the parts of an irreducible system would be functional or advantageous until the entire system is in place. The mousetrap in an analogy disputed by others.[52]
Behe uses the mousetrap as an illustrative example of this concept. A mousetrap consists of five interacting pieces: the base, the catch, the spring, the hammer, and the hold-down bar. All of these must be in place for the mousetrap to work, as the removal of any one piece destroys the function of the mousetrap. Likewise, he asserts that biological
systems require multiple parts working together in order to function. Intelligent design advocates claim that natural selection could not create from scratch those systems for which science is currently unable to find a viable evolutionary pathway of successive, slight modifications, because the selectable function is only present when all parts are
assembled. In his 2008 book Only A Theory, biologist Kenneth R. Miller challenges Behe's claim that the mousetrap is irreducibly complex. [53] Miller observes that various subsets of the five components can be devised to form functional
spandrels before being adapted to the new function of catching mice. In an example taken from his high school experience, Miller recalls that one of his classmates...struck upon the brilliant idea of using an old, broken mousetrap as a spitball catapult, and it worked brilliantly.... It had worked perfectly as something other than a mousetrap... my
rowdy friend had pulled a couple of parts --probably the hold-down bar and catch-- off the trap to make it easier to conceal and more effective as a catapult... [leaving] the base, the spring, and the hammer. Not much of a mousetrap, but a helluva spitball launcher.... I realized why [Behe's] mousetrap analogy had bothered me. It was wrong. The
mousetrap is not irreducibly complex after all.[53] Other systems identified by Miller that include mousetrap components include the spitball launcher/tie clip to create a two-part key chain (base + hammer) glue the spitball
launcher/tie clip to a sheet of wood to create a clipboard (launcher + glue + wood) remove the hold-down bar for use as a toothpick (single element system) The point of the reduction is that—in biology—most or all of the components were already at hand, by the time it became necessary to build a mousetrap. As such, it required far fewer steps to
develop a mousetrap than to design all the components from scratch. Thus, the development of the mousetrap, said to consist of five different parts which had no function on their own, has been reduced to one step: the assembly from parts that are already present, performing other functions. Consequences Supporters of intelligent design argue that
anything less than the complete form of such a system or organ would not work at all, or would in fact be a detriment to the organism, and would therefore never survive the process of natural selection. Although they accept that some complex systems and biological features which are
irreducibly complex cannot be explained by current models, and that an intelligent designer must have created life or guided its evolution. Accordingly, the debate on irreducible complexity can be found in nature, and what significance it would have if it did exist in nature. [54] Behe's original
examples of irreducibly complex mechanisms included the bacterial flagellum of E. coli, the blood clotting cascade, cilia, and the adaptive immune system. Behe argues that organs and biological features which are irreducibly complex cannot be wholly explained by current models of evolution. In explicating his definition of "irreducible complexity" he
notes that: 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 nonfunctional.
Irreducible complexity is not an argument that evolution does not occur, but rather an argument that it is "incomplete". In the last chapter of Darwin's Black Box, Behe goes on to explain his view that irreducible complexity, as defined by Behe, can be
generated by known evolutionary mechanisms. Behe's claim that no scientific literature adequately modeled the origins of biochemical systems through evolutionary mechanisms has been challenged by TalkOrigins. [55][56] The judge in the Dover trial wrote "By defining irreducible complexity in the way that he has, Professor Behe attempts to
exclude the phenomenon of exaptation by definitional fiat, ignoring as he does so abundant evidence which refutes his argument. Notably, the NAS has rejected Professor Behe's claim for irreducible complexity..."[57] Stated examples Behe and others have suggested a number of biological features that they believed to be irreducibly complex. Blood
clotting cascade The process of blood clotting or coagulation cascade in vertebrates is a complex biological pathway which is given as an example of apparent irreducible complexity. [58] The irreducible complexity argument assumes that the necessary parts of a system have always been necessary, and therefore could not have been added
sequentially. However, in evolution, something which is at first merely advantageous can later become necessary.[59] Natural selection can lead to complex biochemical systems being functional systems being functional systems being built up from simpler systems, or to existing functional systems being functional systems being built up from simpler systems, or to existing functional systems being functional systems being functional systems.
factors that Behe listed as a part of the clotting cascade (Factor XII, also called Hageman factor) was later found to be absent in whales, demonstrating that it is not essential for a clotting systems. [60] Many purportedly irreducible structures can be found in other organisms as much simpler systems that utilize fewer parts. These systems, in turn, may
have had even simpler precursors that are now extinct. Behe has responded to critics of his clotting cascade arguments by suggesting that homology is evidence for evolution, but not for natural selection. [61] The "improbability arguments by suggesting that homology is evidence for evolution, but not for natural selection.
protein structure is so unlikely as to be unfeasible, but that is not what Darwin advocated. His explanation is based on small accumulated changes that take place without a final goal. Each step must be advantageous in its own right, although biologists may not yet understand the reason behind all of them—for example, jawless fish accomplish blood
clotting with just six proteins instead of the full ten.[62] Eye Main article: Evolution of the eye (a) A pigment cup(c) The simple optic cup found in abalone(d) The complex lensed eye of the marine snail and the octopus The eye is frequently cited by intelligent design and creationism advocates
as a purported example of irreducible complexity. Behe used the "development of the eye problem" as evidence for intelligent design in Darwin's Black Box. Although Behe acknowledged that the evolution of the minute biochemical reactions
required at a molecular level for light sensitivity still defies explanation. Creationist Jonathan Sarfati has described the eye as evolutionary biologists' "greatest challenge as an example of superb 'irreducible complexity' in God's creation", specifically pointing to the supposed "vast complexity" required for transparency.[63][failed verification][non-
primary source needed] In an often misquoted[64] passage from On the Origin of Species, Charles Darwin actually had a very good understanding of the evolution of the eye (see fallacy of quoting out of context). He notes that
 "to suppose that the eye ... could have been formed by natural selection, seems, I freely confess, absurd in the highest possible degree". Yet this observation was merely a rhetorical device for Darwin. He goes on to explain that if gradual evolution of the eye could be shown to be possible, "the difficulty of believing that a perfect and complex eye could
be formed by natural selection ... can hardly be considered real". He then proceeded to roughly map out a likely course for evolution using examples of gradually more complex eyes of various species.[65] The eyes of vertebrates evolved an inverted retina with a
blind spot over their optic disc, whereas octopuses avoided this with a non-inverted retina. (1 photo-receptors, 2 neural tissue, 3 optic nerve) Since Darwin's day, the eye's ancestry has become much better understood. Although learning about the construction of ancient eyes through fossil evidence is problematic due to the soft tissues leaving no
imprint or remains, genetic and comparative anatomical evidence has increasingly supported the idea of a common ancestry for all eyes. [66][67][68] Current evidence does suggest possible evolutionary lineages for the origins of the anatomical features of the eye. One likely chain of development is that the eyes originated as simple patches of
photoreceptor cells that could detect the presence or absence of light, but not its direction. When, via random mutation across the population, the photosensitive cells happened to have developed on a small depression, it endowed the organism with a better sense of the light's source. This small change gave the organism an advantage over those
 without the mutation. This genetic trait would then be "selected for" as those with the trait would have an increased chance of survival, and therefore progeny, over those without the trait. Individuals with deeper depressions. As ever deeper
depressions were advantageous to the organism, gradually, this depression would become a pit into which light would strike certain cells depending on its angle. The organism slowly gained increasingly precise visual information. And again, this gradually rocess continued as individuals having a slightly shrunken aperture of the eye had an advantage
over those without the mutation as an aperture increases how collimated the light is at any one specific group of photoreceptors. As this trait developed, the eye became effectively a pinhole camera which allowed the organism to dimly make out shapes—the nautilus is a modern example of an animal with such an eye. Finally, via this same selection
process, a protective layer of transparent cells over the aperture was differentiated into a crude lens, and the interior of the eye was filled with humours to assist in focusing images. [69][70][71] In this way, eyes are recognized by modern biologists as actually a relatively unambiguous and simple structure to evolve, and many of the major process.
developments of the eye's evolution are believed to have taken place over only a few million years, during the Cambrian explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that this is only an explanation of the gross anatomical systems that the gross an
that the complexity of light sensitivity at the molecular level and the minute biochemical reactions required for those first "simple patches of photoreceptors to a fully functional eye would actually be considered great, complex leaps in
evolution if viewed on the molecular scale. Other intelligent design proponents claim that the evolution of flagella Main article: Evoluti
presents this as a prime example of an irreducibly complex structure defined as "a single system to effectively cease functioning", and argues that since "an irreducibly complex system that is missing
a part is by definition nonfunctional", it could not have evolved gradually through natural selection.[75] Reducible complexity. In contrast to Behe's claims, many proteins can be deleted or mutated and the flagellum still works, even though sometimes at reduced efficiency.[76] In fact, the composition of flagella is surprisingly diverse across bacteria
with many proteins only found in some species but not others.[77] Hence the flagellar apparatus is clearly very flexible in evolutionary terms and perfectly able to lose or gain protein components. Further studies have shown that, contrary to claims of "irreducible complexity", flagella and the type-III secretion system share several components which
provides strong evidence of a shared evolution from type three secretion systems. The basal body of the flagellum, including horizontal gene transfer. [80] Evolution from type three secretion systems. The basal body of the flagellum, including horizontal gene transfer.
has been found to be similar to the Type III secretion system (TTSS), a needle-like structure that pathogenic germs such as Salmonella and Yersinia pestis use to inject toxins into living eucaryote cells.[75][81] The needle's base has ten elements in common with the flagellum, but it is missing forty of the proteins that make a flagellum work.[82] The
TTSS system negates Behe's claim that taking away any one of the flagellum's parts would prevent the system from functioning. On this basis, Kenneth Miller notes that, "The parts of this supposedly irreducibly complex system actually have functions of their own."[83][84] Studies have also shown that similar parts of the flagellum in different
bacterial species can have different functions despite showing evidence of common descent, and that certain parts of the flagellum can be removed without completely eliminating its functionality.[85] Dembski has argued that phylogenetically, the TTSS is found in a narrow range of bacteria which makes it seem to him to be a late innovation, whereas
flagella are widespread throughout many bacterial groups, and he argues that it was an early innovation. [86][87] Against Dembski's argument, different mechanisms, and publications show a plausible path in which bacterial flagella use completely different mechanisms, and publications show a plausible path in which bacterial groups, and he argues that it was an early innovation. [86][87] Against Dembski's argument, different mechanisms, and publications show a plausible path in which bacterial flagella use completely different mechanisms.
of axoneme microtubules movement by the sliding of dynein protein was cited by Behe as an example of irreducible complexity of intraflagellar transport for two hundred components cilium and many other cellular structures is substantially
greater than was known earlier.[90] Bombardier beetle is able to defend itself by directing a spray of hot fluid at an attacker. The mechanism involves a system for mixing hydroquinones and hydrogen peroxide, which react violently to attain a temperature near boiling point.
and in some species a nozzle which allows the spray to be directed accurately in any direction.[91][92] The unique combination of features of the bombardier beetle's defense mechanism—strongly exothermic reactions, boiling-hot fluids, and explosive release—have been claimed by creationists and proponents of intelligent design to be examples of
irreducible complexity.[93] Biologists such as the taxonomist Mark Isaak note however that step-by-step evolution of the mechanism could readily have occurred. In particular, quinones are precursors to sclerotin, used to harden the skeleton of meny insects, while peroxide is a common by-product of metabolism.[94][95][96] Response of the scientification of the mechanism could readily have occurred.
community Like intelligent design, the concept it seeks to support, irreducible complexity has failed to gain any notable acceptance within the scientific community. Reduciblly complex systems such as blood clotting, the immune
system[97] and the flagellum[98][99]—the three examples Behe proposed. John H. McDonald even showed his example of a mousetrap to be reducible complexity is an insurmountable obstacle to evolution, it should not be possible to conceive of such pathways.[100] Niall Shanks and Karl H. Joplin, both of East Tennessee State
University, have shown that systems satisfying Behe's characterization of irreducible biochemical complexity can arise naturally and spontaneously as the result of self-organizing chemical processes. [7] They also assert that what evolved biochemical and molecular systems actually exhibit is "redundant complexity"—a kind of complexity that is the
product of an evolved biochemical process. They claim that Behe overestimated the significance of irreducible complexity because of his simple, linear view of biochemical processes, while ignoring the redundant complexity of the context in which
those features are naturally embedded. They also criticized his over-reliance on overly simplistic metaphors, such as his mousetrap. A computer model of the co-evolution of proteins binding sites) which contribute to the basic
function; removal of either one leads immediately to the death of the organism. This model fits the definition of irreducible complexity exactly, yet it evolves.[101] (The program can be run from Ev program.) In addition, research published in the peer-reviewed journal Nature has shown that computer simulations of evolution demonstrate that it is
possible for complex features to evolve naturally.[102] One can compare a mousetrap with a cat in this context. Both normally function so as to control the mouse population. The cat has many parts that can be removed leaving it still functional; for example, its tail can be bobbed, or it can lose an ear in a fight. Comparing the cat and the mousetrap
then, one sees that the mousetrap (which is not alive) offers better evidence, in terms of irreducible complexity, for intelligent design than the cat. Even looking at the mousetrap could develop in stages, demonstrating that it is not
irreducibly complex.[52][53] Moreover, even cases where removing a certain component in an organic system will cause the system to fail do not demonstrate that the system could not have been formed in a step-by-step, evolutionary process. By analogy, stone arches are irreducibly complex—if you remove any stone the arch will collapse—yet
humans build them easily enough, one stone at a time, by building over centering that is removed afterward. Similarly, naturally occurring arches of stone from a large concretion that has formed previously. Evolution can act to simplify as well as to complicate. This raises the possibility that seemingly
irreducibly complex biological features may have been achieved with a period of increasing complexity, followed by a period of simplification. A team led by Joseph Thornton, assistant professor of biology at the University of Oregon's Center for Ecology and Evolutionary Biology, using techniques for resurrecting ancient genes, reconstructed the
evolution of an apparently irreducibly complex molecular system. The April 7, 2006 issue of Science published this research.[6][103] Irreducible complexity, but can be explained in terms of simpler precursors. The theory of
facilitated variation challenges irreducible complexity. Marc W. Kirschner, a professor and chair of Department of Systems Biology at Harvard Medical School, and John C. Gerhart, a professor in Molecular and Cell Biology, University of California, Berkeley, presented this theory in 2005. They describe how certain mutation and changes can cause
apparent irreducible complexity. Thus, seemingly irreducibly complex structures are merely "very complex", or they are simply misunderstood or misrepresented. Gradual adaptation to new functions Main article: Exaptation The precursors of complex systems, when they are not useful in themselves, may be useful to perform other, unrelated
functions. Evolutionary biologists argue that evolution of the later form. The term used for this process is exaptation. The mammalian middle ear (derived from a jawbone) and the panda's thumb (derived from a wrist
bone spur) provide classic examples. A 2006 article in Nature demonstrates intermediate states leading toward the development of the ear in a Devonian fish (about 360 million years ago).[104] Furthermore, recent research shows that viruses play a heretofore unexpected role in evolution by mixing and matching genes from various hosts.[105]
Arguments for irreducibility often assume that things started out the same way they ended up—as we see them now. However, that may not necessarily be the case. In the Dover trial an expert witness for the plaintiffs, Ken Miller, demonstrated this possibility using Behe's mousetrap analogy. By removing several parts, Miller made the object
unusable as a mousetrap, but he pointed out that it was now a perfectly functional, if unstylish, tie clip.[53][106] Methods by which irreducible complexity may evolve Further information: Evolvability Irreducible complexity may evolve Further information: Evolvability Irreducible complexity can be seen as equivalent to an "uncrossable valley" in a fitness landscape.[107] A number of mathematical models of evolution
have explored the circumstances under which such valleys can, nevertheless, be crossed.[108][109][107][110] An example of a structure that is irreducibly complex but has evolved is the protein T-urf13, which is responsible for the cytoplasmic male sterility of waxy corn and is due to a completely new gene.[111] It arose from the fusion of several
non-protein-coding fragments of mitochondrial DNA and the occurrence of several mutations, all of which were necessary. Behe's book Darwin Devolves claims that things like this would take billions of years and could not arise from random tinkering, but the corn was bred during the 20th century. When presented with T-urf13 as an example for the
evolvability of irreducibly complex systems, the Discovery Institute resorted to its flawed probability and experimental evidence Some critics, such as Jerry Coyne (professor of evolutionary biology at the University of Chicago) and Eugenie Scott (a physical
by an experiment where such systems are evolved. For example, he posits taking bacteria evolved the bacterial flagellum, then Behe believes that this would refute his theory.[113][non-primary source needed] Other critics take a
different approach, pointing to experimental evidence that they consider falsification of the argument for intelligent design from irreducible complexity. For example, Kenneth Miller describes the lab work of Barry G. Hall on E. coli as showing that "Behe is wrong".[114] Other evidence that irreducible complexity is not a problem for evolution comes
from the field of computer science, which routinely uses computer analogues of the processes of evolution in order to automatically design complex solutions to problems. The results of such genetic algorithms are frequently irreducibly complex solutions to problems.
components. The removal of unused components with no essential function, like the natural process where rock underneath a natural arch is removed, can produce irreducibly complex structures without requiring the intervention of a designer. Researchers applying these algorithms automatically produce human-competitive designs—but no human
intelligent design proponents to assume an intelligent cause, when the proper response of scientists would be to say that we don't know, and further investigation is needed. [118] Other critics describe Behe as saying that evolutionary explanations are not detailed enough to meet his standards, while at the same time presenting intelligent design as
evolutionary theory and intelligent design are the only two valid models to explain life, a false dilemma.[121][122] In the Dover trial While testifying during the 2005 Kitzmiller v. Dover Area School District trial, Behe conceded that there are no peer-reviewed papers supporting his claims that complex molecular systems, like the bacterial flagellum
the blood-clotting cascade, and the immune system, were intelligently designed nor are there any peer-reviewed articles supporting his argument that certain complex molecular structures are "irreducibly complex molecular structures are "irreducibly complex molecular structures". Judge Jones specifically singled out Behe and irreducible complexity
[123] "Professor Behe admitted in "Reply to My Critics" that there was a defect in his view of irreducible complexity because, while it purports to be a challenge to natural selection, it does not actually address "the task facing natural selection, it does not actually address "the task facing natural selection," (Page 73) "As expert
testimony revealed, the qualification on what is meant by "irreducible complexity" renders it meaningless as a criticism of evolution for how systems with multiple parts could have evolved through natural means." (Page 74) "By
defining irreducible complexity in the way that he has, Professor Behe attempts to exclude the phenomenon of exaptation by definitional fiat, ignoring as he does so abundant evidence which refutes his argument. Notably, the NAS has rejected Professor Behe attempts to exclude the phenomenon of exaptation by definitional fiat, ignoring as he does so abundant evidence which refutes his argument. Notably, the NAS has rejected Professor Behe attempts to exclude the phenomenon of exaptation by definitional fiat, ignoring as he does not appear to example at the phenomenon of exaptation by definitional fiat, ignoring as he does not appear to example at the phenomenon of exaptation by definitional fiat, ignoring as he does not appear to example at the phenomenon of exa
testable does not make testable the argument for ID. (2:15 (Miller); 5:39 (Pennock)). Professor Behe has applied the concept of irreducible complexity to only a few select systems: (1) the blood-clotting cascade; and (3) the immune system. Contrary to Professor Behe has applied the concept of irreducible complexity to only a few select systems: (1) the blood-clotting cascade; and (3) the immune system.
systems among the myriad existing in nature, however, Dr. Miller presented evidence, based upon peer-reviewed studies, that they are not in fact irreducibly complex." (Page 76) "...on cross-examination, Professor Behe was questioned concerning his 1996 claim that science would never find an evolutionary explanation for the immune system. He
irreducible complexity has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large. (17:45-46 (Padian); 3:99 (Miller)). Additionally, even if irreducible complexity had not been rejected by the scientific community at large. (17:45-46 (Padian); 3:99 (Miller)).
We will now consider the purportedly "positive argument" for design encompassed in the phrase used numerous times by Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony, which is the "purposeful arrangement of parts." Professors Behe and Minnich throughout their expert testimony are the parts 
for a purpose. The strength of the inference is quantitative; the more parts that are arranged, the more intricately they interact, the stronger is our confidence in design. The appearance of design in aspects of biology is overwhelming. Since nothing other than an intelligent cause has been demonstrated to be able to yield such a strong appearance of
design, Darwinian claims notwithstanding, the conclusion that the design seen in life is real design is rationally justified. (18:90-91, 18:109-10 (Behe); 37:50 (Minnich)). As previously indicated, this argument is merely a restatement of the Reverend William Paley's argument applied at the cell level. Minnich, Behe, and Paley reach the same
conclusion, that complex organisms must have been designed using the same reasoning, except that Professors Behe and Minnich refuse to identify the designer, whereas Paley inferred from the presence of design that it was God. (1:6-7 (Miller); 38:44, 57 (Minnich)). Expert testimony revealed that this inductive argument is not scientific and as
admitted by Professor Behe, can never be ruled out. (2:40 (Miller); 22:101 (Behe); 3:99 (Miller))." (Pages 79-80) Notes and references ^ a b "We therefore find that Professor Behe's claim for irreducible complexity has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large." Ruling, Judge John E.
Jones III, Kitzmiller v. Dover Area School District ^ "True in this latest creationist variant, advocates of so-called intelligent design ... use more slick, pseudoscientific language. They talk about things like "irreducible complexity" Shulman, Seth (2006). Undermining science: suppression and distortion in the Bush Administration. Berkeley: University of
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Textbook Adoption Controversy Archived 2010-09-30 at the Wayback Machine "The Discovery Institute and ID proponents have a number of goals that they hope to achieve using disingenuous and mendacious methods of marketing, publicity, and political persuasion. They do not practice real science because that takes too long, but mainly because
"Why scientists dismiss 'intelligent design' - LiveScience". NBC News. Retrieved 2010-05-17. ^ a b c Scott EC, Matzke NJ (May 2007). "Biological design in science classrooms". Proc Natl Acad Sci USA. 104 (suppl_1): 8669-76, See page 8672. Bibcode:2007PNAS..104.8669S. doi:10.1073/pnas.0701505104. PMC 1876445. PMID 17494747. ^ Behe
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Archived 2015-09-06 at the Wayback Machine ^ Dembski, William A. (2002). No Free Lunch: Why Specified Complexity Cannot Be Purchased Without Intelligence. Lanham, Maryland: Rowman & Littlefield (published 2006). p. 285. ISBN 9780742558106. Retrieved 1 November 2020. A system performing a given basic function is irreducibly complex
if it includes a set of well-matched, mutually interacting, nonarbitrarily individuated parts such that each part in the set is indispensable to maintaining the system. ^ a b William Paley:Natural Theology; or, Evidences of the
Existence and Attributes of the Deity. Collected from the Appearances of Nature 12th edition, 1809 Archived 2008-04-30 at the Wayback Machine ^ On the Nature of the Gods, translated by Francis Brooks, London: Methuen, 1896. ^ See Henry Hallam Introduction to the Literature of Europe in the Fifteenth, Sixteenth, and Seventeenth Centuries
Boston: Little, Brown and Company, 1854 volume 2 page 385 part iii chapter iii section i paragraph 26 footnote u ^ De Formatione Foetus=The Construction of the Embryo, chapter 11 in Galen: Selected Works, translated by P. N. Singer, The World's Classics, Oxford, Oxford University Press, 1997 ISBN 978-0-19-282450-9. One 18th-century
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parenthetical comment: "(here is where the theory of natural selection removes the difficulty)". See Kant's discussion in section IX of the "First Introduction" to the Critique of Judgment and in §§61, 64 (where he uses the expression wechselsweise abhängt="reciprocally dependent"), and §66 of "Part Two, First Division". For example, Kant, Immanuel
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