I'm not a robot

Translation n., plural: ranslations [tʁansla'ts̑jo:n] Definition: a biological process wherein the genetic code from a strand of mRNA is "translated" into amino acids Translation, in general, is the conversion of something into another form, such as a word from one language to another. But what is translation in biology? In biology, translation is a step in protein biosynthesis where a genetic code from a strand of mRNA is decoded to produce a particular sequence of amino acids. In both prokaryotes and eukaryotes, it takes place on the ribosomes. In eukaryotes, though, it occurs on the ribosomes that are attached to the surface of the endoplasmic reticulum (ER) so that the newly-formed protein after translation would undergo further maturation inside the ER and then be labeled in the Golgi apparatus for transport within or outside the cell. The steps of translation are basically the same for both prokaryotes and eukaryotes. These steps are initiation, translation elongation, and translation termination. What is mRNA and what is it's role in protein synthesis? The answers are explained by our Expert. Read them here: What does mRNA do in protein synthesis? Join our Forum now! Translation Definition Translation steps: initiation, elongation, and termination. This illustration shows how translation proceeds in a eukaryotic cell. The genetic code in the mRNA from the nucleus is translated into a specific sequence of amino acids through the action of tRNAs and ribosomes. Biology definition: Translation is the process of translating (converting) the transcript (genetic information) from the mRNA into a specific sequence of amino acids in the growing chain of a polypeptide. The three general steps of translation are initiation, translation elongation, and translation termination. During initiation, the ribosome binds to the mRNA and then the tRNA attaches to the start codon of the transcript. This is followed by translation elongation wherein a specific order of amino acids is brought to the ribosomal site by the tRNAs according to the sequence of codons in the mRNA transcript. The amino acids are joined in a chain by a peptide bond. The stop codon in the transcript signifies that the termination phase is reached. Eventually, translation stops, and the newly formed protein undergoes maturation (e.g. protein folding or post-translation modifications). Etymology: The term translation comes from the Latin trānslātiōn, meaning "a transferring", equivalent to trānslāt(us) + -iōn. Central Dogma In the central dogma of molecular biology, the genetic information is schematically shown to flow from DNA to DNA (by replication) and from DNA to mRNA (transcription) to protein (translation). In the latter, the genetic code from the mRNA is read as a trinucleotide codon, i.e. a set of three adjacent nucleotides. DNA Replication vs. Translation DNA replication is the process of producing an exact copy of a polynucleotide strand such as DNA. The flow of genetic information will be from DNA to DNA by complementary base pairing in terms of adenine-thymine (AT) and guanine-cytosine (GC) base pairing. The enzymes involved in the process are DNA polymerases. Conversely, the flow of genetic information in translation is from mRNA to protein via complementary base pairing with tRNA in terms of adenine-uracil (AU) and guanine-cytosine (GC) base pairing. The enzymes involved in translation are ribozymes. DNA replication is a preparatory step to cell division (mitosis or meiosis). Translation, following transcription, is a step in protein synthesis. Thus, the product of DNA replication is a copy of the DNA whereas the product of translation is a polypeptide chain or protein. In prokaryotes, DNA replication occurs in the cytoplasm, whereas in eukaryotes it occurs in the nucleus. Translation, in contrast, occurs on the ribosomes of prokaryotes and eukaryotes. Transcription vs. Translation Protein biosynthesis is the biological process of creating protein molecules. The first step is amino acid synthesis. Amino acids may be produced from carbon sources, e.g. glucose. Nevertheless, not all amino acids need to be synthesized. Some of them can be obtained from dietary sources. After amino acid synthesis, transcription is the next step. However, in genetic expression, it is taken as the first step. A segment of the DNA is copied into an mRNA template. Unlike DNA replication, transcription does not need a primer. Rather, it occurs when a gene is turned on. Furthermore, complementary base pairing occurs in terms of AU and CG base pairing. In RNA, uracil replaces the thymine of DNA. Thus, during RNA synthesis, including transcription, adenine pairs up with uracil instead of thymine. The template produced from transcription is also called mRNA transcript since the genetic code is transcribed into mRNA. This transcript is decoded in the next step, translation. At this stage, the mRNA transcript is translated into amino acids in a specific sequence in a polypeptide chain. After translation, the newly-created polypeptide further undergoes protein maturation, e.g. post-translational modifications and protein folding. See the table below for the comparison between transcription and translation. Transcription Translation Definition The process of creating a copy of DNA into mRNA The process of translating mRNA transcript to amino acid Steps (1) Initiation (2) Promoter escape (3) Elongation (4) Termination (1) Initiation (2) Elongation (3) Termination Location In prokaryotes, in the cytoplasm In eukaryotes, in the nucleus In prokaryotes and eukaryotes, in the cytoplasm where ribosomes are located Enzymes RNA polymerase Ribozyme Products mRNA Polypeptide or protein Function The first step of gene expression mRNA synthesis The second step of gene expression Peptide or protein synthesis Data summarized by Maria Victoria Gonzaga for Biology Online Which comes first? Translation or the transcription of the code? Share your views here: What does mRNA do in protein synthesis? Join our Forum now! mRNA, tRNA, and rRNA Three RNAs are involved in biological translations. They are mRNA (messenger RNA), tRNA (transfer RNA), and rRNA (ribosomal RNA). mRNA is the RNA produced from transcription. It is comprised of a 5′ cap, 5′UTR region, coding region, 3′UTR region, and poly(A) tail. The copy of a DNA segment for gene expression is located in its coding region. It begins with a start codon at 5′end and a stop codon at the 3′ end. tRNA is the RNA that transfers the specific amino acid to the ribosome to be added to the growing chain of amino acids. It has two major sites: one is the anticodon arm containing the anticodon and the other is the acceptor stem, which is the site for the amino acid. tRNA with amino acid is called aminoacyl-tRNA. The –COOH of the amino acid attaches to the 3′-OH of the adenine in the CCA tail by a covalent bond. Another type of tRNA is the peptidyl tRNA, which is a tRNA carrying the growing peptide chain. rRNA is the RNA component of the ribosome. The ribosome is a cytoplasmic structure in cells of prokaryotes and eukaryotes. The ribosome of prokaryotes is the 70S whereas the ribosome of eukaryotes is 80S. Both 70S and 80S are made up of a large subunit and a small subunit. The large subunit serves as a ribozyme catalyzing the peptide bond formation between two amino acids. In contrast to tRNA and mRNA that carry genetic information, rRNA does not. Nevertheless, it has three binding sites for RNA: A, P, and E sites. The A (aminoacyl) site is where aminoacyl-tRNA docks. The P (peptidyl) site is where peptidyl-tRNA binds. The E (exit) site is where the tRNA leaves the ribosome. Codon Definition (Biology) RNA codon amino acid chart. Codon, in biology, refers to the set of three adjacent nucleotides in mRNA. It is also called a triplet. It complementary base pair with the anticodon of aminoacyl-tRNA. Examples: Guanine-Cytosine-Cytosine (GCC) is the codon for the amino acid alanine. Guanine-Uracil-Uracil (GUU) codes for valine. Cytosine-Uracil-Adenine (CUA) codes for leucine. Uracil-Adenine-Adenine (UAA) is a stop codon. Anticodon Definition (Biology) Anticodon refers to the sequence of three adjacent nucleotides located on tRNA. It complementary-base -pairs with the codon of mRNA. For example, the anticodon for glycine is CCC (Cytosine-Cytosine-Cytosine) that binds to the codon GGG (Guanine-Guanine-Guanine) of mRNA. Translation steps Prior to initiation, a pre-translation step occurs. Called bio-activation, the amino acid binds to the corresponding tRNA by a covalent bond. Step 1: Initiation Translation initiation is the first major step of translation wherein the genetic code carried by mRNA is decoded to produce the specific sequence of amino acids in a polypeptide chain. The small subunit of the ribosome binds to the 5′ end of mRNA as facilitated by initiation factors (IF). The first tRNA attaches to the initiation or start codon. An initiation codon is the codon specified usually by AUG in mRNA. It is recognized by formylmethionyl-tRNA (tRNAf) in prokaryotes and by methionyl-tRNA in eukaryotes. Step 2: Translation elongation After initiation is transcription elongation. This is when the next aminoacyl-tRNA in line binds to the ribosome along with GTP and elongation factor (EF). The ribosome then translocates to the next mRNA codon resulting in the elongation of the amino acid chain. Step 3: Translation termination The last step is translation termination. This is when a peptidyl tRNA encounters a stop codon (e.g. UAA, UAG, or UGA). A stop codon does not code for any amino acid but serves as a termination signal of translation. When the termination codon is reached, the newly produced protein goes through maturation through protein folding or post-translation modifications. Prokaryotic vs. Eukaryotic Translations The major steps of translation in prokaryotes and eukaryotes are the same (i.e. initiation, elongation, translocation, and termination) and in both cells occurs on the ribosome. Translation in prokaryotes, though, occurs on 70S-type of ribosomes whereas translation in eukaryotes occurs on 80S-type of ribosomes. Because prokaryotes lack membrane-bound organelles, their mRNA transcript is synthesized in the cytoplasm. In eukaryotes, mRNA is synthesized in the nucleus and then released into the cytoplasm where ribosomes are located. In eukaryotes, the growing chain of amino acids is released into the lumen of the endoplasmic reticulum via the ribosome attached to it. Translation in prokaryotes Translation in eukaryotes mRNA transcript from DNA is synthesized in the cytoplasm mRNA transcript from DNA is synthesized in the nucleus mRNA is polycistronic mRNA is monocistronic Translation occurs in 70S ribosome Translation occurs in 80S ribosome Major steps: (1) Initiation (2) Elongation (3) Termination Major steps: (1) Initiation (2) Elongation (3) Termination Translation initiation mechanism is cap-independent Translation initiation mechanism is cap-independent or cap-dependent First tRNA is Met-tRNAf First tRNA is Met-tRNA Initiation factors: IF1, IF2, IF3 Initiation factors: eIF1, eIF2, eIF3, eIF4, eIF5A, eIF5B, eIF6 Elongation factors: EF-Tu and EF-Ts Elongation factors: eEF1 and eEF2 Release factors on termination: RF1, RF2, RF3 Release factors on termination: eRF1 Relatively faster, about 20 amino acids per second Relatively slower, 1 amino acid per second Data summarized by Maria Victoria Gonzaga for Biology Online Got questions about translation? Or an opinion about mRNA and protein synthesis? Join us and participate in our Forum: What does mRNA do in protein synthesis? We'd be happy to hear your thoughts! NOTE IT! Unorthodox Ways of Translating Proteins Within the seemingly straightforward standard steps of initiation, elongation, and termination that the translation machinery takes are the off-track nonconventional routes that it treads. Such unorthodox steps appear to help generate an even more so unique protein products, plausibly with new function. It's as if reading a sentence differently to discover a whole new different context. As a matter of fact, such mechanisms are employed by certain bcteria and viruses in order to evade the host's immune system while unraveling novel avenues for replication and pathogenesis. Here are some mechanisms that help create a set of diverse protein products that may have a potential new use or function, all from just a single mRNA: Frameshifting: when the ribosome shifts the reading frame as it reads the mRNA sequence, such as by +1 (one base forward) or -1 (one base backward), leading to the prodcution of protein isoforms. It helps make various proteins from the same genetic instructions by reading the genes differently. This mechanism is employed by the HIV virus to synthesize the viral enzymes reverse transcriptase and integrase. Readthrough (Stop Codon Suppression): when a stop codon doesn't stop the translation. Translations still continues resulting in longer or larger protein. Ribosomal hopping or bypassing: when the ribosome skips a portion of the reading frame, resulting in a protein with a different amino acid sequence/ composition/intermolecular interactions. Nonconventional protein translation. Image prepared by Maria Victoria Gonzaga for Biology Online Try to answer the quiz below to check what you have learned so far about translation. References Central Dogma of Biology. (2014). Retrieved from Csbsju.edu website: 20and%20society/cent_dogma/olcentdogma.html Translation: DNA to mRNA to Protein Learn Science at Scitable. (2013). Retrieved from Nature.com website: Transcription and translation. (2017, April 26). Retrieved from Uq.edu.au website: Transcription / Translation. (2019). Retrieved from Iupui.edu website: Protein Synthesis. (2019). Retrieved from Elmhurst.edu website: Research Guides: BSCI 1510L Literature and Stats Guide: The genetic code and the Central Dogma of Molecular Biology. (2018). Retrieved from Vanderbilt.edu website: Chapter 13 Lecture Notes: DNA Function. (n.d.). Retrieved from: lrunyenj/bio554/lectnotes/Chapter13.pdf DNA and RNA – Computational Medicine Center. (2009). Retrieved from Jefferson.edu website: © Biology Online. Content provided and moderated by Biology Online Editors , the free encyclopedia that anyone can edit. 110,331 active editors 7,023,430 articles in English Game Boy, platform of Donkey Kong Land Donkey Kong Land is a platform game developed by Rare and published by Nintendo for the Game Boy (pictured). Released on June 26, 1995, it condenses the side-scrolling gameplay of Donkey Kong Country with a different level design and boss fights. The player controls Donkey Kong and Diddy Kong as they recover their stolen banana hoard from King K. Rool. Development began in 1994: Rare's Game Boy programmer, Paul Machacek, developed Land as an original game rather than a port of Country, believing that it would be a better use of resources. Land features pre-rendered graphics converted to sprites through a compression technique. Rare retooled Country's gameplay to account for the lower-quality display, and David Wise and Graeme Norgate converted the soundtrack to the Game Boy's sound chip. Critics praised it as successfully translating Country's gameplay, visuals, and music to the Game Boy. Land was rereleased for the Nintendo 3DS and the Nintendo Switch. (Full article...) Recently featured: History of education in Wales (1701–1870) White dwarf Battle of Groix Archive By email More featured articles About Mendel Catholic High School ... that Mendel Catholic High School (pictured) raised $15 million through hosting weekly house dances from 1975? ... that singer Karin Ann made headlines after performing live on Polish state television wrapped in a rainbow flag? ... that voters approved a 600-percent increase in property taxes to fund programs at Valley Medical Center? ... that the Diocese of Poreč and Pula was nearly bankrupted over a dispute with the Italian Benedictines, a case that Dražen Kutleša is credited with quietly resolving? ... that the Dutch government considered converting the incomplete Java-class cruisers into English Channel ferries? ... that Jack Reardon received a heart transplant while serving as the mayor of Kansas City? ... that the symbol for equality in mathematics was not used for 61 years after its introduction, and was later popularized by Isaac Newton? ... that stand-up comedian Dustin Nickerson has said that his children have veto power over any jokes he might tell about them? ... that Saint-Saëns's Phaéton was described by a critic after its premiere as "the noise of a hack coming down from Montmartre"? Archive Start a new article Nominate an article Trifid and Lagoon nebulae The Vera C. Rubin Observatory in Chile releases the first light images (example shown) from its new 8.4-meter (28 ft) telescope. In basketball, the Oklahoma City Thunder defeat the Indiana Pacers to win the NBA Finals. An attack on a Greek Orthodox church in Damascus, Syria, kills at least 25 people. The United States conducts military strikes on three nuclear facilities in Iran. In rugby union, the Crusaders defeat the Chiefs to win the Super Rugby Pacific final. Ongoing: Gaza war Iran–Israel war Russian invasion of Ukraine timeline Sudanese civil war timeline Recent deaths: Maria Voce Wes Hildreth Lucien Nedzi Anne Burrell Frederick W. Smith Ron Taylor Nominate an article June 26 Douglas Skymaster plane Amana 1740 – War of Jenkins' Ear: Spanish troops stormed the British-held strategically crucial position of Fort Mose in Spanish Florida. 1945 – At a conference in San Francisco, delegates from 50 nations signed a charter establishing the United Nations. 1950 – A Douglas DC-4 Skymaster aircraft (pictured) crashed after departing from Perth, becoming the worst peacetime aviation accident in Australia's history. 2010 – A G20 summit, the largest and most expensive security operation in Canadian history, began in downtown Toronto. 2015 – The U.S. Supreme Court ruled in Obergefell v. Hodges that the right of same-sex couples to marry is guaranteed by the Fourteenth Amendment. Robert the Lotharingian (d. 1095)George IV of the United Kingdom (d. 1830)Walter C. Root (d. 1925)Pavel Belyayev (b. 1925) More anniversaries: June 25 June 26 June 27 Archive By email List of days of the year About Atacamite is a copper halide mineral: a copper(II) chloride hydroxide with the chemical formula $Cu_2Cl(OH)_3$. It was first described in 1802 by Dmitri Alekseyevich Golitsyn from deposits in Chile's Atacama Desert, after which it is named. Atacamite is a comparatively rare mineral, formed from primary copper minerals in the oxidation or weathering zone of arid climates. It has also been reported as a volcanic sublimate from fumarole deposits, as sulfide alteration products in black smokers. This photograph shows a specimen of atacamite, on a malachite matrix, from the Mount Gunson Mines in South Australia. The picture was focus-stacked from 42 separate images. Photograph credit: Ivar Leidus Recently featured: Turban Head eagle Springbok Geraldine Ulmar Archive More featured pictures Community portal – The central hub for editors, with resources, links, tasks, and announcements. Village pump – Forum for discussions about Wikipedia itself, including policies and technical issues. Site news – Sources of news about Wikipedia and the broader Wikimedia movement. Teahouse – Ask basic questions about using or editing Wikipedia. Help desk – Ask questions about using or editing Wikipedia. Reference desk – Ask research questions about encyclopedic topics. Content portals – A unique way to navigate the encyclopedia. Wikipedia is written by volunteer editors and hosted by the Wikimedia Foundation, a non-profit organization that also hosts a range of other volunteer projects: CommonsFree media repository MediaWikiWiki software development Meta-WikiWikimedia project coordination WikibooksFree textbooks and manuals WikidataFree knowledge base WikinewsFree-content news WikiquoteCollection of quotations WikisourceFree-content library WikispeciesDirectory of species WikiversityFree learning tools WikivoyageFree travel guide WiktionaryDictionary and thesaurus This Wikipedia is written in English. Many other Wikipedias are available; some of the largest are listed below. 1,000,000+ articles العربية Deutsch Español فارسی Français Italiano Nederlands 日本語 Polski Português Русский Svenska Українська Tiếng Việt 中文 250,000+ articles Bahasa Indonesia Bahasa Melayu Bân-lâm-gú Български Català Čeština Dansk Eesti Ελληνικά Esperanto Euskara עברית Հայերեն Magyar Norsk bokmål Română Simple English Slovenčina Srpski Srpskohrvatski Suomi Türkçe Oʻzbekcha 50,000+ articles Asturianu Azərbaycanca Bosanski کوردی Frysk Gaeilge Galego Hrvatski ქართული Kurd Latviešu Lietuvių Македонски Norsk nynorsk Shqip Slovenščina اردو Retrieved from " 2 Calendar year Years Millennium 2nd millennium Centuries 17th century 18th century 19th century Decades 1720s 1730s 1740s 1750s 1760s Years 1737 1738 1739 1740 1741 1742 1743 vte October 9: The Batavia Massacre by the Dutch East India Company of at least 5,000 Chinese Indonesians begins in what is now Jakarta. 1740 by topic Arts and science Archaeology Architecture Art Literature Poetry Music Science Countries Canada Denmark France Great Britain Ireland Japan Norway Russia Scotland Spain Sweden Lists of leaders State leaders Colonial governors Religious leaders Birth and death categories Births Deaths Establishments and disestablishments categories Establishments Disestablishments Works category Works vte 1740 in various calendarsGregorian calendar1740MDCCXLAb urbe condita2493Armenian calendar1189ԹՎ ՌՃՁԹAssyrian calendar6490Balinese saka calendar1661–1662Bengali calendar1146–1147Berber calendar2690British Regnal year13 Geo. 2 – 14 Geo. 2Buddhist calendar2284Burmese calendar1102Byzantine calendar7248–7249Chinese calendar己未年 (Earth Goat)4437 or 4230 — to —庚申年 (Metal Monkey)4438 or 4231Coptic calendar1456–1457Discordian calendar2906Ethiopian calendar1732–1733Hebrew calendar5500–5501Hindu calendars - Vikram Samvat1796–1797 - Shaka Samvat1661–1662 - Kali Yuga4840–4841Holocene calendar11740Igbo calendar740–741Iranian calendar1118–1119Islamic calendar1152–1153Japanese calendarGenbun 5(元文５年)Javanese calendar1664–1665Julian calendarGregorian minus 11 daysKorean calendar4073Minguo calendar172 before ROC民前172年Nanakshahi calendar272Thai solar calendar2282–2283Tibetan calendar阴土羊年(female Earth-Goat)1866 or 1485 or 713 — to —阳金猴年(male Iron-Monkey)1867 or 1486 or 714 Wikimedia Commons has media related to 1740. 1740 (MDCCXL) was a leap year starting on Friday of the Gregorian calendar and a leap year starting on Tuesday of the Julian calendar, the 1740th year of the Common Era (CE) and Anno Domini (AD) designations, the 740th year of the 2nd millennium, the 40th year of the 18th century, and the 1st year of the 1740s decade. As of the start of 1740, the Gregorian calendar was 11 days ahead of the Julian calendar, which remained in localized use until 1923. Calendar year January 8 – All 237 crewmen on the Dutch East India Company ship Rooswijk are drowned when the vessel strikes the shoals of Goodwin Sands, off of the coast of England, as it is beginning its second voyage to the Indies. The wreckage is discovered more than 250 years later, in 2004.[1] February 20 – The North Carolina General Assembly incorporates the town of Newton as Wilmington, North Carolina, named for Spencer Compton, 1st Earl of Wilmington and patron of Royal Governor Gabriel Johnston. March 16 – King Edward of the Miskito Indians signs a treaty making his kingdom, located on the coast of modern-day Nicaragua, a protectorate of Great Britain.[2] March 25 – Construction begins on Bethesda Orphanage for boys near Savannah, Georgia, founded by George Whitefield. April 8 – War of the Austrian Succession: The Royal Navy captures the Spanish ship of the line Princesa off Cape Finisterre and takes her into British service. May 31 – Frederick II becomes King in Prussia upon the death of his father, Frederick William I. June 1 – Plantation Act 1740 or Naturalization Act 1740 of the Parliament of Great Britain comes into effect providing for Protestant alien immigrants (including Huguenots, and also Jews) residing in the American colonies for 7 years to receive British nationality. June 16 – Pour le Mérite first awarded in Prussia as a military honour. June 26 – War of Jenkins' Ear: Siege of Fort Mose – A Spanish column of 300 regular troops, free Black militia and Indian auxiliaries storms Britain's strategically crucial position of Fort Mose, Florida. July 7 – Adam Smith sets out from Scotland to take up a scholarship at Balliol College, Oxford.[3] July 11 – Pogrom: Jews are expelled from Little Russia. August 1 – The song Rule, Britannia! is first performed at Cliveden, the country home of Frederick, Prince of Wales, in England.[4] August 17 – Pope Benedict XIV succeeds Pope Clement XII, as the 247th pope. September 8 – Hertford College, Oxford, England, is founded for the first time.[5] October 9–22 – Batavia Massacre: Troops of the Dutch East India Company massacre 5,000–10,000 Chinese Indonesians in Batavia.[6] October 20 – Maria Theresa inherits the hereditary dominions of the Habsburg monarchy (Austria, Bohemia, Hungary and modern-day Belgium) under the terms of the Pragmatic Sanction of 1713 on the death of her father, Charles VI. Her succession to the Holy Roman Empire is contested widely because she is a woman, but she will reign for 40 years. November 6 – Samuel Richardson's popular and influential epistolary novel, Pamela; or, Virtue Rewarded, is published anonymously in London. November 14 – The University of Pennsylvania is officially established. December 16 – Frederick II of Prussia invades the Habsburg possession of Silesia, starting the War of the Austrian Succession. Enfield, North Carolina, is founded. Spain begins construction on Fort Matanzas in the Matanzas Inlet, approximately 15 miles (24 km) south of St. Augustine, Florida. The fairy-tale Beauty and the Beast by French novelist Gabrielle-Suzanne Barbot de Villeneuve was published. February 4 – Carl Michael Bellman, Swedish poet, composer (d. 1795) February 15 – Juan Andrés, Spanish Jesuit (d. 1817) February 16 – Giambattista Bodoni, Italian publisher and engraver (d. 1813) February 17 – John Sullivan, American General in the American Revolutionary War, delegate in the Continental Congress (d. 1795) March – Johann van Beethoven, German musician, father of Ludwig van Beethoven (d. 1792) March 16 – Johann Jacob Schweppe, German-born inventor, founder of the Schweppes Company (d. 1821) April 7 – Haym Salomon, Polish-Jewish American financier of the American Revolution (d. 1785) April 14 – Anna Strong, Patriot spy during the American Revolutionary War (d. 1812) May 7 – Nikolai Arkharov, Russian police chief (d. 1814) Marquis de Sade June 2 – Marquis de Sade, French author, for whom sadism is named (d. 1814) June 24 – Juan Ignacio Molina, Spanish-Chilean Jesuit priest, naturalist, historian, translator, geographer, botanist, ornithologist and linguist (d. 1829) June 27 – James Woodforde, English clergyman and diarist (d. 1803) July 27 – Jeanne Baré, French explorer (d. 1803) August 23 – Emperor Ivan VI of Russia (d. 1764) August 26 – Joseph-Michel Montgolfier, French inventor (d. 1810) September 12 – Johann Heinrich Jung, German writer (d. 1817) September 23 – Empress Go-Sakuramachi of Japan (d. 1813) September 25 – Hercules Mulligan, tailor and spy during the American Revolutionary War (d. 1825) October 29 – James Boswell, Scottish author (d. 1795) October 31 – Philip James de Loutherbourg, English artist (d. 1812) December – Elisabeth Olin, Swedish opera singer (d. 1828) Ali Pasha of Ioannina, Albanian ruler (d. 1822) Margaret Bingham, Countess of Lucan, born Margaret Smith, English portrait miniature painter and writer (d. 1814)[7] John Milton, American politician and officer of the Continental Army (d. 1817) (earliest estimated date of birth) Septimanie d'Egmont, French salonist (d. 1773) Pope Clement XII Frederick William I, King in Prussia Saint Theophilus of Corte Charles VI, Holy Roman Emperor Anna, Empress of Russia January – Louise Élisabeth de Joybert, politically active Canadian governors' wife (b. 1673) January 5 – Antonio Lotti, Italian composer (b. 1667) January 17 – Matthias Buchinger, German artist (b. 1674) January 20 – Niccolò Comneno Papadopoli, Italian jurist of religious law and historian (b. 1655) January 21 – Nicholas Trott, colonial magistrate, South Carolina Chief Justice (b. 1663) January 27 – Louis Henri, Duke of Bourbon, Prime Minister of France (b. 1692) January 29 – Richard Lumley, 2nd Earl of Scarbrough (b. 1686) February 6 – Pope Clement XII (b. 1652)[8] February 23 – Massimiliano Soldani Benzi, Italian artist (b. 1656) February 29 – Pietro Ottoboni, Italian cardinal (b. 1667) March 23 – Olof Rudbeck the Younger, Swedish scientist and explorer (b. 1660) April 28 – Bajirao I, Great Maratha warrior and Prime Minister of Marartha Empire (b.1700) April 23 – Thomas Tickell, English writer (b. 1685) May 17 – Jean Cavalier, French Protestant rebel leader (b. 1681) May 31 – Frederick William I, King in Prussia (b. 1688) June 1 – Samuel Werenfels, Swiss theologian (b. 1657) June 6 – Alexander Spotswood, British governor of Virginia Colony (b. 1676) June 17 Theophilus of Corte, Italian Roman Catholic priest, preacher and missionary, canonized (b. 1676) William Wyndham, English politician (b. 1687) June 18 – Piers Butler, 3rd Viscount Galmoye, Anglo-Irish nobleman (b. 1652) July 2 – Thomas Baker, English antiquarian (b. 1656) October 5 – Johann Philipp Baratier, German scholar (b. 1721) October 11 – Princess Magdalena Augusta of Anhalt-Zerbst, Duchess of Saxe-Gotha-Altenburg (b. 1679) October 20 – Charles VI, Holy Roman Emperor (b. 1685) October 28 – Anna, Empress of Russia (b. 1693) December 1 – John Abernethy, Irish Protestant minister (b. 1680) December 20 – Richard Boyle, 2nd Viscount Shannon, British military officer and statesman (b. 1675) December 30 – John Senex, English geographer (b. ca. 1678)[9] ^ Wendy van Duivenvoorde, Dutch East India Company Shipbuilding: The Archaeological Study of Batavia and Other Seventeenth-Century VOC Ships (Texas A&M University Press, 2015) p145 ^ "Mosquito Coast", in Historical Dictionary of the British Empire, ed. by Kenneth J. Panton (Rowman & Littlefield, 2015) p384 ^ "On this day in 1740..." Adam Smith Institute. July 7, 2010. Retrieved November 19, 2019. ^ Williams, Hywel (2005). Cassell's Chronology of World History. London: Weidenfeld & Nicolson. p. 308. ISBN 0-304-35730-8. ^ Hamilton, Sidney Graves (1903). Hertford College. University of Oxford college histories. London: Robinson. ^ "Image: Bird's eye view of Batavia showing the massacre of the Chinese". Archived from the original on September 21, 2009. Retrieved November 12, 2006. ^ This article incorporates text from a publication now in the public domain: Stephen, Leslie, ed. (1886). "Bingham, Margaret". Dictionary of National Biography. Vol. 5. London: Smith, Elder & Co. ^ "Clement XII | pope". Encyclopedia Britannica. Retrieved April 22, 2021. ^ "The Historical Theater in the Year 400 AD, in Which Both Romans and Barbarians Resided Side by Side in the Eastern Part of the Roman Empire". World Digital Library. 1725. Retrieved July 27, 2013. Retrieved from " 3One hundred years, from 1601 to 1700 Millennia 2nd millennium Centuries 16th century 17th century 18th century Timelines 16th century 17th century 18th century State leaders 16th century 17th century 18th century Decades 1600s 1610s 1620s 1630s 1640s 1650s 1660s 1670s 1680s 1690s Categories: Births – Deaths Establishments – Disestablishments vte The 17th century lasted from January 1, 1601 (represented by the Roman numerals MDCI), to December 31, 1700 (MDCC). It falls into the early modern period of Europe and in that continent (whose impact on the world was increasing) was characterized by the Baroque cultural movement, the latter part of the Spanish Golden Age, the Dutch Golden Age,[1] the French Grand Siècle dominated by Louis XIV, the Scientific Revolution, the world's first public company and megacorporation known as the Dutch East India Company, and according to some historians, the General Crisis. From the mid-17th century, European politics were increasingly dominated by the Kingdom of France of Louis XIV, where royal power was solidified domestically in the civil war of the Fronde. The semi-feudal territorial French nobility was weakened and subjugated to the power of an absolute monarchy through the reinvention of the Palace of Versailles from a hunting lodge to a gilded prison, in which a greatly expanded royal court could be more easily kept under surveillance. With domestic peace assured, Louis XIV caused the borders of France to be expanded. It was during this century that the English monarch became increasingly involved in conflicts with the Parliament - this would culminate in the English civil war and an end to the dominance of the English monarchy.A scene on the ice, Dutch Republic, first half of the 17th centuryBy the end of the century, Europeans were masters of logarithms, electricity, the telescope and microscope, calculus, universal gravitation, Newton's Laws of Motion, air pressure, and calculating machines due to the work of the first scientists of the Scientific Revolution, including Galileo Galilei, Johannes Kepler, René Descartes, Pierre Fermat, Blaise Pascal, Robert Boyle, Christiaan Huygens, Antonie van Leeuwenhoek, Robert Hooke, Isaac Newton, and Gottfried Wilhelm Leibniz. It was also a period of development of culture in general (especially theater, music, visual arts and philosophy). Some of the greatest inventions took place in this century. It was during this period that the European colonization of the Americas began in earnest, including the exploitation of the silver deposits, which resulted in bouts of inflation as wealth was drawn into Europe.[2] Also during this period, there would be a more intense European presence in Southeast Asia and East Asia (such as the colonization of Taiwan). These foreign elements would contribute to a revolution in Ayutthaya. The Mataram Sultanate and the Aceh Sultanate would be the major powers of the region, especially during the first half of the century.[2] In the Islamic world, the gunpowder empires – the Ottoman, Safavid, and Mughal – grew in strength as well. The southern half of India would see the decline of the Deccan Sultanates and extinction of the Vijayanagara Empire. The Dutch would colonize Ceylon and endure hostilities with Kandy. The end of the 17th century saw the first major surrender of Ottoman territory in Europe when the Treaty of Karlowitz ceded most of Hungary to the Habsburgs in 1699. In Japan, Tokugawa Ieyasu established the Tokugawa shogunate at the beginning of the century, beginning the Edo period; the isolationist Sakoku policy began in the 1630s and lasted until the 19th century. In China, the collapsing Ming dynasty was challenged by a series of conquests led by the Manchu warlord Nurhaci, which were consolidated by his son Hong Taiji and finally consummated by his grandson, the Shunzhi Emperor, founder of the Qing dynasty.[3] Qing China spent decades of this century with economic problems (results of civil wars between the Qing and former Ming dynasty loyalists), only recovering well at the end of the century. The greatest military conflicts of the century were the Thirty Years' War,[4] Dutch–Portuguese War,[5] the Great Turkish War, the Nine Years' War, Mughal–Safavid Wars, and the Qing annexation of the Ming. For a chronological guide, see Timeline of the 17th century. Main articles: 1600s, 1610s, 1620s, 1630s, and 1640s Persian Ambassador during his entry into Kraków for the wedding ceremonies of King Sigismund III of Poland in 1605. 1601: 4th Spanish Armada; in the Battle of Kinsale, England defeats Irish and Spanish forces, driving the Gaelic aristocracy out of Ireland and destroying the Gaelic clan system. 1601–1603: The Russian famine of 1601–1603 kills perhaps one-third of Russia.[6] 1602: Matteo Ricci produces the Map of the Myriad Countries of the World (坤輿萬國全圖, Kūnyú Wànguó Quántú), a world map that will be used throughout East Asia for centuries. 1602: The Dutch East India Company (VOC) is established by merging competing Dutch trading companies.[7] Its success contributes to the Dutch Golden Age. 1603: Elizabeth I of England dies and is succeeded by her cousin King James VI of Scotland, uniting the crowns of Scotland and England. 1603: Tokugawa Ieyasu takes the title of shōgun, establishing the Tokugawa shogunate. This begins the Edo period, which will last until 1868. 1603: In Nagasaki, the Portuguese Jesuit missionary João Rodrigues publishes Nippo Jisho, the first dictionary of Japanese to a European (Portuguese) language. 1605: The King of Gowa, a Makassarese kingdom in South Sulawesi, converts to Islam.Tsar Michael I of Russia reigned 1613–1645 1605–1627: The reign of Mughal emperor Jahangir after the death of emperor Akbar. 1606: The Long Turkish War between the Ottoman Empire and Austria is ended with the Peace of Zsitvatorok—Austria abandons Transylvania. 1606: Treaty of Vienna ends an anti-Habsburg uprising in Royal Hungary. 1606: Willem Janszoon captained the first recorded European landing on the Australian continent, sailing from Bantam, Java, in the Duyfken. 1607: Flight of the Earls (the fleeing of most of the native Gaelic aristocracy) occurs from County Donegal in the west of Ulster in Ireland. 1607: Iskandar Muda becomes the Sultan of Aceh for 30 years. He will launch a series of naval conquests that will transform Aceh into a great power in the western Malay Archipelago. 1610: The Polish–Lithuanian Commonwealth army defeats combined Russian–Swedish forces at the Battle of Klushino and conquers Moscow. 1610: King Henry IV of France is assassinated by François Ravaillac. 1611: The Pontifical and Royal University of Santo Tomas, the oldest existing university in Asia, is established by the Dominican Order in Manila[8] 1611: The first publication of the King James Bible. 1612: The first Cotswold Olympic Games, an annual public celebration of games and sports begins in the Cotswolds, England. 1613: The Time of Troubles in Russia ends with the establishment of the House of Romanov, which rules until 1917. 1613–1617: Polish–Lithuanian Commonwealth is invaded by the Tatars dozens of times.[9]James I of England and VI of Scotland ruled in the first quarter of the 17th century 1613: The Dutch East India Company is forced to evacuate Gresik due to the Mataram siege in neighboring Surabaya. The dutch negotiates with Mataram and is allowed to set up a trading post in Jepara. 1614–1615: The Siege of Osaka (last major threat to Tokugawa shogunate) ends. 1616: The last remaining Moriscos (Moors who had nominally converted to Christianity) in Spain are expelled. 1616: English poet and playwright William Shakespeare dies. 1618: The Defenestration of Prague. 1618: The Bohemian Revolt precipitates the Thirty Years' War, which devastates Europe in the years 1618–48. 1618: The Manchus start invading China. Their conquest eventually topples the Ming dynasty. 1619: European slaving reaches America when the first Africans are brought to the present-day United States. 1619: The Dutch East India Company storm Jayakarta and withstand a months-long siege by the combined English, Bantenese and Jayakartan forces. They are relieved by Jan Pieterszoon Coen and a fleet of ships from Ambon. The dutch destroys Jayakarta and builds its new headquarters, Batavia, on top of it. 1620–1621: Polish–Ottoman War over Moldavia. 1620: Bethlen Gabor allies with the Ottomans and an invasion of Moldavia takes place. The Polish suffer a disaster at Cecora on the River Prut. 1620: The Mayflower sets sail from Plymouth, England to what became the Plymouth Colony in New England.The 1622 massacre was instrumental in causing English colonists to view all natives as enemies 1621: The Battle of Chocim: Poles and Cossacks under Jan Karol Chodkiewicz defeat the Ottomans. 1622: Jamestown massacre: Algonquian natives kill 347 English settlers outside Jamestown, Virginia (approximately one-third of the colony's population)[10][11] and burn the Henricus settlement. 1624–1642: As chief minister, Cardinal Richelieu centralises power in France. 1626: St. Peter's Basilica in the Vatican completed. 1627: Aurochs go extinct.[12] 1628–1629: Sultan Agung of Mataram launches a failed campaign to conquer Dutch Batavia. 1629: Abbas I, the Safavids king, died. 1629: Cardinal Richelieu allies with Swedish Protestant forces in the Thirty Years' War to counter Ferdinand II's expansion. 1630: Birth of Shivaji at Shivneri fort, in present day Maharashtra, India, who later founded Maratha Empire in year 1674.[13] 1631: Mount Vesuvius erupts. 1632: Battle of Lützen, death of king of Sweden Gustav II Adolf.Battle of Nördlingen (1634). The Catholic Imperial army, bolstered by professional Habsburg Spanish troops won a great victory in the battle over the combined Protestant armies of Sweden and their German allies 1632: Taj Mahal building work started in Agra, India. 1633: Galileo Galilei arrives in Rome for his trial before the Inquisition. 1633–1639: Japan transforms into "locked country". 1634: Battle of Nördlingen results in Catholic victory. 1636: Harvard University is founded in Cambridge, Massachusetts. 1637: Shimabara Rebellion of Japanese Christians, rōnin and peasants against Edo. 1637: The first opera house, Teatro San Cassiano, opens in Venice. 1637: Qing dynasty attacked the Joseon dynasty. 1639: Naval Battle of the Downs – Republic of the United Provinces fleet decisively defeats a Spanish fleet in English waters. 1639: Disagreements between the Farnese and Barberini Pope Urban VIII escalate into the Wars of Castro and last until 1649. 1639–1651: Wars of the Three Kingdoms, civil wars throughout Scotland, Ireland, and England. 1640–1668: The Portuguese Restoration War led to the end of the Iberian Union.The inauguration of the Royal Academy of Turku in 1640. 1641: The Irish Rebellion, by Irish Catholics who wanted an end to discrimination, greater self-governance, and reverse ownership of the plantations of Ireland. 1641: René Descartes publishes Meditationes de prima philosophia Meditations on First Philosophy. 1642: Beginning of English Civil War, conflict will end in 1649 with the execution of King Charles I, the abolition of the monarchy and the establishment of the supremacy of Parliament over the king. 1643: L'incoronazione di Poppea, Monterverdi 1644: The Manchu conquer China ending the Ming dynasty. The subsequent Qing dynasty rules until 1912. 1644–1674: The Mauritanian Thirty-Year War. 1645–1669: Ottoman war with Venice. The Ottomans invade Crete and capture Canea. 1647–1652: The Great Plague of Seville. 1648: The Peace of Westphalia ends the Thirty Years' War and the Eighty Years' War and marks the ends of Spain and the Holy Roman Empire as major European powers.Map of Europe in 1648 at the end of the Thirty Years' War 1648–1653: Fronde civil war in France. 1648–1657: The Khmelnytsky Uprising – a Cossack rebellion in Ukraine which turned into a Ukrainian war of liberation from Poland. 1648–1667: The Deluge wars leave Polish–Lithuanian Commonwealth in ruins. 1648–1669: The Ottomans capture Crete from the Venetians after the Siege of Candia. 1649: King Charles I is executed for high treason, the first and only English king to be subjected to legal proceedings in a High Court of Justice and put to death. 1649–1653: The Cromwellian conquest of Ireland. Main articles: 1650s, 1660s, 1670s, 1680s, 1690s, and 1700s The Night Watch or The Militia Company of Captain Frans Banning Cocq, 1642. Oil on canvas; on display at the Rijksmuseum, Amsterdam 1651: English Civil War ends with the Parliamentarian victory at the Battle of Worcester. 1656–1661: Mehmed Köprülü is Grand Vizier. 1655–1661: The Northern Wars cement Sweden's rise as a Great Power. 1657 : Sambhaji, the second King of Maratha Empire and eldest son of King Shivaji was born at Purandar Fort on 14 May.[citation needed] 1658: After his father Shah Jahan completes the Taj Mahal, his son Aurangzeb deposes him as ruler of the Mughal Empire. 1659: King Shivaji killed Adil Shahi dynasty's general Afzal Khan at Pratapgad fort on 9 November.[14] 1660: The Commonwealth of England ends and the monarchy is brought back during the English Restoration. 1660: The Royal Society is founded. 1660: The Bruneian Civil War begins 1661: The reign of the Kangxi Emperor of China begins. 1663: Ottoman war against Habsburg Hungary. 1664: The Battle of St. Gotthard: count Raimondo Montecuccoli defeats the Ottomans. The Peace of Vasvar – intended to keep the peace for 20 years. 1665: Maratha King Shivaji signed the Treaty of Purandar with Mughal general Jai Singh I after Battle of Purandar.[citation needed] 1665: Robert Hooke discovers cells using a microscope. 1665: Portugal defeats the Kongo Empire at the Battle of Mbwila.Taj Mahal, completed by 1653 and commissioned by Shah Jahan, one of the Wonders of the World 1665–1667: The Second Anglo-Dutch War fought between England and the United Provinces. 1666: The Great Fire of London. 1666: Shivaji visited Aurangzeb at Agra Fort and forced him into house arrest. Shivaji later escaped and returned to the Maratha kingdom.[citation needed] 1667: The Raid on the Medway during the Second Anglo-Dutch War. 1667–1668: The War of Devolution: France invades the Netherlands. The Peace of Aix-la-Chapelle (1668) brings this to a halt. 1667–1699: The Great Turkish War halts the Ottoman Empire's expansion into Europe. 1672–1673: Ottoman campaign to help the Ukrainian Cossacks. John Sobieski defeats the Ottomans at the second battle of Khotyn (1673). 1672–1674: The Third Anglo-Dutch War fought between England and the United Provinces 1672–1676: Polish–Ottoman War.French invasion of the Netherlands, which Louis XIV initiated in 1672, starting the Franco-Dutch War 1672–1678: Franco-Dutch War. 1673: The Bruneian Civil War ends with Muhiyiddin winning the war. 1674: Shivaji founded the Maratha Empire and crowned himself as first Chatrapati of the empire. 1676–1681: Russia and the Ottoman Empire commence the Russo-Turkish Wars. 1678: The Treaty of Nijmegen ends various interconnected wars among France, the Dutch Republic, Spain, Brandenburg, Sweden, Denmark, the Prince-Bishopric of Münster, and the Holy Roman Empire.Claiming Louisiana for France in 1682 1680: The Pueblo Revolt drives the Spanish out of New Mexico until 1692. 1680: Prince Sambhaji crowned himself as the second Chatrapati of Maratha Empire 20 July.[citation needed] 1682: French explorer Robert La Salle claims all the land east of the Mississippi River.[15] 1683: China conquers the Kingdom of Tungning and annexes Taiwan. 1683: The Ottoman Empire is defeated in the second Siege of Vienna. 1683–1699: The Great Turkish War leads to the conquest of most of Ottoman Hungary by the Habsburgs. 1687: Isaac Newton publishes Philosophiae Naturalis Principia Mathematica. 1688: The Siege of Derry, the first major event in the Williamite War in Ireland. 1688: Siamese revolution of 1688 ousted French influence and virtually severed all ties with the West until the 19th century. 1688–1689: The Glorious Revolution starts with the Dutch Republic invading England, England becomes a constitutional monarchy. 1688–1691: The War of the Two Kings in Ireland. 1688–1697: The Grand Alliance sought to stop French expansion during the Nine Years' War. 1689: The Battle of Killiecrankie is fought between Jacobite and Williamite forces in Highland Perthshire. 1689: The Karposh rebellion is crushed in present-day North Macedonia, Skopje is retaken by the Ottoman Turks. Karposh is killed, and the rebels are defeated.The Battle of Vienna (1683) marked the historic end of the expansion of the Ottoman Empire into Europe 1689: Bill of Rights gains royal consent. 1689: John Locke publishes Two Treatises of Government and A Letter Concerning Toleration. 1690: The Battle of the Boyne in Ireland. 1692: Port Royal in Jamaica is struck by an earthquake and a tsunami. Approximately 2,000 people die and 2,300 are injured. 1692–1694: Famine in France kills two million.[16] 1693: College of William & Mary is founded in Williamsburg, Virginia, by a royal charter. 1694: The Bank of England is established. 1695: The Mughal Empire nearly bans the East India Company in response to pirate Henry Every's capture of the trading ship Ganj-i-Sawai. 1696–1697: Famine in Finland wipes out almost one-third of the population.[17] 1697–1699: Grand Embassy of Peter the Great to Western Europe. 1699: Thomas Savery demonstrates his first steam engine to the Royal Society. Catholic general Albrecht von Wallenstein (1583–1634), supreme commander of the armies of the Imperial Army during the Thirty Years War Jan Pieterszoon Coen (1587–1629), the founder of Batavia, was an officer of the Dutch East India Company (VOC), holding two terms as its Governor-General of the Dutch East Indies René Descartes (1596–1650) with Queen Christina of Sweden (1626–1689) Cardinal Mazarin (1602–1661), who served as the chief minister to the kings of France Louis XIII and Louis XIV Mughal Emperor Aurangzeb (1618–1707), who ruled over almost the entire Indian subcontinent for a period of 49 years Chhatrapati Shivaji (1630–1680) founder of Maratha Empire is widely regarded as one of the greatest Hindu rulers Kangxi Emperor (1661–1722) one of the most influential emperors of the Qing dynasty Shōgun Tokugawa Ieyasu was the founder of Japan's final shogunate, which lasted well into the 19th century See also: Timeline of historic inventions § 17th century Major changes in philosophy and science take place, often characterized as the Scientific Revolution. Banknotes reintroduced in Europe. Ice cream. Tea and coffee become popular in Europe. Central Banking in France and modern Finance by Scottish economist John Law. Minarets, Jamé Mosque of Isfahan, Isfahan, Persia (Iran), are built. 1604: Supernova SN 1604 is observed in the Milky Way. 1605: Johannes Kepler starts investigating elliptical orbits of planets. 1605: Johann Carolus of Germany publishes the 'Relation', the first newspaper. 1608: Refracting telescopes first appear. Dutch spectacle-maker Hans Lippershey tries to obtain a patent on one, spreading word of the invention. 1610: The Orion Nebula is identified by Nicolas-Claude Fabri de Peiresc of France. 1610: Galileo Galilei and Simon Marius observe Jupiter's Galilean moons. 1611: King James Bible or 'Authorized Version' first published. 1612: The first flintlock musket likely created for Louis XIII of France by gunsmith Marin Bourgeois. 1614: John Napier introduces the logarithm to simplify calculations. 1616: Niccolò Zucchi describes experiments with a bronze parabolic mirror trying to make a reflecting telescope. 1620: Cornelis Drebbel, funded by James I of England, builds the first 'submarine' made of wood and greased leather. 1623: The third English dictionary, English Dictionarie, is published by Henry Cockeram, listing difficult words with definitions. 1628: William Harvey publishes and elucidates his earlier discovery of the circulatory system. 1637: Dutch Bible published. 1637: Teatro San Cassiano, the first public opera house, opened in Venice. 1637: Pierre de Fermat formulates his so-called Last Theorem, unsolved until 1995. 1637: Although Chinese naval mines were earlier described in the 14th century Huolongjing, the Tian Gong Kai Wu book of Ming dynasty scholar Song Yingxing describes naval mines wrapped in a lacquer bag and ignited by an ambusher pulling a rip cord on the nearby shore that triggers a steel-wheel flint mechanism. 1642: Blaise Pascal invents the mechanical calculator called Pascal's calculator. 1642: Mezzotint engraving introduces grey tones to printed images. 1643: Evangelista Torricelli of Italy invents the mercury barometer. 1645: Giacomo Torelli of Venice, Italy invents the first rotating stage. 1651: Giovanni Riccioli renames the lunar maria. 1656: Christiaan Huygens describes the true shape of the rings of Saturn. 1657: Christiaan Huygens develops the first functional pendulum clock based on the learnings of Galileo Galilei. 1659: Christiaan Huygens first to observe surface details of Mars. 1662: Christopher Merret presents first paper on the production of sparkling wine. 1663: James Gregory publishes designs for a reflecting telescope. 1669: The first known operational reflecting telescope is built by Isaac Newton. 1676: Antonie van Leeuwenhoek discovers Bacteria. 1676: First measurement of the speed of light. 1679: Binary system developed by Gottfried Wilhelm Leibniz. 1684: Calculus independently developed by both Gottfried Wilhelm Leibniz and Sir Isaac Newton and used to formulate classical mechanics. ^ "Exchange History NL – 400 years: the story". 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ISBN 0-7486-3887-3 Detail of a 17th-century Tekke Turkmen carpet Chang, Chun-shu, and Shelley Hsueh-lun Chang. Crisis and Transformation in Seventeenth-Century China (1998). Langer, William. An Encyclopedia of World History (5th ed. 1973); highly detailed outline of events online free Reid, A. J. S. Trade and State Power in 16th & 17th Century Southeast Asia (1977). Spence, J. D. The Death of Woman Wang: Rural Life in China in the 17th Century (1978). Clark, George. The Seventeenth Century (2nd ed. 1945). Hampshire, Stuart. The Age of Reason the 17th Century Philosophers, Selected, with Introduction and Interpretive Commentary (1961). Hugon, Cécile (1997) [1911]. "Social Conditions in 17th-Century France (1649-1652)". In Halsall, Paul (ed.). Social France in the XVII Century. London: Methuen. pp. 171–172, 189. ISBN 9780548161944. Archived from the original on 23 August 2016. Retrieved 7 August 2021. Lewitter, Lucian Ryszard. "Poland, the Ukraine and Russia in the 17th Century." 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Translation n., plural: ranslations [tʁansla'ts̑jo:n] Definition: a biological process wherein the genetic code from a strand of mRNA is "translated" into amino acids Translation, in general, is the conversion of something into another form, such as a word from one language to another. But what is translation in biology? In biology, translation is a step in protein biosynthesis where a genetic code from a strand of mRNA is decoded to produce a particular sequence of amino acids. In both prokaryotes and eukaryotes, it takes place on the ribosomes. In eukaryotes, though, it occurs on the ribosomes that are attached to the surface of the endoplasmic reticulum (ER) so that the newly-formed protein after translation would undergo further maturation inside the ER and then be labeled in the Golgi apparatus for transport within or outside the cell. The steps of translation are basically the same for both prokaryotes and eukaryotes. These steps are initiation, translation elongation, and translation termination. What is mRNA and what is it's role in protein synthesis? The answers are explained by our Expert. Read them here: What does mRNA do in protein synthesis? Join our Forum now! Translation Definition Translation steps: initiation, elongation, and termination. This illustration shows how translation proceeds in a eukaryotic cell. The genetic code in the mRNA from the nucleus is translated into a specific sequence of amino acids through the action of tRNAs and ribosomes. Biology definition: Translation is the process of translating (converting) the transcript (genetic information) from the mRNA into a specific sequence of amino acids in the growing chain of a polypeptide. The three general steps of translation are initiation, translation elongation, and translation termination. During initiation, the ribosome binds to the mRNA and then the tRNA attaches to the start codon of the transcript. This is followed by translation elongation wherein a specific order of amino acids is brought to the ribosomal site by the tRNAs according to the sequence of codons in the mRNA transcript. The amino acids are joined in a chain by a peptide bond. The stop codon in the transcript signifies that the termination phase is reached. Eventually, translation stops, and the newly formed protein undergoes maturation (e.g. protein folding or post-translation modifications). Etymology: The term translation comes from the Latin trānslātiōn, meaning "a transferring", equivalent to trānslāt(us) + -iōn. Central Dogma In the central dogma of molecular biology, the genetic information is schematically shown to flow from DNA to DNA (by replication) and from DNA to mRNA (transcription) to protein (translation). In the latter, the genetic code from the mRNA is read as a trinucleotide codon, i.e. a set of three adjacent nucleotides. DNA Replication vs. Translation DNA replication is the process of producing an exact copy of a polynucleotide strand such as DNA. The flow of genetic information will be from DNA to DNA by complementary base pairing in terms of adenine-thymine (AT) and guanine-cytosine (GC) base pairing. The enzymes involved in the process are DNA polymerases. Conversely, the flow of genetic information in translation is from mRNA to protein via complementary base pairing with tRNA in terms of adenine-uracil (AU) and guanine-cytosine (GC) base pairing. The enzymes involved in translation are ribozymes. DNA replication is a preparatory step to cell division (mitosis or meiosis). Translation, following transcription, is a step in protein synthesis. Thus, the product of DNA replication is a copy of the DNA whereas the product of translation is a polypeptide chain or protein. In prokaryotes, DNA replication occurs in the cytoplasm, whereas in eukaryotes it occurs in the nucleus. Translation, in contrast, occurs on the ribosomes of prokaryotes and eukaryotes. Transcription vs. Translation Protein biosynthesis is the biological process of creating protein molecules. The first step is amino acid synthesis. Amino acids may be produced from carbon sources, e.g. glucose. Nevertheless, not all amino acids need to be synthesized. Some of them can be obtained from dietary sources. After amino acid synthesis, transcription is the next step. However, in genetic expression, it is taken as the first step. A segment of the DNA is copied into an mRNA template. Unlike DNA replication, transcription does not need a primer. Rather, it occurs when a gene is turned on. Furthermore, complementary base pairing occurs in terms of AU and CG base pairing. In RNA, uracil replaces the thymine of DNA. Thus, during RNA synthesis, including transcription, adenine pairs up with uracil instead of thymine. The template produced from transcription is also called mRNA transcript since the genetic code is transcribed into mRNA. This transcript is decoded in the next step, translation. At this stage, the mRNA transcript is translated into amino acids in a specific sequence in a polypeptide chain. After translation, the newly-created polypeptide further undergoes protein maturation, e.g. post-translational modifications and protein folding. See the table below for the comparison between transcription and translation. Transcription Translation Definition The process of creating a copy of DNA into mRNA The process of translating mRNA transcript to amino acid Steps (1) Initiation (2) Promoter escape (3) Elongation (4) Termination (1) Initiation (2) Elongation (3) Termination Location In prokaryotes, in the cytoplasm In eukaryotes, in the nucleus In prokaryotes and eukaryotes, in the cytoplasm where ribosomes are located Enzymes RNA polymerase Ribozyme Products mRNA Polypeptide or protein Function The first step of gene expression mRNA synthesis The second step of gene expression Peptide or protein synthesis Data summarized by Maria Victoria Gonzaga for Biology Online Which comes first? Translation or the transcription of the code? Share your views here: What does mRNA do in protein synthesis? Join our Forum now! mRNA, tRNA, and rRNA Three RNAs are involved in biological translations. They are mRNA (messenger RNA), tRNA (transfer RNA), and rRNA (ribosomal RNA). mRNA is the RNA produced from transcription. It is comprised of a 5′ cap, 5′UTR region, coding region, 3′UTR region, and poly(A) tail. The copy of a DNA segment for gene expression is located in its coding region. It begins with a start codon at 5′end and a stop codon at the 3′ end. tRNA is the RNA that transfers the specific amino acid to the ribosome to be added to the growing chain of amino acids. It has two major sites: one is the anticodon arm containing the anticodon and the other is the acceptor stem, which is the site for the amino acid. tRNA with amino acid is called aminoacyl-tRNA. The –COOH of the amino acid attaches to the 3′-OH of the adenine in the CCA tail by a covalent bond. Another type of tRNA is the peptidyl tRNA, which is a tRNA carrying the growing peptide chain. rRNA is the RNA component of the ribosome. The ribosome is a cytoplasmic structure in cells of prokaryotes and eukaryotes. The ribosome of prokaryotes is the 70S whereas the ribosome of eukaryotes is 80S. Both 70S and 80S are made up of a large subunit and a small subunit. The large subunit serves as a ribozyme catalyzing the peptide bond formation between two amino acids. In contrast to tRNA and mRNA that carry genetic information, rRNA does not. Nevertheless, it has three binding sites for RNA: A, P, and E sites. The A (aminoacyl) site is where aminoacyl-tRNA docks. The P (peptidyl) site is where peptidyl-tRNA binds. The E (exit) site is where the tRNA leaves the ribosome. Codon Definition (Biology) RNA codon amino acid chart. Codon, in biology, refers to the set of three adjacent nucleotides in mRNA. It is also called a triplet. It complementary base pair with the anticodon of aminoacyl-tRNA. Examples: Guanine-Cytosine-Cytosine (GCC) is the codon for the amino acid alanine. Guanine-Uracil-Uracil (GUU) codes for valine. Cytosine-Uracil-Adenine (CUA) codes for leucine. Uracil-Adenine-Adenine (UAA) is a stop codon. Anticodon Definition (Biology) Anticodon refers to the sequence of three adjacent nucleotides located on tRNA. It complementary-base -pairs with the codon of mRNA. For example, the anticodon for glycine is CCC (Cytosine-Cytosine-Cytosine) that binds to the codon GGG (Guanine-Guanine-Guanine) of mRNA. Translation steps Prior to initiation, a pre-translation step occurs. Called bio-activation, the amino acid binds to the corresponding tRNA by a covalent bond. Step 1: Initiation Translation initiation is the first major step of translation wherein the genetic code carried by mRNA is decoded to produce the specific sequence of amino acids in a polypeptide chain. The small subunit of the ribosome binds to the 5′ end of mRNA as facilitated by initiation factors (IF). The first tRNA attaches to the initiation or start codon. An initiation codon is the codon specified usually by AUG in mRNA. It is recognized by formylmethionyl-tRNA (tRNAf) in prokaryotes and by methionyl-tRNA in eukaryotes. Step 2: Translation elongation After initiation is transcription elongation. This is when the next aminoacyl-tRNA in line binds to the ribosome along with GTP and elongation factor (EF). The ribosome then translocates to the next mRNA codon resulting in the elongation of the amino acid chain. Step 3: Translation termination The last step is translation termination. This is when a peptidyl tRNA encounters a stop codon (e.g. UAA, UAG, or UGA). A stop codon does not code for any amino acid but serves as a termination signal of translation. When the termination codon is reached, the newly produced protein goes through maturation through protein folding or post-translation modifications. Prokaryotic vs. Eukaryotic Translations The major steps of translation in prokaryotes and eukaryotes are the same (i.e. initiation, elongation, translocation, and termination) and in both cells occurs on the ribosome. Translation in prokaryotes, though, occurs on 70S-type of ribosomes whereas translation in eukaryotes occurs on 80S-type of ribosomes. Because prokaryotes lack membrane-bound organelles, their mRNA transcript is synthesized in the cytoplasm. In eukaryotes, mRNA is synthesized in the nucleus and then released into the cytoplasm where ribosomes are located. In eukaryotes, the growing chain of amino acids is released into the lumen of the endoplasmic reticulum via the ribosome attached to it. Translation in prokaryotes Translation in eukaryotes mRNA transcript from DNA is synthesized in the cytoplasm mRNA transcript from DNA is synthesized in the nucleus mRNA is polycistronic mRNA is monocistronic Translation occurs in 70S ribosome Translation occurs in 80S ribosome Major steps: (1) Initiation (2) Elongation (3) Termination Major steps: (1) Initiation (2) Elongation (3) Termination Translation initiation mechanism is cap-independent Translation initiation mechanism is cap-independent or cap-dependent First tRNA is Met-tRNAf First tRNA is Met-tRNA Initiation factors: IF1, IF2, IF3 Initiation factors: eIF1, eIF2, eIF3, eIF4, eIF5A,

eIF5B, eIF6 Elongation factors: EF-Tu and EF-Ts Elongation factors: eEF1 and eEF2 Release factors on termination: RF1, RF2, RF3 Release factors on termination: eRF1 Relatively faster, about 20 amino acids per second Relatively slower, 1 amino acid per second Data summarized by Maria Victoria Gonzaga for Biology Online Got questions about translation? Or an opinion about mRNA and protein synthesis? Join us and participate in our Forum: What does mRNA do in protein synthesis? We'd be happy to hear your thoughts! NOTE IT! Unorthodox Ways of Translating Proteins Within the seemingly straightforward standard steps of initiation, elongation, and termination that the translation machinery takes are the off-track nonconvential routes that it treads. Such unorthodox steps appear to help generate an even more so unique protein products, plausibly with new function. It's as if reading a sentence differently to discover a whole new different context. As a matter of fact, such mechanisms are employed by certain bcteria and viruses in order to evade the host's immune system while unraveling novel avenues for replication and pathogenesis. Here are some mechanisms that help create a set of diverse protein products that may have a potential new use or function, all from just a single mRNA: Frameshifting: when the ribosome shifts the reading frame as it reads the mRNA sequence, such as by +1 (one base forward) or -1 (one base backward), leading to the prodcution of protein isoforms. It helps make various proteins from the same genetic instructions by reading the genes differently. This mechanism is employed by the HIV virus to synthesize the viral enzymes reverse transcriptase and integrase. Readthrough (Stop Codon Suppression): when a stop codon doesn't stop the translation. Translations still continues resulting in longer or larger protein. Ribosomal hopping or bypassing: when the ribosome skips a portion of the reading frame, resulting in a protein with a different amino acid sequence/ composition/intermolecular interactions. Nonconventional protein translation. Image prepared by Maria Victoria Gonzaga for Biology Online Try to answer the quiz below to check what you have learned so far about translation.

References Central Dogma of Biology. (2014). Retrieved from Csbsju.edu website: 20and%20society/cent_dogma/olcentdogma.html Translation: DNA to mRNA to Protein Learn Science at Scitable. (2013). Retrieved from Nature.com website: Transcription and translation. (2017, April 26). Retrieved from Uq.edu.au website: Transcription / Translation. (2019). Retrieved from Iupui.edu website: Protein Synthesis. (2019). Retrieved from Elmhurst.edu website: Research Guides: BSCI 1510L Literature and Stats Guide: The genetic code and the Central Dogma of Molecular Biology. (2018). Retrieved from Vanderbilt.edu website: Chapter 13 Lecture Notes: DNA Function. (n.d.). Retrieved from: lrunyenj/bio554/lectnotes/Chapter13.pdf DNA and RNA – Computational Medicine Center. (2009). Retrieved from Jefferson.edu website:

Transcript Name: ___________________________________ Date: ________ Per: _________ Transcription – Translation Practice Worksheet Fill in with the mRNA strand, then translate to the amino acid sequence #1 DNA: A T G G G G A G A T T C A T G A TRANSLATION Protein (amino acid sequence): T G T TRANSCRIPTION mRNA: #2 A C T DNA: A C C C C T C T A A T A C T TRANSCRIPTION mRNA: Protein (amino acid sequence): #3 DNA: A T G T G A C A G T T T G C A A T mRNA: Protein (amino acids): TRANSLATION A G A A G G C T TRANSCRIPTION TRANSLATION A A G C G T T C #4 T DNA: A C A A A C G T mRNA: Protein (amino acids): #5 DNA: T A C C G C T mRNA: Protein (amino acids): T A T C T T C C G A T T C G C A T T TRANSCRIPTION TRANSLATION C C G C C G T C G A TRANSCRIPTION TRANSLATION C A A T A C C A C T Answer Key Name: ___________________________________ Date: ________ Per: _________ Transcription – Translation Practice Worksheet Fill in with the mRNA strand, then translate to the amino acid sequence #1 DNA: A T G G G G A G A T mRNA: U A C C C T A C T G T C A T G A TRANSCRIPTION C U C U A A U G A C A G U A C U TRANSLATION Protein (amino acid sequence): Tyr – Pro – Ser – Asn – Asp – Ser - Thr #2 T DNA: A C C C C T C T A A T G A C A G T TRANSCRIPTION mRNA: A U G G G G A G A U U A C U G U C A C T A U G A TRANSLATION Protein (amino acid sequence): Met – Gly – Arg – Leu – Leu – Ser - Stop #3 DNA: A T G T T T G C A A T mRNA: U A C A A A C Protein (amino acids): A G A A G G C T A A G C G T T C TRANSCRIPTION G U U A U C U U C TRANSLATION Tyr – Lys – Arg – Tyr – Leu – Arg – Ile – Arg - Lys C G A U U C G C A A G #4 T DNA: A C A A A C G T mRNA: A U G U U U G C T A T C T T C C G A T T C G C A T T TRANSCRIPTION A A U A G A A G G C U A A G C G U A A TRANSLATION Protein (amino acids): Met – Phe – Ala – Ile – Glu – Gly – Stop – no more decoding! #5 DNA: T A C C G C T mRNA: A U G C G C C C G C C G T C G A C A A T A C C A C T TRANSCRIPTION A G Protein (amino acids): G C G G C A G C TRANSLATION Met – Pro – Arg – Arg – Gln – Leu – Leu – Trp - Stop U G U U A U G G U G A

1. The Central Dogma of Molecular Biology 2. The Central Dogma of Molecular Biology Describes the flow of genetic information from DNA to RNA to Proteins DNA Replication Transcription Translation 3. DNA Replication DNA Replication is semi-conservative Each newly synthesized molecule contains 1 "parent template" strand and 1 new "daughter" strand 4. DNA Replication Step 1: Initiation Helicase unwinds DNA forming a " replication fork " Multiple replication forks along a DNA molecule create replication bubbles 5. DNA Replication Step 2: Elongation---Adding New Nucleotides RNA Primase adds a complimentary RNA primer to each template strand as a starting point for replication DNA Polymerase reads the template strand (3' to 5') and adds new complimentary nucleotides (5' to 3') DNA synthesized in the direction of the replication fork is called the leading strand 6. DNA Replication DNA polymerase can only add new nucleotides in the 5' to 3' direction Because of the antiparallel nature of DNA, replication occurs in two directions An RNA primer is laid down on the other strand, and new nucleotides are added 5' to 3' moving away from the replication fork. This is the lagging strand and the segment of DNA produced is called an Okazaki fragment 7. DNA Replication The DNA unwinds some more and the leading strand is extended by DNA polymerase adding more DNA nucleotides. Thus, the leading strand is synthesized continuously. 8. DNA Replication On the top template strand, a new RNA primer is synthesized by primase near the replication fork DNA polymerase adds new DNA . This produces the second Okazaki fragment. Thus, the lagging strand is synthesized discontinously 9. DNA Replication Step 3: Termination A different type of DNA polymerase removes the RNA primer and replaces it with DNA DNA ligase joins the two Okazaki fragments with phosphodiester bonds to produce a continuous chain Each new DNA molecule is rewound by helicase. Each molecule is identical 10. DNA Replication Summary and Other Facts: Leading Strand: 1 primer, 5' to 3' continuous Lagging Strand: multiple primers, 5' to 3' discontinuous In humans, DNA polymerase adds 50 nucleotides/second DNA polymerase can proofread its own work and does excision repair 1 in 10,000 bases are in error After proofreading, rate of mutation is 1 in 10,000,000 11. DNA Replication Check out these animations and reviews: DNA replication animation Meselson and Stahl experiment that showed DNA replication is semi-conservative BioCoach Biosynthesis of DNA practice BioCoach adding new DNA practice BioCoach enzymes and molecules of replication practice DNA structure and replication self-quiz 12. RNA Sytnthesis: Transcription RNA is an important type of nucleic acid that plays several roles in the production of protein RNA is necessary to carry the instructions of the DNA out of the nucleus and to the ribosomes 13. RNA Sytnthesis: Transcription The genome of any organism contains all the information for making that organism. The information is encoded in various types of genes that are transcribed into 4 types of RNA: mRNA - Messenger RNA: Encodes amino acid sequence of a polypeptide tRNA - Transfer RNA: Brings amino acids to ribosomes during translation rRNA - Ribosomal RNA: With ribosomal proteins, makes up the ribosomes, the organelles that translate the mRNA snRNA - Small nuclear RNA: With proteins, forms complexes that are used in RNA processing in eukaryotes 14. RNA Sytnthesis: Transcription Messenger RNA carries the actual code that specifies the amino acid sequence in a polypeptide (protein) Making mRNA starts with a protein encoding gene on a template strand of DNA 15. RNA Sytnthesis: Transcription Step 1: Initiation RNA Polymerase binds to a promoter which is a region of bases that signals the beginning of a gene RNA Polymerase is bound to the TATA box of the promoter by transcription factors The double helix unwinds and is ready to be transcribed 16. RNA Sytnthesis: Transcription Step 2: Elongation RNA Polymerase moves along the protein encoding gene adding new RNA nucleotides in the 5' to 3' direction and complimentary to the DNA template Works at up to 60 nucleotides/second 17. RNA Sytnthesis: Transcription Step 3: Termination RNA Polymerase reaches the terminator region of the protein encoding gene All the enzymes and factors are released The product of these 3 steps is called immature or pre-mRNA 18. RNA Processing Most eukaryotic protein encoding genes contain non-coding segments called introns , which break up the amino acid coding sequence into segments called exons RNA Processing includes modification and splicing 19. RNA Processing Modification At the 5' end, a cap is added consisting of a modified GTP (guanosine triphosphate). This occurs at the beginning of transcription. The 5' cap is used as a recognition signal for ribosomes to bind to the mRNA At the 3' end, a poly(A) tail of 150 or more adenine nucleotides is added. The tail plays a role in the stability of the mRNA 20. RNA Processing Splicing (Intron Removal) The intron loops out as snRNPs (small nuclear ribonucleoprotein particles) bind to form the spliceosome The intron is excised, and the exons are then spliced together Results in mature mRNA 21. RNA Sytnthesis: Transcription Check out these animations and reviews: Transcription animation Transcription BioCoach practice Transcription self-quiz 22. Protein Synthesis: Translation The language of nucleic acids in translated into the language of proteins Nucleic acids have a 4 letter language Proteins have a 20 letter language 23. Protein Synthesis: Translation The Genetic Code If 3 RNA bases code for 1 amino acid, RNA could code for 4 3 = 64 amino acids. More than enough coding capacity for 20 amino acids Code is redundant for most amino acids 26. Protein Synthesis: Translation Ribosomes Made of rRNA and protein 2 subunits (large and small) form a 3D groove 2 major sites: P site ---holds the growing polypeptide A site ---new amino acids enter here 27. Protein Synthesis: Translation Transfer RNA (tRNA) Carries amino acids to the ribosome During tRNA charging each tRNA picks up an amino acid from the INP 3 base anitcodon pairs with the mRNA codon 30. Protein Synthesis: Translation Step 1: Initiation 5' G-cap of mRNA binds to ribosome Start codon AUG and anticodon with Methionine bind a P site A site is open and ready to receive new tRNAs 31. Protein Synthesis: Translation Step 2: Elongation Adding New Amino Acids Codon recognition Peptide bond formation Translocation : ribosome moves along mRNA, aminoacyl tRNA shifts from A site to P site 33. Protein Synthesis: Translation Check out the following links and animations for review: Animation of translation Transcribe and translate a gene tRNA Charging Initiation Review Elongation Review Termination Review Translation BioCoach Practice Translation Self-Quiz 34. Translation, Polypeptides, and Mutations Normally, the genetic code is translated and the correct protein is formed from a long chain of amino acids. Translation of codons is dependent on the reading frame , or a grouping of codons in a gene transcript. AAU GCG GAC UAC GGC AAC GCC 35. Translation, Polypeptides, and Mutations Mutations: Any change in the nucleotide sequence of DNA Mutations can involve large sections of chromosomes or single base pairs Mutations can change the reading frame of a gene transcript 36. Translation, Polypeptides, and Mutations 37. Translation, Polypeptides, and Mutations Sickle Cell Anemia Normal Hemoglobin Sickle Cell Hemoglobin DNA GGA CTT GCA GGA CAT GCA mRNA CCU GAA CGU CCU GUA CGU A.A. PRO GLU ARG PRO VAL ARG Changes in one or a few bases is called a Point Mutation 2 Types: Substitution or Insertion/Deletions 38. Translation, Polypeptides, and Mutations Deletion or insertion mutations are most disruptive because they change the reading frame, causing a frame shift Substitution mutations have varied impact on amino acid sequences. Substitutions of 1 st or 2 nd base in codon almost always changes the amino acid Substitution of 3 rd base in codon does not always change the amino acid 39. Translation, Polypeptides, and Mutations What causes mutations? Errors in DNA Replication Errors in chromosome crossover in meiosis Mutagens Mutagens are physical or chemical factors that cause mutations UV Radiation and X-Rays Chemicals like DDT 40. Translation, Polypeptides, and Mutations Many mutations are harmful and cause the organism to die or function incorrectly. Some mutations are beneficial and help the organism to survive. (Peppered Moths) If mutations are present in gametes , they can be passed on to offspring. This is the driving force of Natural Selection.