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How did organic life start

Natural process by which life arises from non-living matter "Origin of Life" redirects here. For non-scientific views on the origins of life, see Creation myth. Not to be confused with Biogenesis. For the oldest life forms, see Earliest known life forms. The earliest known life forms are putative fossilized microorganisms, found in hydrothermal vent precipitates, that may have lived as early as 4.28 Gya (billion years ago), relatively soon after the formation of the oceans 4.41 Gya, and not long after the formation of the Earth 4.54 Gya.[1][2] In biology, abiogenesis or the origin of life[3][4][5] is the natural process by which life has arisen from non-living matter, such as simple organic compounds.[6][4][7][8] While the details of this process are still unknown, the prevailing scientific hypothesis is that the transition from non-living to living entities was not a single event, but an evolutionary process of increasing complexity that involved molecular self-replication, self-assembly, autocatalysis, and the emergence of cell membranes.[9][10][11]

Although the occurrence of abiogenesis is uncontroversial among scientists, its possible mechanisms are poorly understood. There are several principles and hypotheses for how abiogenesis could have occurred.[12] The study of abiogenesis aims to determine how pre-life chemical reactions gave rise to life under conditions strikingly different from modern Earth conditions. The study of abiogenesis is approached through experimental and theoretical methods, and has been applied to a wide range of molecules, including nucleic acids, lipids, and proteins. The study of abiogenesis is closely related to the study of evolution, and builds largely upon four key families of chemical molecules: lipids (cell membranes), carbohydrates (sugars, cellulose), amino acids (protein metabolism), and nucleic acids (DNA and RNA). Any successful theory of abiogenesis must explain the origins and interactions of these classes of molecules.[16] Many approaches to abiogenesis investigate how self-replicating molecules, or their components, came into existence. Researchers generally think that current life descends from an RNA world,[17] although other self-replicating molecules may have preceded RNA.[18][19] The classic 1952 Miller-Urey experiment and similar research demonstrated that most amino acids, the chemical constituents of the proteins used in all living organisms, can be synthesized from inorganic compounds under conditions intended to replicate those of the early Earth. Various external sources of energy may have triggered these reactions, including lightning and radiation. Other approaches ("metabolism-first" hypotheses) focus on understanding how catalysis in chemical systems on the early Earth might have provided the precursor molecules necessary for self-replication.[20] Earth remains the only place in the universe known to harbor life.[21][22] and fossil evidence from the Earth informs most studies of abiogenesis. The age of the Earth is 4.54 Gya (billion years).[23][24][25] the earliest undisputed evidence of life on Earth dates from at least 3.5 Gya (Gyo ago),[26][27][28] and possibly as early as the Eoarchean Era (3.6–4.0 Ga). In 2017, possible evidence of early life on land was found in 3.48 Gyo (Gy old) geyserite and other related mineral deposits (often found around hot springs and geysers) uncovered in the Pilbara Craton of Western Australia.[29][30][31][32] Other discoveries suggest that life may have appeared on Earth even earlier. As of [2017update], microfossils (fossilized microorganisms) within hydrothermal-vent precipitates dated 3.77 to 4.28 Gya in rocks in Quebec may harbor the oldest record of life on Earth, soon after ocean formation 4.4 Gya during the Hadean Eon. [33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52][53][54][55][56][57][58][59][60][61][62][63][64][65][66][67][68][69][70][71][72][73][74][75][76][77][78][79][80][81][82][83][84][85][86][87][88][89][90][91][92][93][94][95][96][97][98][99][100][101][102][103][104][105][106][107][108][109][110][111][112][113][114][115][116][117][118][119][120][121][122][123][124][125][126][127][128][129][130][131][132][133][134][135][136][137][138][139][140][141][142][143][144][145][146][147][148][149][150][151][152][153][154][155][156][157][158][159][160][161][162][163][164][165][166][167][168][169][170][171][172][173][174][175][176][177][178][179][180][181][182][183][184][185][186][187][188][189][190][191][192][193][194][195][196][197][198][199][200][201][202][203][204][205][206][207][208][209][210][211][212][213][214][215][216][217][218][219][220][221][222][223][224][225][226][227][228][229][230][231][232][233][234][235][236][237][238][239][240][241][242][243][244][245][246][247][248][249][250][251][252][253][254][255][256][257][258][259][260][261][262][263][264][265][266][267][268][269][270][271][272][273][274][275][276][277][278][279][280][281][282][283][284][285][286][287][288][289][290][291][292][293][294][295][296][297][298][299][300][301][302][303][304][305][306][307][308][309][310][311][312][313][314][315][316][317][318][319][320][321][322][323][324][325][326][327][328][329][330][331][332][333][334][335][336][337][338][339][340][341][342][343][344][345][346][347][348][349][350][351][352][353][354][355][356][357][358][359][360][361][362][363][364][365][366][367][368][369][370][371][372][373][374][375][376][377][378][379][380][381][382][383][384][385][386][387][388][389][390][391][392][393][394][395][396][397][398][399][400][401][402][403][404][405][406][407][408][409][410][411][412][413][414][415][416][417][418][419][420][421][422][423][424][425][426][427][428][429][430][431][432][433][434][435][436][437][438][439][440][441][442][443][444][445][446][447][448][449][450][451][452][453][454][455][456][457][458][459][460][461][462][463][464][465][466][467][468][469][470][471][472][473][474][475][476][477][478][479][480][481][482][483][484][485][486][487][488][489][490][491][492][493][494][495][496][497][498][499][500][501][502][503][504][505][506][507][508][509][510][511][512][513][514][515][516][517][518][519][520][521][522][523][524][525][526][527][528][529][530][531][532][533][534][535][536][537][538][539][540][541][542][543][544][545][546][547][548][549][550][551][552][553][554][555][556][557][558][559][560][561][562][563][564][565][566][567][568][569][570][571][572][573][574][575][576][577][578][579][580][581][582][583][584][585][586][587][588][589][590][591][592][593][594][595][596][597][598][599][600][601][602][603][604][605][606][607][608][609][610][611][612][613][614][615][616][617][618][619][620][621][622][623][624][625][626][627][628][629][630][631][632][633][634][635][636][637][638][639][640][641][642][643][644][645][646][647][648][649][650][651][652][653][654][655][656][657][658][659][660][661][662][663][664][665][666][667][668][669][670][671][672][673][674][675][676][677][678][679][680][681][682][683][684][685][686][687][688][689][690][691][692][693][694][695][696][697][698][699][700][701][702][703][704][705][706][707][708][709][710][711][712][713][714][715][716][717][718][719][720][721][722][723][724][725][726][727][728][729][730][731][732][733][734][735][736][737][738][739][740][741][742][743][744][745][746][747][748][749][750][751][752][753][754][755][756][757][758][759][760][761][762][763][764][765][766][767][768][769][770][771][772][773][774][775][776][777][778][779][780][781][782][783][784][785][786][787][788][789][790][791][792][793][794][795][796][797][798][799][800][801][802][803][804][805][806][807][808][809][810][811][812][813][814][815][816][817][818][819][820][821][822][823][824][825][826][827][828][829][830][831][832][833][834][835][836][837][838][839][840][841][842][843][844][845][846][847][848][849][850][851][852][853][854][855][856][857][858][859][860][861][862][863][864][865][866][867][868][869][870][871][872][873][874][875][876][877][878][879][880][881][882][883][884][885][886][887][888][889][890][891][892][893][894][895][896][897][898][899][900][901][902][903][904][905][906][907][908][909][910][911][912][913][914][915][916][917][918][919][920][921][922][923][924][925][926][927][928][929][930][931][932][933][934][935][936][937][938][939][940][941][942][943][944][945][946][947][948][949][950][951][952][953][954][955][956][957][958][959][960][961][962][963][964][965][966][967][968][969][970][971][972][973][974][975][976][977][978][979][980][981][982][983][984][985][986][987][988][989][990][991][992][993][994][995][996][997][998][999][1000][1001][1002][1003][1004][1005][1006][1007][1008][1009][1010][1011][1012][1013][1014][1015][1016][1017][1018][1019][1020][1021][1022][1023][1024][1025][1026][1027][1028][1029][1030][1031][1032][1033][1034][1035][1036][1037][103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