Click to prove you're human



```
Get detail failed: Detail not found CAS Common Chemistry, you agree to the terms and conditions of this license. By using CAS Common Chemistry, you agree to the terms and conditions of this license. By using CAS Common Chemistry, you agree to the terms and conditions of this license. By using CAS Common Chemistry, you agree to the terms and conditions of this license. By using CAS Common Chemistry, you agree to the terms and conditions of this license. By using CAS Common Chemistry, you agree to the terms and conditions of this license.
build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit, provide a link to the license terms. Attribution in any way that suggests the licensor cannot revoke these freedoms as long as you follow the license, and indicate if changes were made. You must give appropriate credit, provide a link to the license, and indicate if changes were made.
endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply
with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation. No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the
material. ATP is the acronym for adenosine triphosphate. This organic molecule is the main form of energy currency in metabolism. In biology and biochemistry, ATP is the acronym for adenosine triphosphate. This organic molecule responsible for intracellular energy transfer in cells. For this reason, it's often called the "energy currency" of
metabolism and cells. Here is a look at ATP structure, its functions, how ATP transfers energy, and interesting facts about the molecule the body uses directly as energy. Other forms of chemical energy get turned into ATP. It's easy to recycle, so a cell can use a
single molecule again and again. You can think of ATP as a molecule built from three subunits: adenine, ribose, and phosphate groups attach sequentially to 5'
carbon of the ribose. So, the 5' carbon from ribose bonds to the oxygen of the first phosphate group. This opposite oxygen connects to the phosphate group from the group closest to the ribose. If you remove one phosphate group from ATP, you get
ADP (adenosine diphosphate). Removing two phosphate groups from ATP forms AMP (adenosine monophosphate is the process of phosphorylation, while releasing phosphate groups by forming ADP or AMP from ATP releases energy. Note
that while cells mainly use ATP, ADP, and AMP, a similar process occurs using other nitrogenous bases. For example, phosphorylation of guanosine forms GMP, and RNA synthesis, signaling between synapses, and intracellular
signaling. Here are some metabolic processes that use ATP:ATP is how cells turn the sugar glucose into a useful form of chemical energy. Synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme ATP synthesis of ATP primarily occurs within the mitochondrial matrix using the enzyme at the en
produces about 32 molecules of ATP. ATP production also occurs under anaerobic conditions, but in humans this process only yields two molecules of ATP per molecules of ATP for energy, the cell cleaves the chemical bond between phosphate groups. This
 bond, called a phosphodiester bond, holds a lot of energy because there is a significant repulsion between phosphate groups due to their electronegativity. Breaking the phosphodiester bond is an exothermic reaction, so it releases heat. While heat is a form of energy, it not how a cell uses ATP for power. Instead, the energy release from turning ATP
into ADP (or AMP) is coupled to an energetically unfavorable (endothermic) reaction, giving it the activation energy it needs to proceed. The final energy carriers are electrical charges in the form of protons (H+ ions), electrons, or other ions. Empirical Formula C10H16N5O13P3Chemical Formula C10H8N4O2NH2 (OH2) (PO3H)3HMolecular
Mass507.18 g.mol-1Density1.04 g/cm3 (slightly heavier than water)Melting Point368.6°F (187°C)IUPAC NameO1-{[(2R,3S,4R,5R)-5-(6-Amino-9H-purin-9-yl)-3,4-dihydroxyoxolan-2-yl]methyl} tetrahydrogen triphosphateATP fast factsHere are some interesting facts about ATP or adenosine triphosphate:The amount of ATP recycled each day is about
the same as your body weight, even though the average person only has about 250 grams of ATP at any given time. In other words, a single ATP molecule gets recycled 500 to 700 times per day. At any given moment, your body has about the same amount of ADP (adenosine diphosphate) as ATP. This is important because cells can't store ATP, so
having ADP present as a precursor allows for quick recycling. Karl Lohmann and Cyrus Fiske/Yellapragada Subbarow independently discovered they key tole ATP in 1949. Fritz Albert Lipmann and Herman Kalckar discovered they key tole ATP plays in metabolism in 1941. Alexander Todd first synthesized ATP in 1948. The 1997 Nobel Prize in Chemistry honored
Paul D. Boyer and John E. Walker for clarifying the enzymatic mechanism of ATP synthesis and to Jens C. Skou for discovering the ion-transporting enzyme Na+, K+-ATPase. Berg, J. M.; Tymoczko, J. L.; Stryer, L. (2003). Biochemistry. New York, NY: W. H. Freeman. ISBN 978-0-7167-4684-3. Ferguson, S. J.; Nicholls, David; Ferguson, Stuart (2002).
Bioenergetics 3 (3rd ed.). San Diego, CA: Academic. ISBN 978-0-12-518121-1. Knowles, J. R. (1980). "Enzyme-catalyzed phosphoryl transfer reactions". Ann. Rev. Biochem. 49: 877-919. doi:10.1146/annurev.bi.49.070180.004305The Nobel Prize in Chemistry (1997). Nobelprize.orgTörnroth-Horsefield, S.; Neutze, R. (December 2008). "Opening and
closing the metabolite gate". Proc. Natl. Acad. Sci. USA. 105 (50): 19565-19566. doi:10.1073/pnas.0810654106Related Posts Adenosine triphosphate (ATP) is an energy-carrying molecule known as "the energy currency of life" or "the fuel of life," because it's the universal energy source for all living cells. Every living organism consists of cells that
rely on ATP for their energy needs. ATP is made by converting the food we eat into energy. It's an essential building block for all life forms. Without ATP, cells wouldn't have the fuel or power to perform functions necessary to stay alive, and they would eventually die. All forms of life rely on ATP to do the things they must do to survive. This article
explains how adenosine triphosphate works and how it's made. It also discusses why ATP is so important to cellular processes, and what makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for life and makes it vital to all life forms. ATP is essential for 
couldn't stay alive. As a real-world example, when a car runs out of gas and is parked on the side of the road, the only thing that will make the car drivable again is putting some gasoline back in the tank. For all living cells, ATP is like the gas in a car's fuel tank. Without ATP, cells wouldn't have a source of usable energy, and the organism would die.
ATP is a neurotransmitter. It carries messages from one nerve cells in the body (peripheral neurons) as well as nerve cells in the central nervous system (brain and spinal cord). Its role as a neurotransmitter is to maintain homeostasis (equilibrium) throughout the body. Your body needs ATP to
make DNA and RNA. It needs the triphosphate in ATP to make RNA. For DNA, your body first converts ATP to deoxyribonucleotide (dATP) by removing an oxygen atom. Sending messages within cells requires ATP. ATP's role in intracellular signaling is to release messengers, such as hormones, enzymes, lipid mediators, neurotransmitters, nitric
oxide, growth factors, and reactive oxygen species. These messengers regulate the inner workings of cells. ATP is also involved in muscles can store a small amount of ATP. This ATP is used up rather quickly when you're exercising. Then your body makes more ATP and sends it to the
muscles to sustain exercise levels. The clinical uses of ATP include pain management, anesthesia, cardiology, and surgery. ATP administered through a vein (intravenously) can help control pain by acting on the A1 adenosine receptor. This initiates a signaling process, which can aid in relieving pain due to inflammation. In some cases, the effect can
last for weeks. ATP can be used to help with anesthesia. Administered in low doses, ATP can reduce opioid use after surgery. ATP is safe for use in people with high blood
pressure in the pulmonary artery (pulmonary hypertension). Pulmonary hypertension can lead to difficulty breathing and a reduced ability to perform everyday tasks. If left untreated, this condition can cause heart failure and early death. ATP can also be used in surgery to cause low blood pressure (hypotension). This helps to reduce bleeding and
provide a better view of the surgical site. ATP may be helpful for people with advanced solid tumors. ATP made in the laboratory is being studied to see if can decreases weight loss and improve muscle strength in these people. ATP is made of a nitrogen base (adenine) and a sugar molecule (ribose), which create adenosine, plus three phosphate
molecules. If adenosine only has one phosphate molecule, it's called adenosine monophosphate (AMP). If it has two phosphate molecules are what really matter. The
most energy-loaded composition for adenosine is ATP, which has three phosphates. ATP was first discovered during the 1920s. In 1929, Karl Lohmann—a German chemist studying muscle contractions—isolated what we now call adenosine triphosphate in a laboratory. At the time, Lohmann—a German chemist studying muscle contractions—isolated what we now call adenosine triphosphate in a laboratory.
in 1939, that Nobel Prize-winner Fritz Lipmann established that ATP is the universal carrier of energy in all living cells and coined the term "energy-rich phosphate bonds." Lipmann focused on phosphate bonds as the key to ATP being the universal energy source for all living cells, because adenosine triphosphate releases energy when one of its three
phosphate bonds breaks off to form ADP. ATP is a high-energy molecule with three phosphate (ATP) becomes adenosine triphosphate (ATP) becomes adenosine triphosphate (ATP) becomes adenosine triphosphate (ATP) when one of its three phosphate bonds. Adenosine triphosphate (ATP) becomes adenosine triphosphate 
Conversely, ADP becomes ATP when a phosphate molecule is added. As part of an ongoing energy cycle, ADP is constantly recycled back into ATP. Much like a rechargeable battery with a fluctuating state of charge, ATP molecule loses a
phosphate bond, it becomes ADP; energy is released via the process of ATP becoming ADP. On the flip side, when a phosphate bond is added, ADP becomes fully charged ATP. This energy-creation and energy-depletion cycle happens time
and time again, much like your smartphone battery can be recharged countless times during its lifespan. The human body uses molecules held in the fats, proteins, and carbohydrates we eat or drink as sources of energy to make ATP. This happens through a process called hydrolysis. After food is digested, it's synthesized into glucose, which is a form
of sugar. Glucose is the main source of fuel that your cells' mitochondria use to convert caloric energy from food into ATP, which is an energy from that occurs in the mitochondria are tiny subunits within a cell that specialize in extracting energy from
the foods we eat and converting it into ATP. Mitochondria can convert glucose into ATP via two different types of cellular respiration: Aerobic (without oxygen) Aerobic (without oxygen) Aerobic (without oxygen) Aerobic cellular respiration transforms glucose into ATP in a three-step process, as follows: Step 1: GlycolysisStep 2: The Krebs cycle (also called the citric acid
cycle)Step 3: Electron transport chain During glycolysis, glucose (i.e., sugar) from food sources is broken down into pyruvate molecules. This is followed by the Krebs cycle, which is an aerobic process that uses oxygen to finish breaking down sugar and harnesses energy into electron carriers that fuel the synthesis of ATP. Lastly, the electron
transport chain (ETC) pumps positively charged protons that drive ATP production throughout the mitochondria's inner membrane. Mitochondria are mini-structures within a cell that convert glucose into "the energy molecule" known as ATP via aerobic or anaerobic cellular respiration. ATP can also be produced without oxygen (i.e., anaerobic), which
is something plants, algae, and some bacteria do by converting the energy held in sunlight into energy that can be used by a cell via photosynthesis. Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working out "without oxygen." Anaerobic exercise means that your body is working the properties of the pro
is present during cellular respiration, pyruvate can't enter the Krebs cycle and is oxidized into lactic acid. In the absence of oxygen, lactic acid fermentation makes ATP anaerobic high-intensity interval training (HIIT) that maxes out your aerobic
capacity or during a strenuous weight-lifting workout is lactic acid, which is used to make ATP via anaerobic glycolysis. During aerobic exercise, mitochondria have enough oxygen to perform cellular respiration aerobically, the process can still
happen anaerobically, but it creates a temporary burning sensation in your skeletal muscles. Eating a well-balanced diet and staying hydrated should give your body all the resources it needs to produce plenty of ATP. Although some athletes may slightly improve their performance by taking supplements or ergonomic aids designed to increase ATP.
production, it's debatable that oral adenosine triphosphate supplementation actually increases energy. ATP is essential to providing energy to cells. It has many functions in the body, including neurotransmission, DNA and RNA synthesis, intracellular signaling, and muscle contraction. It can also be used clinically in pain management, anesthesia,
cardiology, and surgery. The body makes ATP from dietary fats, proteins, and carbohydrates. The cells' mitochondria convert glucose into ATP through aerobic as well as anaerobic respiration. Always use common sense and talk to a healthcare provider before spending money or ingesting supplements that make potentially hyped-up marketing claims
about increasing energy by boosting ATP production. Frequently Asked Questions An average cell in the human body uses about 10 million ATP molecules per second and can recycle all of its ATP in less than a minute. Over 24 hours, the human body turns over its weight in ATP. ATP deficiencies can reduce energy and make you feel lethargic.
Although eating a well-balanced diet and staying hydrated should give your body enough fuel to produce plenty of ATP, certain diseases such as fibromyalgia and chronic fatigue syndrome may disrupt ATP hydrolysis. Adenosine metabolism rates may affect your vulnerability to sleep deprivation and your deep-sleep quality. Research suggests that
sleep-wake cycles are influenced by how adenosine is metabolized in the brain. Figure 8.2 Chemical Structure of ATP Chemic
(nitrogen containing), a ribose (five carbon sugar), and three phosphate groups.. The chemical bond between the second and third phosphate groups, termed a high-energy bond, represents the greatest source of energy in a cell. It is the first bond that catabolic enzymes break when cells require energy to do work. During this reaction, a molecule of
water is added (in a hydrolysis reaction) to the bond between the second and third phosphate groups. The bond is hydrolysed and the energy is released. Figure 8.3 Hydrolysis (left side) and Rephosphorylation (right side) of ATP Creation of ATP Creation is catalyzed by the enzyme ATPase and the products of this reaction are a molecule of
adenosine diphosphate (ADP) and a lone inorganic phosphate group (Pi). ATP, ADP, and Pi are constantly being cycled through reactions that build ATP and release energy, and reactions that break down ATP and release energy. The energy from ATP drives all bodily functions, such as contracting muscles, maintaining the electrical potential of nerve
cells, and absorbing food in the gastrointestinal tract. During exercise, the energy released from this reaction can be harnessed by the exercising muscle and converted to the mechanical energy required for muscle contraction. ATP can be produced from carbohydrates, fats, amino acids, and creatine phosphate. The body does not store ATP to any
great extent. Small amounts are stored in the fibers of skeletal muscles, but only enough to support a few seconds of muscle contraction to continue. The process of resynthesizing ADP back to ATP is called rephosphorylation and can
be seen in Figure 8.3. In this reaction, ADP is reconnected to Pi to produce ATP. Creatine phosphate (CP) is another high-energy phosphate compound that is stored in the muscles and is used to rapidly rephosphorylate ADP to ATP when ATP levels decrease. ATP is also made from your body's stores of carbohydrate, protein, and fat. Carbohydrate
and CP can be used to make ATP very quickly, while fat makes ATP more slowly but in greater amounts. Protein can be used to make ATP but it makes ATP slowly and in small amounts so does not provide a significant contribution to your body's overall energy supply. Figure 8.4 Recap of ATP Reactions Hydrolysis and Rephosphorylation of ATP As
mentioned earlier, ATP is not stored to any great extent in the body so we can say that ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is slow but if you need more ATP production is slow but if you need more ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is slow but if you need more ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is slow but if you need more ATP because you want to go for a run, your body will respond to that demand by increasing the amount of ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low, so ATP production is a "make it as you go" system. For example, at rest your ATP needs are low at the production is a "make it as you go" at a "m
There are three major energy systems, as seen in Figure 8.5, the body can use to make or resynthesize ATP during exercise. These energy systems that Contribute to ATP Production Major Energy Systems and ATP Production The three primary energy producing systems
in the human body are the ATP-CP system (also known as the phosphagen system), anaerobic glycolysis, and aerobic metabolism (Krebs cycle/electron transport system). Before we begin discussing the amount of ATP produced and speed of each of the three systems, it is important to understand how the systems work together to provide the body
with a steady supply of energy during different types of activity and as the intensity of an activity changes. Physical activity determine which energy system is predominating as the main source of ATP production. The term
"predominating" is key, because no energy system operates at the exclusion of the other systems. All three systems operate simultaneously and continuously. One system may predominate as the main producer of ATP, but the other systems operate simultaneously and continuously.
activities that predominantly use that energy system. Always remembering that the other systems are still contributing, even if only a small percentage, to the overall ATP production. How can financial brands set themselves apart through visual storytelling? Our experts explain how. Learn MoreThe Motorsport Images Collections captures events from
1895 to today's most recent coverage. Discover The Collection Curated, compelling, and worth your time. Explore our latest gallery of Editors' Picks. Browse Editors' Favorites How can financial brands set themselves apart through visual storytelling? Our experts explain how. Learn MoreThe Motorsport Images Collections captures events from 1895 to
today's most recent coverage. Discover The Collection Curated, compelling, and worth your time. Explore our latest gallery of Editors' Picks. Browse Editors' Picks. Browse Editors' Favorites How can financial brands set themselves apart through visual storytelling? Our experts explain how. Learn MoreThe Motorsport Images Collections captures events from 1895 to today's
most recent coverage. Discover The Collection Curated, compelling, and worth your time. Explore our latest gallery of Editors' Picks. Browse Picks. Browse Picks. Browse Picks. Browse Picks. Browse Picks. Br
articleMovement, the intricate cooperation of muscle and nerve fibres, is the means by which an organism must move to find food or, if it is sedentary, must have the means to bring food to itself. An animal to carry out the normal activities of life. An organism must move to find food or, if it is sedentary, must have the means to bring food to itself. An animal to carry out the normal activities of life.
must be able to move nutrients and fluids through its body, and it must be able to react to external or internal stimuli. Muscle cells fuel their actions by converting chemical energy. The science of creating artificial muscles Researchers
develop methods for producing artificial muscles with polymer covalent organic frameworks (polyCOFs). See all videos for this articleMuscle is contractile tissue grouped into coordinated systems for greater efficiency. In humans the muscle systems are classified by gross appearance and location of cells. The three types of muscles are striated (or
skeletal), cardiac, and smooth (or nonstriated muscle is almost exclusively attached to the skeleton and constitutes the bulk of the body's muscle tissue. The multinucleated fibres are under the control of the somatic nervous system and elicit movement by forces exerted on the skeleton similar to levers and pulleys. The rhythmic contraction
of cardiac muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is specialized striated muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is specialized striated muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is specialized striated muscle is specialized striated muscle is specialized striated muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is specialized striated muscle is regulated by the sinoatrial node, the heart's pacemaker. Although cardiac muscle is regulated by the sinoatrial node, the heart's pacemaker.
autonomic nervous system and thus are not under voluntary control. The nucleus of each short tapering cell is located centrally. Unicellular organisms, simple animals, and the motile cells of complex animals do not have vast muscle systems. Rather, movement in these organisms is elicited by hairlike extensions of the cell membrane called cilia and
flagella or by cytoplasmic extensions called pseudopodia. This article consists of a comparative study of the muscle system as it relates to upright posture, see muscle system, human. What parts of the brain control voluntary
and involuntary muscle movements? Voluntary muscles are controlled by the motor cortex, while involuntary muscles are controlled by other regions of the brain such as the hypothalamus. See all videos for this article Muscle powers the movements of multicellular animals and maintains posture. Its gross appearance is familiar as meat or as the flesh
of fish. Muscle is the most plentiful tissue in many animals; for example, it makes up 50 to 60 percent in antelopes. Some muscles are under conscious control and are called voluntary muscles, called involuntary muscles, are not consciously controlled by the organism. For example,
are apparent in blushing and paling due to increased or decreased blood flow, respectively, to the skin.) Muscles are not the only means of movement in animals. Many protists (unicellular organisms) move instead by using cilia or flagella (actively beating processes of the cell surface that propel the organism through water). Some unicellular
organisms are capable of amoeboid movement, in which the cell contents flow into extensions, called pseudopodia, from the cell body. Some of the ciliated protozoans move by means of rods called myonemes, which are capable of shortening rapidly. Nonmuscular methods of movement are important for multicellular animals as well. Many microscopic
animals swim by means of beating cilia. Some small mollusks and flatworms crawl using cilia on the underside of the body. Some invertebrates that feed by filtering particles from water currents. In higher animals, white blood cells use amoeboid movements, and cilia from cells lining the respiratory tract removes
foreign particles from the delicate membranes. Muscles consist of long slender cells (fibres), each of which is a bundle of finer fibrils (Figure 1). Within each fibril are relatively thick filaments of the protein myosin and thin ones of actin and other proteins. When a muscle fibre lengthens or shortens, the filaments remain essentially constant in length
but slide past each other as shown in Figure 2. Tension in active muscles is produced by cross bridges (i.e., projections from the thick filaments slide past each other, the cross bridges repeatedly detach and reattach in new positions
Their action is similar to pulling in a rope hand over hand. Some muscle fibres are several centimetres long, but most other cells are only a fraction of a millimetre long. Because these long fibres cannot be served adequately by a single nucleus, numerous nuclei are distributed along their length. The work done by muscle requires chemical energy
derived from the metabolism of food. When muscles shorten while exerting tension and performing mechanical energy is converted to work and some is lost as heat. When muscles lengthen while exerting tension (such as in slowly lowering a weight), the chemical energy that is used, along with the mechanical energy is converted to work and some is lost as heat.
absorbed by the action, is converted to heat. Generation of heat is an important function of muscle in warm-blooded animals. Shivering is muscle activity that generates heat and warms the body. Similarly, some insects vibrate their wings for a while before flight, heating the muscles to the temperature at which they work best. Energy-carrying
molecule in living cells Adenosine-5'-triphosphate Names IUPAC name O1-{[(2R,3S,4R,5R)-5-(6-Amino-9H-purin-9-yl)-3,4-dihydroxyoxolan-2-yl]methyl} tetrahydrogen triphosphate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate in living cells Adenosine-5'-triphosphate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate in living cells Adenosine-5'-triphosphate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate in living cells Adenosine-5'-triphosphate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers CAS Number 56-65-5 (free acid) Y34369-07-8 (disodium salt hydrate) N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate Identifiers N 3D model (JSmol) and the salt hydrate 
[C@@H]3Oc1nc(c2c(n1)n(cn2)[C@H]3[C@@H]([C@@H]([C@@H]((C@H)(O3)COP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)O
Absorbance ε259 = 15.4 mM-1 cm-1 [1] Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). Y verify (what is YN?) Infobox references Chemical compound Interactive animation of the structure of ATP Adenosine triphosphate (ATP) is a nucleoside triphosphate[2] that provides energy to
to adenosine monophosphate (AMP). Other processes around 50 kilograms (about 100 moles) daily.[4] From the perspective of biochemistry, ATP is classified as a nucleoside triphosphate, which indicates that it consists of three
components: a nitrogenous base (adenine), the sugar ribose, and the triphosphate atom to the 1' carbon atom of a sugar (ribose), which in turn is attached at the 5' carbon atom of the sugar to a
triphosphate group. In its many reactions related to metabolism, the adenine and sugar groups remain unchanged, but the triphosphate is converted to di- and monophosphate, giving respectively the derivatives ADP and AMP. The three phosphoryl groups are labeled as alpha (α), beta (β), and, for the terminal phosphate, gamma (γ).[6] In neutral phosphate is converted to di- and monophosphate is converted to di- 
solution, ionized ATP exists mostly as ATP4-, with a small proportion of ATP3-.[7] Polyanionic and featuring a potentially chelating polyphosphate group, ATP binds metal cations with high affinity. The binding constant for Mg2+ is (9554).[8] The binding of a divalent cation, almost always magnesium, strongly affects the interaction of ATP with
various proteins. Due to the strength of the ATP-Mg2+ interaction, ATP exists in the cell mostly as a complex with Mg2+ bonded to the phosphate oxygen centers.[7][9] A second magnesium ion is critical for ATP binding in the kinase domain.[10] The presence of Mg2+ regulates kinase activity.[11] It is interesting from an RNA world perspective that
ATP can carry a Mg ion which catalyzes RNA polymerization. [citation needed] Salts of ATP can be isolated as colorless solids. [12] The cycles of synthesis and degradation of ATP; 2 and 1 represent input and output of energy, respectively. ATP is stable in aqueous solutions between pH 6.8 and 7.4 (in the absence of catalysts). At more extreme pH
levels, it rapidly hydrolyses to ADP and phosphate. Living cells maintain the ratio of ATP to ADP at a point ten orders of magnitude from equilibrium, with ATP concentrations fivefold higher than the concentration of ADP.[13][14] In the context of biochemical reactions, the P-O-P bonds are frequently referred to as high-energy bonds.[15] The
hydrolysis of ATP into ADP and inorganic phosphate ATP4-(aq) + H2O(l) = ADP3-(aq) + H2O(l) = 
 phosphate (Pi) or a pyrophosphate (PPi) unit from ATP at standard state concentrations of 1 mol/L at pH 7 are:[17] ATP + H2O \rightarrow ADP + Pi \Delta G^{\circ}' = -45.6 kJ/mol (-10.9 kcal/mol) These abbreviated equations at a pH near 7 can be written more explicitly (R = adenosyl): [RO-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-O-P(O)2-
 P(O)^2-O-PO3]4- + H^2O \rightarrow [RO-P(O)^2-O-PO3]3- + [HPO4]2- + H+ [RO-P(O)^2-O-PO3]4- + H^2O \rightarrow [RO-PO3]4- + H^2O \rightarrow [RO-PO3]3- + H+ At cytoplasmic conditions, where the ADP/ATP ratio is 10 orders of magnitude from equilibrium, the \Delta G is around -57 kJ/mol.[13] Along with pH, the free energy change of ATP hydrolysis is also
associated with Mg2+ concentration, from \Delta G^{\circ} = -35.7 kJ/mol at a Mg2+ concentration of zero, to \Delta G^{\circ} = -31 kJ/mol at [Mg2+] = 5 mM. Higher concentrations of Mg2+ decrease free energy released in the reaction due to binding of Mg2+ ions to negatively charged oxygen atoms of ATP at pH 7.[18] This image shows a 360-degree rotation of a
single, gas-phase magnesium-ATP chelate with a charge of -2. The anion was optimizer to reflect the probable electronic structure. A typical intracellular concentration of ATP may be 1-10 µmol per gram of tissue in a variety of eukaryotes
[19] The dephosphorylation of ATP and rephosphorylation of ADP and AMP occur repeatedly in the course of aerobic metabolism. [20] ATP can be produced by a number of distinct cellular processes; the three main pathways in eukaryotes are (1) glycolysis, (2) the citric acid cycle/oxidative phosphorylation, and (3) beta-oxidation. The overall process
of oxidizing glucose to carbon dioxide, the combination of pathways 1 and 2, known as cellular respiration, produces about 30 equivalents of ATP from each molecule of glucose. [21] ATP production by a non-photosynthetic aerobic eukaryote occurs mainly in the mitochondria, which comprise nearly 25% of the volume of a typical cell. [22] Main article
Glycolysis In glycolysis, glucose and glycerol are metabolized to pyruvate. Glycolysis generates two equivalents of ATP through substrate phosphorylation catalyzed by two enzymes, phosphoglycerate kinase (PGK) and pyruvate kinase. Two equivalents of nicotinamide adenine dinucleotide (NADH) are also produced, which can be oxidized via the
electron transport chain and result in the generation of additional ATP by ATP synthase. The pyruvate generated as an end-product of glycolysis is a substrate for the Krebs Cycle.[23] Glycolysis is a substrate 
One ATP is invested in Step 1, and another ATP is invested in Step 3. Steps 1 and 3 of glycolysis are referred to as "Priming Steps". In Phase 2, two equivalents of ATP are produced. In Steps 7 and 10, ATP is generated from ADP. A net of
two ATPs is formed in the glycolysis cycle. The glycolysis pathway is later associated with the Citric Acid Cycle which produces additional equivalents of ATP.[24] In glycolysis, hexokinase is directly inhibited by its product, glucose-6-phosphate, and pyruvate kinase is inhibited by ATP itself. The main control point for the glycolytic pathway is
phosphofructokinase (PFK), which is allosterically inhibited by high concentrations of ATP and activated by high concentrations of AMP. The inhibition of PFK by ATP is unusual since ATP is also a substrate in the reaction catalyzed by PFK; the active form of the enzyme is a tetramer that exists in two conformations, only one of which binds the second
 substrate fructose-6-phosphate (F6P). The protein has two binding sites for ATP - the active site is accessible in either protein conformation, but ATP binding to the inhibitor site stabilizes the conformation that binds F6P poorly.[23] A number of other small molecules can compensate for the ATP-induced shift in equilibrium conformation and
reactivate PFK, including cyclic AMP, ammonium ions, inorganic phosphate, and fructose-1,6- and -2,6-biphosphate, and fructose-1,6- and fr
cycle and Oxidative phosphorylation In the mitochondrion, pyruvate is oxidized by the citric acid cycle (also known as the Krebs cycle). Every "turn" of the citric acid cycle produces two molecules of carbon dioxide by the pyruvate is oxidized to carbon dioxide by the citric acid cycle (also known as the Krebs cycle).
triphosphate (GTP) through substrate-level phosphorylation catalyzed by succinyl-CoA synthetase, as succinyl-CoA synthetase, as succinyl-CoA is converted to succinate, three equivalents of NADH, and one equivalent of FADH2. NADH and FADH2 are recycled (to NAD+ and FADH2 are recycled (to NAD+ and FADH2 are recycled (to NAD+ and FADH2) are recycled (to NAD+ and FADH2).
results in the synthesis of 2-3 equivalents of ATP, and the oxidation of one FADH2 yields between 1-2 equivalents of ATP.[21] The majority of cellular ATP is generated by this process. Although the citric acid cycle itself does not involve molecular oxygen, it is an obligately aerobic process because O2 is used to recycle the NADH and FADH2. In the
absence of oxygen, the citric acid cycle ceases. [22] The generation of ATP by the mitochondrion from cytosolic NADH and NAD+. Instead of transferring the generated NADH, a malate-aspartate shuttle) because the inner mitochondrial membrane is impermeable to NADH and NAD+. Instead of transferring the generated NADH, a malate-aspartate shuttle)
dehydrogenase enzyme converts oxaloacetate to malate, which is translocated to the mitochondrial matrix. Another malate dehydrogenase-catalyzed reaction occurs in the opposite direction, producing oxaloacetate and NADH from the newly transported malate and the mitochondrion's interior store of NAD+. A transaminase converts the
oxaloacetate to aspartate for transport back across the membrane space. [22] In oxidative phosphorylation, the passage of electrons from NADH and FADH2 through the electron transport chain releases the energy to pump protons out of the mitochondrial matrix and into the intermembrane space. This pumping generates
a proton motive force that is the net effect of a pH gradient across the inner mitochondrial membrane. Flow of protons down this potential gradient - that is, from the intermembrane space to the matrix - yields ATP by ATP synthase. [25] Three ATP are produced per turn. Although oxygen consumption appears
fundamental for the maintenance of the proton motive force, in the event of oxygen shortage (hypoxia), intracellular acidosis (mediated by enhanced glycolytic rates and ATP hydrolysis), contributes to mitochondria will be used for cellular
processes in the cytosol; thus it must be exported from its site of synthesis in the mitochondrial matrix. ATP outward movement is favored by the membrane's electrochemical potential because the cytosol has a relatively positive charge compared to the relatively negative matrix. For every ATP transported out, it costs 1 H+. Producing one ATP costs
about 3 H+. Therefore, making and exporting one ATP requires 4H+. The inner membrane contains an antiporter, the ADP/ATP translocase, which is an integral membrane protein used to exchange newly synthesized ATP in the matrix for ADP in the intermembrane space. [27] The citric acid cycle is regulated mainly by the availability of key
substrates, particularly the ratio of NAD+ to NADH and the concentrations of calcium, inorganic phosphate, ATP, ADP, and AMP. Citrate - the ion that gives its name to the cycle - is a feedback inhibitor of citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits PFK, providing a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the citrate synthase and also inhibits a direct link between the regulation of the c
confusing or unclear to readers. Please help clarify the article: Beta-oxidation In the presence of air and various cofactors and enzymes, fatty acids are converted to acetyl-CoA. The pathway is called beta-oxidation. Each
cycle of beta-oxidation shortens the fatty acid chain by two carbon atoms and produces one equivalent each of acetyl-CoA, NADH, and FADH2 are used by oxidative phosphorylation to generate ATP. Dozens of ATP equivalents are generated by the
beta-oxidation of a single long acyl chain. [28] In oxidative phosphorylation, the key control point is the reaction catalyzed by cytochrome c oxidase, which is regulated by the amounts of other substrates: 1 2 NADH +
1 2 ([ADP][Pi][ATP]) Keq {\displaystyle {\frac {\[mathrm {ADP} ]}}\right)^{\frac {\[mathrm {ADP} ]}}\right) Keq {\displaystyle {\frac {\[mathrm {ADP} ]}}\right)^{\frac {\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}\right)^{\[mathrm {ADP} ]}}\right)^{\[mathrm {ADP} ]}\right)^{\[mathrm {ADP} ]}\right)
ratio of [ADP] [Pi] to [ATP] imply a high amount of reduced cytochrome c and a high level of cytochrome c oxidase activity.[23] An additional level of regulation is introduced by the transport rates of ATP and NADH between the mitochondrial matrix and the cytoplasm.[27] Main article: Ketone bodies Ketone bodies can be used as fuels, yielding 22
ATP and 2 GTP molecules per acetoacetate molecule when oxidized in the mitochondria. Ketone bodies are transported from the liver to other tissues, where acetoacetate and beta-hydroxybutyrate can be reconverted to acetyl-CoA to produce reducing equivalents (NADH and FADH2), via the citric acid cycle. Ketone bodies cannot be used as fuel by
the liver, because the liver lacks the enzyme β-ketoacyl-CoA transferase, also called thiolase. Acetoacetate in low concentrations is taken up by the liver and undergoes detoxification through the methylglyoxal pathway which ends with lactate. Acetoacetate in high concentrations is absorbed by cells other than those in the liver and enters a different
pathway via 1,2-propanediol. Though the pathway follows a different series of steps requiring ATP, 1,2-propanediol can be turned into pyruvate. [29] Fermentation is the metabolism of organic compounds in the absence of air. It involves substrate-level phosphorylation in the absence of a respiratory electron transport chain. The equation for the
reaction of glucose to form lactic acid is: C6H12O6 + 2 ADP + 2 Pi \rightarrow 2 CH3CH(OH)COOH + 2 ATP + 2 H2O Anaerobic respiration in the absence of O2. Prokaryotes can utilize a variety of electron acceptors. These include nitrate, sulfate, and carbon dioxide. In anaerobic organisms and prokaryotes, different pathways result in ATP. ATP
is produced in the chloroplasts of green plants in a process similar to oxidative phosphorylation, called photophosphorylation, called photophosphorylation, called photophosphate sas a high-energy
phosphate donor, and the ATP:guanido-phosphotransferase family.[citation needed] In plants, ATP is synthesized in the thylakoid membrane of the chloroplast. The process is called photophosphorylation. The "machinery" is similar to that in mitochondria except that light energy is used to pump protons across a membrane to produce a proton-motive
force. ATP synthase then ensues exactly as in oxidative phosphorylation.[30] Some of the ATP produced in the chloroplasts is consumed in the Calvin cycle, which produces triose sugars. The total quantity of ATP in the human body is about 0.1 mol/L.[31] The majority of ATP is recycled from ADP by the aforementioned processes. Thus, at any given
time, the total amount of ATP + ADP remains fairly constant. The energy used by human cells in an adult requires the hydrolysis of 100 to 150 mol/L of ATP over the course of the day.[32] Each equivalent of ATP is recycled 1000-1500 times during a single day (150 / 0.1 =
1500),[31] at approximately 9×1020 molecules/s.[31] An example of the Rossmann fold, a structural domain of a decarboxylase enzyme from the bacterium Staphylococcus epidermidis (PDB: 1G5Q) with a bound flavin mononucleotide cofactor The conversion of ATP to ADP is the principal mechanism for energy supply in biological processes.[5]
Energy is produced in cells when the terminal phosphate group in an ATP molecule is removed from the chain to produce adenosine diphosphate (AMP) also produces extra
energy.[5] ATP is involved in signal transduction by serving as substrate for kinases, enzymes that transfer phosphate groups. Kinases are the most common ATP-binding proteins. They share a small number of common folds.[34]
ATP is also a substrate of adenylate cyclase, most commonly in G protein-coupled receptor signal transduction is particularly important in brain function
although it is involved in the regulation of a multitude of other cellular processes. [36] ATP is one of four monomers required in the synthesis of RNA. The process is promoted by RNA polymerases. [37] A similar process occurs in the formation of DNA, except that ATP is first converted to the deoxyribonucleotide dATP. Like many condensation
reactions in nature, DNA replication and DNA transcription also consume ATP. Main article: Amino acid activation Aminoacyl-tRNA synthetase enzymes consume ATP in the attachment tRNA to amino acid, forming aminoacyl-tRNA synthetase enzymes consume ATP.
ATP \rightarrow aa-AMP + PPi aa-AMP + tRNA \rightarrow aa-tRNA + AMP The amino acid is coupled to the penultimate nucleotide at the 3'-end of the tRNA (the A in the sequence CCA) via an ester bond (roll over in illustration). Transporting chemicals out of a cell against a gradient is often associated with ATP hydrolysis. Transport is mediated by ATP binding
cassette transporters. The human genome encodes 48 ABC transporters, that are used for exporting drugs, lipids, and other compounds.[38] Cells secrete ATP to communicate with other cells in a process called purinergic signalling. ATP serves as a neurotransmitter in many parts of the nervous system, modulates ciliary beating, affects vascular
oxygen supply etc. ATP is either secreted directly across the cell membrane through channel proteins [39][40] or is pumped into vesicles[41] which then fuse with the membrane. Cells detect ATP using the purinergic receptor proteins P2X and P2Y.[42] ATP has been shown to be a critically important signalling molecule for microglia - neuron
interactions in the adult brain, [43] as well as during brain development. [44] Furthermore, tissue-injury induced ATP-signalling is a major factor in rapid microglial phenotype changes. [45] ATP fuels muscle contractions are regulated by specific pathways.
and stimuli based on their particular function. However, in all muscle types, contraction is performed by the proteins actin and myosin. [47] ATP is initially bound to myosin. When ATPase hydrolyzes the bound ATP and Pi forms cross-
bridges with actin and the subsequent release of ADP and Pi releases energy as the power stroke. The power stroke causes actin filament to slide past the myosin, releasing it from actin and allowing this process to repeat. [47][48] ATP has
recently been proposed to act as a biological hydrotrope[49] and has been shown to affect proteome-wide solubility.[50] Acetyl phosphate (AcP), a precursor to ATP, can readily be synthesized at modest yields from thioacetate in pH 7 and 20 °C and pH 8 and 50 °C, although acetyl phosphate is less stable in warmer temperatures and alkaline
conditions than in cooler and acidic to neutral conditions. It is unable to promote polymerization of ribonucleotides and was only capable of phosphorylation of nucleotides could promote polymerization
above 75 °C in the absence of Na+. It is possible that polymerization promoted by AcP and other nucleoside triphosphates were not phosphorylated by AcP. This might explain why all lifeforms use ATP to drive biochemical reactions.[52]
Biochemistry laboratories often use in vitro studies to explore ATP-dependent molecular processes. ATP analogs are also used in X-ray crystallography to determine a protein structure in complex with ATP, often together with other substrates. [citation needed] Enzyme inhibitors of ATP-dependent enzymes such as kinases are needed to examine the
binding sites and transition states involved in ATP-dependent reactions.[citation needed] Most useful ATP analogs cannot be hydrolyzed as ATP would be; instead, they trap the enzyme in a structure closely related to the ATP-bound state. Adenosine 5'-(γ-thiotriphosphate) is an extremely common ATP analog in which one of the gamma-phosphate
oxygens is replaced by a sulfur atom; this anion is hydrolysed at a dramatically slower rate than ATP itself and functions as an inhibitor of ATP-dependent processes. In crystallographic studies, hydrolysis transition states are modeled by the bound vanadate ion. Caution is warranted in interpreting the results of experiments using ATP analogs, since
some enzymes can hydrolyze them at appreciable rates at high concentration.[53] ATP is used intravenously for some heart-related conditions.[54] ATP was discovered in 1929 from muscle tissue by Karl Lohmann [de][5][55] and Jendrassik[56] and, independently, by Cyrus Fiske and Yellapragada Subba Rao of Harvard Medical School,[57] both teams
competing against each other to find an assay for phosphorus. It was proposed to be the intermediary between energy-requiring reactions in cells by Fritz Albert Lipmann in 1941.[58] He played a major role in establishing that ATP is the energy currency of a cell.[5] It was first synthesized in the laboratory by Alexander Todd in
1948,[59] and he was awarded the Nobel Prize in Chemistry in 1957 partly for this work. The 1978 Nobel Prize in Chemistry was divided, one half jointly to Paul D. Boyer and John E. Walker "for their
 elucidation of the enzymatic mechanism underlying the synthesis of adenosine triphosphate (ATP)" and the other half to Jens C. Skou "for the first discovery of an ion-transporting enzyme, Na+, K+ -ATPase."[60] Adenosine-tetraphosphatase Adenosine methylene triphosphate ATPases ATP test Creatine Cyclic adenosine monoph
Nucleotide exchange factor Phosphagen ^ a b "Adenosine 5'-triphosphate disodium salt Product Information" (PDF). Sigma. Archived (PDF) from the original on 2019-03-23. Retrieved 2019-03-23. Retrieved 2019-03-23. Retrieved 2019-03-23. Retrieved 2019-03-24.
November 2023. ^ Knowles, J. R. (1980). "Enzyme-catalyzed phosphoryl transfer reactions". Annu. Rev. Biochem. 49: 877-919. doi:10.1146/annurev.bi.49.070180.004305. PMID 6250450. ^ "An average individual with a daily diet of 8000 kJ and a 30% efficiency of turning foodstuffs into chemical energy will synthesize (and hydrolyze) about 50 kg of
ATP during 1 day." Wilkens, Stephan (2008). "ATP Synthesis, Chemistry of". Wiley Encyclopedia of Chemical Biology. doi:10.1002/9780470048672.wecb648. ISBN 9780471754770. ^ a b c d e f g Myers, Richard L. (2007). The 100 Most Important Chemical Compounds: A Reference Guide. ABC-CLIO. pp. 18-19. ISBN 978-0-313-33758-1. Archived from
the original on 17 June 2016. Retrieved 21 November 2015. ^ Dunn, Jacob; Grider, Michael H. (2023), "Physiology, Adenosine Triphosphate", StatPearls, Treasure Island (FL): StatPearls Publishing, PMID 31985968, retrieved 2023-09-28 ^ a b Storer, A.; Cornish-Bowden, A. (1976). "Concentration of MgATP2- and other ions in solution. Calculation of
the true concentrations of species present in mixtures of associating ions". Biochem. J. 159 (1): 1-5. doi:10.1042/bj1590001. PMC 1164030. PMID 11772. \(^\text{Vilson, J.; Chin, A. (1991).}\) "Chelation of divalent cations by ATP, studied by titration calorimetry". Anal. Biochem. 193 (1): 16-19. doi:10.1016/0003-2697(91)90036-S. PMID 1645933. \(^\text{Garfinkel}\)
L.; Altschuld, R.; Garfinkel, D. (1986). "Magnesium in cardiac energy metabolism". J. Mol. Cell. Cardiol. 18 (10): 1003-1013. doi:10.1016/S0022-2828(86)80289-9. PMID 3537318. ^ Saylor, P.; Wang, C.; Hirai, T.; Adams, J. (1998). "A second magnesium ion is critical for ATP binding in the kinase domain of the oncoprotein v-Fps". Biochemistry. 37 (36):
12624-12630. doi:10.1021/bi9812672. PMID 9730835. ^ Lin, X.; Ayrapetov, M; Sun, G. (2005). "Characterization of the interactions between the active site of a protein tyrosine kinase and a divalent metal activator". BMC Biochem. 6: 25. doi:10.1186/1471-2091-6-25. PMC 1316873. PMID 16305747. ^ Budavari, Susan, ed. (2001). The Merck Index:
An Encyclopedia of Chemicals, Drugs, and Biologicals (13th ed.). Merck. ISBN 0911910131. ^ a b Ferguson, S. J.; Nicholls, David; Ferguson, S. J.; Nicholls, David; Ferguson, S. J.; Stryer, L. (2003). Biochemistry. New York, NY: W. H. Freeman. p. 376. ISBN 978-0-12-518121-1.
7167-4684-3. ^ Chance, B.; Lees, H.; Postgate, J. G. (1972). "The Meaning of "Reversed Electron" in Biochemistry". Nature. 238 (5363): 330-331. Bibcode: 1972Natur. 238..330C. doi:10.1038/238330a0. PMID 4561837. S2CID 4298762. ^ Gajewski, E.; Steckler, D.; Goldberg, R. (1986). "Thermodynamics of the
hydrolysis of adenosine 5'-triphosphate to adenosine 5'-triphosphate to adenosine 5'-diphosphate to adenosine 5'-diphosphate to adenosine 5'-triphosphate to adenosine 5'-triphosphate to adenosine 5'-diphosphate to adenosine 5'-triphosphate to adenosine 5'-triphosphate to adenosine 5'-diphosphate to adenosine 
Charles M. (2016). Biochemistry (6th ed.). Cengage Learning. p. 68. ISBN 978-1305577206. Beis, I.; Newsholme, E. A. (October 1, 1975). "The contents of adenine nucleotides, phosphagens and some glycolytic intermediates in resting muscles from vertebrates and invertebrates." Biochem. J. 152 (1): 23–32. doi:10.1042/bj1520023. PMC 1172435.
PMID 1212224. ^ "Adenosine triphosphate". Britannica. 11 November 2023. Retrieved 1 December 2023. ^ a b Rich, P. R. (2003). "The molecular machinery of Keilin's respiratory chain". Biochem. Soc. Trans. 31 (6): 1095-1105. doi:10.1042/BST0311095. PMID 14641005. ^ a b c Lodish, H.; Berk, A.; Matsudaira, P.; Kaiser, C. A.; Krieger, M.; Scott,
M. P.; Zipursky, S. L.; Darnell, J. (2004). Molecular Cell Biology (5th ed.). New York, NY: W. H. Freeman. ISBN 978-0-7167-4366-8. ^ a b c d e Voet, D.; Voet, J. G. (2004). Biochemistry. Vol. 1 (3rd ed.). Hoboken, NJ: Wiley. ISBN 978-0-471-19350-0. ^ Mehta S (20 September 2011). "Glycolysis - Animation and Notes". PharmaXchange. Archived from
the original on 25 March 2012. Retrieved 22 September 2011. Abrahams, J.; Leslie, A.; Lutter, R.; Walker, J. (1994). "Structure at 2.8 Å resolution of F1-ATPase from bovine heart mitochondria". Nature. 370 (6491): 621-628. Bibcode:1994Natur.370..621A. doi:10.1038/370621a0. PMID 8065448. S2CID 4275221. Devaux, JBL; Hedges, CP; Hickey,
AJR (January 2019). "Acidosis Maintains the Function of Brain Mitochondria in Hypoxia-Tolerant Triplefin Fish: A Strategy to Survive Acute Hypoxic Exposure?". Front Physiol. 9, 1914: 1941. doi:10.3389/fphys.2018.01941. PMC 6346031. PMID 30713504. ^ a b Dahout-Gonzalez, C.; Nury, H.; Trézéguet, V.; Lauquin, G.; Pebay-Peyroula, E.; Brandolin,
G. (2006). "Molecular, functional, and pathological aspects of the mitochondrial ADP/ATP carrier". Physiology. 21 (4): 242-249. doi:10.1152/physiol.00005.2006. PMID 16868313. ^ Ronnett, G.; Kim, E.; Landree, L.; Tu, Y. (2005). "Fatty acid metabolism as a target for obesity treatment". Physiol. Behav. 85 (1): 25-35.
doi:10.1016/j.physbeh.2005.04.014. PMID 15878185. S2CID 24865576. ^ "Integrated Risk Information System" (PDF). 2013-03-15. Archived (PDF) from the original on 2015-09-24. Retrieved 2019-02-01. ^ Allen, J. (2002). "Photosynthesis of ATP-electrons, proton pumps, rotors, and poise". Cell. 110 (3): 273-276. doi:10.1016/S0092-8674(02)00870-X.
PMID 12176312. S2CID 1754660. ^ a b c Fuhrman, Bradley P.; Zimmerman, Jerry J. (2011). Pediatric Critical Care. Elsevier. pp. 1058-1072. ISBN 978-0-323-07307-3. Retrieved 16 May 2020. ^ Scheeff, E.;
Bourne, P. (2005). "Structural evolution of the protein kinase-like superfamily". PLOS Comput. Biol. 1 (5): e49. Bibcode: 2005PLSCB...1...49S. doi:10.1371/journal.pcbi.0010049. PMC 1261164. PMID 16244704. ^ Mishra, N.; Tuteja, N. (2006). "Signaling through MAP kinase networks in plants". Arch. Biochem. Biophys. 452 (1): 55-68.
doi:10.1016/j.abb.2006.05.001. PMID 16806044. ^ Kamenetsky, M.; Middelhaufe, S.; Bank, E.; Levin, L.; Buck, J.; Steegborn, C. (2006). "Molecular details of cAMP generation in mammalian cells: a tale of two systems". J. Mol. Biol. 362 (4): 623-639. doi:10.1016/j.jmb.2006.07.045. PMC 3662476. PMID 16934836. ^ Hanoune, J.; Defer, N. (2001).
"Regulation and role of adenylyl cyclase isoforms". Annu. Rev. Pharmacol. Toxicol. 41 (1): 145-174. doi:10.1146/annurev.pharmtox.41.1.145. PMID 11264454. ^ Joyce, C. M.; Steitz, T. A. (1995). "Polymerase structures and function: variations on a theme?". J. Bacteriol. 177 (22): 6321-6329. doi:10.1128/jb.177.22.6321-6329.1995. PMC 177480.
PMID 7592405. ^ Borst, P.; Elferink, R. Oude (2002). "Mammalian ABC transporters in health and disease" (PDF). Annual Review of Biochemistry. 71: 537-592. doi:10.1146/annurev.biochem.71.102301.093055. PMID 12045106. S2CID 34707074. Archived (PDF) from the original on 2018-04-21. Retrieved 2018-04-20. ^ Romanov, Roman A.; Lasher,
Robert S.; High, Brigit; Savidge, Logan E.; Lawson, Adam; Rogachevskaja, Olga A.; Zhao, Haitian; Rogachevsky, Vadim V.; Bystrova, Marina F.; Churbanov, Gleb D.; Adameyko, Igor; Harkany, Tibor; Yang, Ruibiao; Kidd, Grahame J.; Marambaud, Philippe; Kinnamon, John C.; Kolesnikov, Stanislav S.; Finger, Thomas E. (2018). "Chemical synapses
without synaptic vesicles: Purinergic neurotransmission through a CALHM1 channel-mitochondrial signaling complex". Science Signaling. 11 (529): eaao1815. ISSN 1945-0877. PMC 5966022. PMID 29739879. ^ Dahl, Gerhard (2015). "ATP release through pannexon channels". Philosophical Transactions of the Royal
Society B: Biological Sciences. 370 (1672): 20140191. doi:10.1098/rstb.2014.0191. ISSN 0962-8436. PMC 4455760. PMID 26009770. ^ Larsson, Max; Sawada, Keisuke; Morland, Cecilie; Hiasa, Miki; Ormel, Lasse; Moriyama, Yoshinori; Gundersen, Vidar (2012). "Functional and Anatomical Identification of a Vesicular Transporter Mediating Neuronal
ATP Release". Cerebral Cortex. 22 (5): 1203-1214. doi:10.1093/cercor/bhr203. ISSN 1460-2199. PMID 21810784. ^ Puchałowicz, Kamila; Tarnowski, Maciej; Baranowska-Bosiacka, Irena; Chlubek, Dariusz; Dziedziejko, Violetta (2014-12-18). "P2X and P2Y Receptors—Role in the Pathophysiology of the Nervous System". International Journal of
Molecular Sciences. 15 (12): 23672-23704. doi:10.3390/ijms151223672. ISSN 1422-0067. PMC 4284787. PMID 25530618. ^ Csaba, Cserep; Balazs, Pósfai (2020). "Microglia monitor and protect neuronal function through specialized somatic purinergic junctions". Science. 367 (6477): 528-537. Bibcode:2020Sci...367...528C.
doi:10.1126/science.aax6752. PMID 31831638. ^ Csaba, Cserep; Anett, Schwarcz D (2022). "Microglial control of neuronal development via somatic purinergic junctions". Cell Reports. 40 (12). doi:10.1016/j.celrep.2022.111369. PMC 9513806. PMID 36130488. ^ Peter, Berki; Csaba, Cserep; Zsuzsanna, Környei (2024). "Microglia contribute to
neuronal synchrony despite endogenous ATP-related phenotypic transformation in acute mouse brain slices". Nature Communications. 15 (1): 5402. Bibcode:2024NatCo..15.5402B. doi:10.1038/s41467-024-49773-1. PMC 11208608. PMID 38926390. ^ Hultman, E.; Greenhaff, P. L. (1991). "Skeletal muscle energy metabolism and fatigue during intense
exercise in man". Science Progress. 75 (298 Pt 3-4): 361-370. ISSN 0036-8504. PMID 1842855. ^ a b Kuo, Ivana Y.; Ehrlich, Barbara E. (February 2015). "Signaling in Muscle Contraction". Cold Spring Harbor Perspectives in Biology. 7 (2): a006023. doi:10.1101/cshperspect.a006023. ISSN 1943-0264. PMC 4315934. PMID 25646377. ^ "38.17:
Muscle Contraction and Locomotion - ATP and Muscle Contraction". Biology LibreTexts. 2018-07-16. Retrieved 2024-05-01. ^ Hyman, Anthony A.; Krishnan, Yamuna; Alberti, Simon; Wang, Jie; Saha, Shambaditya; Malinovska, Liliana; Patel, Avinash (2017-05-19). "ATP as a biological hydrotrope". Science. 356 (6339): 753-756.
Bibcode:2017Sci...356..753P. doi:10.1126/science.aaf6846. ISSN 0036-8075. PMID 28522535. S2CID 24622983. ^ Savitski, Mikhail M.; Bantscheff, Marcus; Huber, Wolfgang; Dominic Helm; Günthner, Ina; Werner, Thilo; Kurzawa, Nils; Sridharan, Sindhuja (2019-03-11). "Proteome-wide solubility and thermal stability profiling reveals distinct
regulatory roles for ATP". Nature Communications. 10 (1): 1155. Bibcode:2019NatCo..10.1155S. doi:10.1038/s41467-019-09107-y. ISSN 2041-1723. PMC 6411743. PMID 30858367. ^ Whicher, Alexandra; Camprubi, Eloi; Pinna, Silvana; Herschy, Barry; Lane, Nick (2018-06-01). "Acetyl Phosphate as a Primordial Energy Currency at the Origin of Life"
Origins of Life and Evolution of Biospheres, 48 (2): 159-179, Bibcode: 2018OLEB...48..159W. doi:10.1007/s11084-018-9555-8. ISSN 1573-0875. PMC 6061221. PMID 29502283. ^ "Ancient chemistry may explain why living things use ATP as the universal energy currency: An early step in metabolic evolution set the stage for emergence of ATP as the
universal energy carrier". ScienceDaily. Retrieved 2023-08-27. ^ Resetar, A. M.; Chalovich, J. M. (1995). "Adenosine 5'-(gamma-thiotriphosphate): an ATP analog that should be used with caution in muscle contraction studies". Biochemistry. 34 (49): 16039-16045. doi:10.1021/bi00049a018. PMID 8519760. ^ Pelleg, Amir; Kutalek, Steven P.;
Flammang, Daniel; Benditt, David (February 2012). "ATPace: injectable adenosine 5'-triphosphate". Purinergic Signalling. 8 (Suppl 1): 57-60. doi:10.1007/s11302-011-9268-1. ISSN 1573-9538. PMC 3265710. PMID 22057692. ^ Lohmann, K. (August 1929). "Über die Pyrophosphatefraktion im Muskel" [On the pyrophosphate fraction in muscle].
Naturwissenschaften (in German). 17 (31): 624-625. Bibcode:1929NW.....17..624.. doi:10.1007/BF01506215. S2CID 20328411. \(^\text{Vaughan, Martha; Hill, Robert L.; Simoni, Robert L.; Si
e21. PMID 12161449. Archived from the original on 2017-08-08. Retrieved 2017-10-24. Maruyama, K. (March 1991). "The discovery of adenosine triphosphate and the establishment of its structure". J. Hist. Biol. 24 (1): 145-154. doi:10.1007/BF00130477. S2CID 87425890. Lipmann, F. (1941). "Metabolic generation and utilization of phosphate
bond energy". Adv. Enzymol. 1: 99-162. ISSN 0196-7398. ^ "History: ATP first discovered in 1929". The Nobel Prize in Chemistry 1997. Nobel Prize in Chemist
Wikimedia Commons has media related to Adenosine Triphosphate ATP and Exercise PubChem entry for ATP and Exercise PubChem entry for ATP and Exercise PubChem entry for ATP and Exercise PubChe
IUPAC name [(2R,3S,5R)-3-hydroxy-5-(5-methyl-2,4-dioxopyrimidin-1-yl)oxolan-2-yl]methyl (hydroxy-phosphonooxyphosphoryl) hydrogen phosphate CAS Number23198-01-8 YPubChem CID451388ChemSpider397621 NUNII26L4U23SYMChEMBL607677 NCompTox Dashboard (EPA)DTXSID001303289 Chemical and physical
data Formula C10H17N2O15P3Molar\ mass 498.166\ g\cdot mol-13D\ model\ (JSmol) Interactive\ image\ SMILES\ CC1=CN(C(=O)NC1=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=O)(O)OP(=
14H,3H2,1H3,(H,20,21)(H,22,23)(H,11,15,16)(H2,17,18,19)/t5-,6-,7-,9-/m1/s1 NKey:RZCIEJXAILMSQK-JXOAFFINSA-N N NY (what is this?) (verify) 5-Methyluridine triphosphate or m5UTP is one of five nucleoside triphosphate or m5UT
term thymidine triphosphate is used for the deoxyribonucleoside by convention.[2] ^ Kaneko K (2016). "5.24: Nucleosides". Molecular mechanisms in the pathogenesis of idiopathic nephrotic syndrome. Tokyo: Springer. ISBN 978-4-431-55270-3. ^ Coghill AM, Garson LR, eds. (2006). The ACS style guide: effective communication of scientific
information (3rd ed.). Washington, D.C.: American Chemical Society. p. 244. ISBN 978-0-8412-3999-9. This biochemistry article is a stub. You can help Wikipedia by expanding it.vte Retrieved from " 3 The following pages link to 5-Methyluridine triphosphate External tools (link count transclusion count sorted list). See help page for transcluding
these entries Showing 50 items. View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500) Adenosine (links | edit) Guanosine (links | edit) Guanosine (links | edit) Purine (links | edit) Purine (links | edit) Purine (links | edit) Purine (links | edit) Adenine (links | edit) Adenine (links | edit) Purine (li
Uracil (links | edit) Thymine (links | edit) Thymine (links | edit) Uridine (links | edit) Deoxyguanosine (links | edit) Deoxy
Adenosine diphosphate (links | edit) Adenosine monophosphate (links | edit) Cyclic nucleotide (links | edit) Cyclic nucleotide (links | edit) Guanosine triphosphate (links | edit) Guanosine diphosphate (links | edit) Guanosine triphosphate (links | edit) Guanosine diphosphate (links | edit) Guanosine triphosphate (links | edit) Guanos
monophosphate (links | edit) Thymidine monophosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine diphosphate (links | edit) Thymidine diphosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine diphosphate (links | edit) Uridine diphosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine monophosphate (links | edit) Uridine monophosphate (links | edit) Uridine monophosphate (links | edit) Uridine diphosphate (links | edit) Uridine monophosphate (links | edit
```

Deoxyribonucleotide (links | edit) Deoxyguanosine triphosphate (link

WhatLinksHere/5-Methyluridine triphosphate"