# DOWNLOAD PDF CHAIN REACTIONS LARGE AND SMALL

## Chapter 1 : c - Solving Chain Reaction on Small Boards: Verifying Correctness - Code Review Stack Excha

*Domino Chain Reaction Stephen Morris. A chain of dominos of increasing size makes a kind of mechanical chain reaction that starts with a tiny push and knocks down an impressively large domino.*

The string pulls down a lever. The lever releases a ball. The ball rolls down a track and turns on a radio In this class, we read a story in which one thing leads to another, to another, to another and then we built chain reactions. Goals of the Workshop Get inspired to make a large construction out of many parts that all work together for a shared goal. Experiment with materials and motion to find ways to trigger a sensor Plan and revise your design to be part of the larger construction. Materials Sensors - light sensors, touch sensors, and resistance sensors are especially useful Copper foil Marbles - glass and metal Building supplies: Set Up We offered this 2-hour chain reaction workshop for a small group of adults. For our chain reaction workshop, we used laptops so we could have computers and building space together on a table large enough for pairs to work together. For a chain reaction workshop, it also works to have the computers nearby and large tables or floor space for building. We set materials out on tables, grouped roughly by category: Introduction I started the workshop by reading Harold and the Purple Crayon. Harold and the Purple Crayon is a chain reaction that tells a story. To get groups thinking about motion, we made a people-powered chain reaction. We have participants devise ball-moving tools on the fly out of craft materials and pass a ball around the table without using their hands. While the participants were still standing in a line, we paired them up, and made the order of that line the sequence of the chain reaction. When we have more time we sometimes ask the group to make a chain reaction drawing that went all around the table. Each person drew an imaginary contraption that was part of the chain reaction: We asked participants to work in pairs. We determined the order of the chain reaction before anyone started building. Most groups start by experimenting with the motors and sensors As part of week-long workshop, we sometimes have the kids make mini-marble mazes as a one-day, warm-up activity. They get to test out the sensors and motors and do a little programming before starting work on the big chain reaction.

## Chapter 2 : Chain Reaction Cycles Bike Bag Review

*A chain of dominos of increasing size makes a kind of mechanical chain reaction that starts with a tiny push and knocks down an impressively large domino.*

He was a cartoonist that kind of invented these inventions. After all of this research we learned that these contraptions are simply a machine that takes multiple complex steps to perform an extremely simple task. In short, a really fun waste of time. Have you ever built your own chain reaction toy? Share with us your experience or fun chain reaction toys you find. Turn your junk drawer into a fun toy! It is time to dump out your junk drawer and make some chain reaction toys. Our Design Department would like to share some tips to help you start designing your own chain reaction toy. Tips from our Design Department inspired by mousetrapcontraptions. Decide on a goal for your machine. The goal should be the last step of your machine. The goal could be something useful, funny, or surprising. Gather a few things from around the house, in your toy box, junk drawer, or garage. Balls, marbles, dominoes, string, toy cars, magnets, cardboard or tubes, etc. Avoid dangerous objects and chemicals. Now play with the things! What can the car bump into or knock down? Can the string pull something up? What can push the ball down the cardboard ramp? Get a piece of paper and start writing down any idea that pops into your head. This is called brainstorming. No matter how crazy the idea seems, just write it down for later. Once you get a few good ideas for your machine, make a list, in order, of the steps, or draw a simple picture of the steps. Plan on making quite a few changes to your machine as you build it. It may look different from your original drawing. Try not to get frustrated, this is part of learning what works best. If you get stuck at a certain step of your machine, why not try to work your way backwards? Start at the last step, and connect the part to it that triggers it. Or take a break away from the machine. A true Rube Golberg machine would be boring without some commom household items old toys, toilet plunger, egg beater, typewriter Setup and test your machine in stages. Once they are working, put each of the stages together. If you have the ability to, it would be fun to video tape your chain reaction toy. List of Action Words Sometimes even just words can spark ideas Here is a list of some action words to get your brain churning. Good luck with your designs! Chain Reaction Toys We love this part We would like to see what you come up with. Here are a couple of our ideas: Lights Out Machine 1. It could be a ball race track for two players. Feel free to post a completed machine concept or to simply post a section of a machine. If it makes it easier you could come up with a better solution to one of the machines that we designed above. It might also be easier to understand you ideas if there is a sketch on this one. This game is a classic! If your family does not have one yet, I highly recommend you get one The game is played by building a mini chain reaction machine designed to trap mice. Once the machine is build it is a race to try and trap all your opponents mice before you get caught in the mouse trap. To increase you odds of winning; participate more than once in the design process, subscribe to get email updates, or like us on our new facebook page. Read more details about our giveaways here. Playful Factory will draw a winner randomly on Monday, September 20th. This giveaway includes free shipping within the US. Winners for Chain Reaction Toys This toy design topic is very difficulty. So, congratulations to all of those that participated. The winners for this week are Weekly Free Toy Giveaway Out of all those that participated this week we randomly selected the winner of the free toy giveaway It is a very fun idea to use a chain reaction toy to surprise people. Way to be creative in using a balloon to float up and pop! This design has been added to the selection of possible monthly toy designs to be made into a real toy at the Playful Factory. Read more about the details here. Look for the project launch tomorrow to see what our new design topic is going to be.

## Chapter 3 : Playful Invention and Exploration - Chain Reactions

*The big chain reaction Small push big impact: Experience the thrill and captivating motivation for your whole team. This team building event strengthen the team spirit and motivates you to conquer challenges together.*

History[ edit ] In , the German chemist Max Bodenstein first put forth the idea of chemical chain reactions. If two molecules react, not only molecules of the final reaction products are formed, but also some unstable molecules which can further react with the parent molecules with a far larger probability than the initial reactants In the new reaction, further unstable molecules are formed besides the stable products, and so on.. This means that one photon of light is responsible for the formation of as many as molecules of the product HCl. Nernst suggested that the photon dissociates a Cl2 molecule into two Cl atoms which each initiate a long chain of reaction steps forming HCl. The result is in fact an exponential growth, thus giving rise to explosive increases in reaction rates, and indeed to chemical explosions themselves. This was the first proposal for the mechanism of chemical explosions. A quantitative chain chemical reaction theory was created later on by Soviet physicist Nikolay Semyonov in  In effect the active particle serves as a catalyst for the overall reaction of the propagation cycle. Termination elementary step in which the active particle loses its activity; e. The chain length is defined as the average number of times the propagation cycle is repeated, and equals the overall reaction rate divided by the initiation rate. The propagation is a sequence of two steps whose net effect is to replace an H atom by another H atom plus two OH radicals. This leads to an explosion under certain conditions of temperature and pressure. Chain transfer corresponds to transfer of the activity from this growing chain, whose growth is terminated, to another molecule which may be a second growing polymer chain. For polymerization, the kinetic chain length defined above may differ from the degree of polymerization of the product macromolecule. Polymerase chain reaction , a technique used in molecular biology to amplify make many copies of a piece of DNA by in vitro enzymatic replication using a DNA polymerase. Nuclear chain reactions[ edit ] Main article: Nuclear chain reaction A nuclear chain reaction was proposed by Leo Szilard in , shortly after the neutron was discovered, yet more than five years before nuclear fission was first discovered. This would in theory produce a chain reaction at the level of the nucleus. He did not envision fission as one of these neutron-producing reactions, since this reaction was not known at the time. Experiments he proposed using beryllium and indium failed. In this reaction, a neutron plus a fissionable atom causes a fission resulting in a larger number of neutrons than the single one that was consumed in the initial reaction. Thus was born the practical nuclear chain reaction by the mechanism of neutron-induced nuclear fission. Specifically, if one or more of the produced neutrons themselves interact with other fissionable nuclei, and these also undergo fission, then there is a possibility that the macroscopic overall fission reaction will not stop, but continue throughout the reaction material. This is then a self-propagating and thus self-sustaining chain reaction. This is the principle for nuclear reactors and atomic bombs. Demonstration of a self-sustaining nuclear chain reaction was accomplished by Enrico Fermi and others, in the successful operation of Chicago Pile-1 , the first artificial nuclear reactor, in late  Electron avalanche in gases[ edit ] An electron avalanche happens between two unconnected electrodes in a gas when an electric field exceeds a certain threshold. Random thermal collisions of gas atoms may result in a few free electrons and positively charged gas ions, in a process called impact ionization. Acceleration of these free electrons in a strong electric field causes them to gain energy, and when they impact other atoms, the energy causes release of new free electrons and ions ionization , which fuels the same process. If this process happens faster than it is naturally quenched by ions recombining, the new ions multiply in successive cycles until the gas breaks down into a plasma and current flows freely in a discharge. Electron avalanches are essential to the dielectric breakdown process within gases. The process can culminate in corona discharges , streamers , leaders , or in a spark or continuous electric arc that completely bridges the gap. The extremely high temperature of the resulting plasma cracks the surrounding gas molecules and the free ions recombine to create new chemical compounds. This is the mechanism of a Geiger counter and also the visualization possible with a spark chamber and other wire chambers. Avalanche breakdown in semiconductors[ edit ] An avalanche breakdown process can happen in semiconductors, which in some ways conduct electricity analogously to a mildly ionized gas. Semiconductors rely on free electrons knocked out of the crystal by thermal vibration for conduction. Thus, unlike metals, semiconductors become better conductors the higher the temperature. This sets up conditions for the same type of positive feedbackâ€”heat from current flow causes temperature to rise, which increases charge carriers, lowering resistance, and causing more current to flow. This can continue to the point of complete breakdown of normal resistance at a semiconductor junction, and failure of the device this may be temporary or permanent depending on whether there is physical damage to the crystal. Certain devices, such as avalanche diodes , deliberately make use of the effect.

## Chapter 4 : Domino DomainChain Reactions - Domino Domain

*A chain reaction is a nuclear reaction that occurs when sufficient unstable nuclei are present so that when one splits (decays), its products hit other unstable nuclei, causing them to decay and initiating a chain reaction.*

There is one handle on the front which is down quite low, meaning you have to bend right down and lift the bag right up. This is a bit of a pain in the neck, and could easily rectified with some front castors a-la the Scicon Aerocomfort 2 TSA and a handle higher up. Single front handle The bag ships with two shoulder straps which are pretty well made with metal clips, and attach to the bag onto metal eyelets. The metal clips are Quick Release QR so you can quickly unclip them and stow the straps inside the bag. Eyelets for shoulder straps One thing I did notice is that there are no handles on the sides, top, or back, so baggage handlers are not going to be happy. Convenience Convenience refers to being able to quickly get your bike in and out of the bag ready to ride or ready to travel. You can see below that the bag is not even close to being able to be zipped up around the handlebars. Remove handlebars, seat and post Remove seat and post Stability This bag is fairly stable when packed, but, due to a pretty narrow lateral wheelbase, could tip over fairly easily. Also an issue will be cross winds. Compactibility As you can see, the bike bag packs down into a fairly compact package which means it can be easily stored standing up in your house or garage. New in box This bag weighs around 7kg unloaded claimed 6. I was not expecting much given the price point but this bag has been built to last. The exterior of the bag is ripstop. The zips are metallic and pretty large gauge. They are not YKK zips. After a bit of fiddling I managed to fix it, but keep in mind this is on a brand new unused bag. A change to YKK zips might fix this. There are plastic rails on the base to help protect the base from wear and tear. The base seems to be a PVC type material inside the base bash guard material which will aid in the longevity of the bag. Plastic rails on base The wheels are robust and are recessed inside the bag as opposed to the EVOC bike travel bag. The wheels are a little low on the quality side, but in fairness, this is an extremely low price point bag, so compromises are to be expected. Wheels There is a whole lot of this tear-proof latex or rubber-like material on the bottom, extending about halfway up the front and back of the bag. This is great thinking as these are the areas most likely to get scratched and torn. Rubber-like bash material Protection for Bike and Contents Protection for Bike Another outstanding feature is the protection for the bike. There is a uniform and generous amount of padding throughout the top and sides of this bag. This will protect your crankset and the bag. A big improvement here would be straps to secure the bike higher up the side of the bag, off the bottom of the bag. Or, a block could be added in the bottom like on the EVOC to rest the bottom bracket and chain stays on. Bike sits on BB and chain rings Bike sits on BB and chain rings Your best bet is to lay the bike bag on its side, put your bike in and put some and by some, I mean a LOT of padding underneath the bike to protect the chain stays and bottom bracket. Protection for Wheels The bike bag ships with two Chain Reaction Cycles wheel bags, which in and of themselves, are excellent quality. A bike bag that ships with two padded wheel bags â€" tremendous value. The wheel bags are padded, with an internal pocket for skewers and other stuff. The pockets are generously sized so you can fit a few things in there. Below, you can see the 2 included shoulder straps for the bike bag and the tool roll. Wheel Bags The wheel bags had protector disks for the hubs and are internally protected from grease by surfboard bag foil. Inside the wheel bags The wheel bags slot into your bike bag wherever you would like them to, and are a welcome extra bit of protection for the bike. I like the idea of putting your wheels inside wheel bags inside the bike bag. The bike gets extra protection and the wheels get extra protection. Plus as an added bonus, you get two wheel bags for everyday use races, etc. Integrated Seat Post ISP bikes almost certainly will not fit in this bike bag, as it is does not have a large height dimension i. Richard from Quebec tells me he fitted his Scott Addict into this bag. I had a Scott Addict with integrated seatpost and was able to fit the bike in the bagâ€¦ by removing the crankset. Ok so that sucks, but it eliminates the issue of needing to protect the crank and rings if left on the bike. Storage The person who designed this bag is either a big Ikea fan, or, really is a cyclist. There are two very large ones opposite ends of bag â€" good design thinking , two large ones, and 4 small ones. This is a good thing â€" everything for cycling, in one bag unless you lose it, then this is bad. If you are travelling domestically â€" or even internationally if you pack light â€" this bag would carry everything you needed for a short cycling trip, with extras in carry-on luggage. The bike bag also ships with a tool roll â€" totally unexpected. Tool roll Securing the Bike As I mentioned, this bag is a bit smaller than the EVOC so, once you pack out all the storage pockets, and put your bike and wheel bags in, your bike is going to be very snug. Which is just as well, because â€" wait for it â€" there are no internal straps to secure the bike. Like I said, once you get your bike and everything else in, your bike is going to be nice and snug, negating the need for straps. Utility The only major issue with this bag is the main zips. They do not extend all the way to the base of the bag, meaning you cannot lay the bag down â€" completely open with each side on the ground â€" to pack the bag. This means packing the bag is a frustrating episode where the bag sides flip-flop all over the place and the bag constantly tips over. The main zips do have padlock holes which is cool. Main zips with padlock holes There are 4 zips on the exterior that unzip to provide complete access into the bag. These are so you can hang your bike bag on a bike rack. I am not convinced as to the utility of these â€" they could easily provide access for someone who was up to no good. My personal feeling is that the bag does not need these â€" handles for baggage handlers could go here instead. Bike rack holders The internal storage uses single zips, which cuts costs, but is a bit of a pain. If you have the pockets full of stuff, and only one zip, when you zip them open to gain access, things can just fall out â€" i. The internal material is surfboard bag material, so when it gets greasy, some eucalyptus oil or citrus cleanser will have it clean in a jiffy. All the other considerations contribute to provide a bag with a high degree of utility, or usefulness. Summary I will be brutally honest â€" I was not expecting much from this bag given the price point. However, after unpacking the box, and really getting into the bag, I was pleasantly surprised. Great padding, loads of pockets, pretty good zips, solid construction â€" this is a pretty well thought out bag. Apart from the shortcomings listed below â€" especially the main zips not extending to the ground â€" this is a great bike bag that is STUPIDLY good value.

## Chapter 5 : Chain Reaction Toys | Playful Factory Toy Blog

*Four links large and small sculptures. Artworks Michael Van Dam > Links - Stainless Chain Reaction. Links Sculptures 'For every action there is a Chain Reaction'.*

Placing more than one atom in the same square creates a molecule. The more atoms in a molecule, the more unstable it becomes. When a molecule becomes too unstable it splits and its atoms move to orthogonally adjacent squares, changing the color of the atoms in those squares to match their color. This can cause a chain reaction of splitting molecules. Molecules in the four corner squares require two atoms to split. Molecules on the edge of the board require three atoms to split. Molecules in the center of the board require four atoms to split. Atoms of a splitting molecule each move in a different direction. The game ends immediately after one player captures all of the atoms belonging to the other player. Here are the values I obtained: A negative value represents a loss for Red. The absolute value represents the number of moves to the terminal state under optimal play. A move consists of a turn by each player. Therefore, a value of -2 means that Red loses in two moves i. Red loses in 4 turns. Red wins in 7 turns. This is assuming Red plays first starting on an empty board. I used negamax with alpha beta pruning and transposition tables. I used bitboards to represent the game state. The variables w, x, y and z hold the four bitboards that represent the game state. The variable m holds the bitboard for the current move. An explanation of how these bitboards work is found here. The values are represented by integers such that: Hence, the values are multiplied by 4. For lower bounds, the values are incremented. For upper bounds, the values are decremented. Critiques and suggestions to improve my code are also welcome.

## Chapter 6 : Chain Reactions

*Ass Saver Big. This mud guard is suitable for MTB and Gravel bike tyres up to 55mm in width. It is simple to fit and requires no tools at all. Designed to protect from mud all day long, no matter what the trail or weather conditions.*

Input[ edit ] The stages of binary fission in a liquid drop model. Energy input deforms the nucleus into a fat "cigar" shape, then a "peanut" shape, followed by binary fission as the two lobes exceed the short-range nuclear force attraction distance, then are pushed apart and away by their electrical charge. In the liquid drop model, the two fission fragments are predicted to be the same size. The nuclear shell model allows for them to differ in size, as usually experimentally observed. Once the nuclear lobes have been pushed to a critical distance, beyond which the short range strong force can no longer hold them together, the process of their separation proceeds from the energy of the longer range electromagnetic repulsion between the fragments. The result is two fission fragments moving away from each other, at high energy. About 6 MeV of the fission-input energy is supplied by the simple binding of an extra neutron to the heavy nucleus via the strong force; however, in many fissionable isotopes, this amount of energy is not enough for fission. Uranium, for example, has a near-zero fission cross section for neutrons of less than one MeV energy. If no additional energy is supplied by any other mechanism, the nucleus will not fission, but will merely absorb the neutron, as happens when U absorbs slow and even some fraction of fast neutrons, to become U The remaining energy to initiate fission can be supplied by two other mechanisms: Such high energy neutrons are able to fission U directly see thermonuclear weapon for application, where the fast neutrons are supplied by nuclear fusion. However, this process cannot happen to a great extent in a nuclear reactor, as too small a fraction of the fission neutrons produced by any type of fission have enough energy to efficiently fission U fission neutrons have a mode energy of 2 MeV, but a median of only 0. This extra binding energy is made available as a result of the mechanism of neutron pairing effects. This extra energy results from the Pauli exclusion principle allowing an extra neutron to occupy the same nuclear orbital as the last neutron in the nucleus, so that the two form a pair. In such isotopes, therefore, no neutron kinetic energy is needed, for all the necessary energy is supplied by absorption of any neutron, either of the slow or fast variety the former are used in moderated nuclear reactors, and the latter are used in fast neutron reactors , and in weapons. As noted above, the subgroup of fissionable elements that may be fissioned efficiently with their own fission neutrons thus potentially causing a nuclear chain reaction in relatively small amounts of the pure material are termed " fissile. The exact isotope which is fissioned, and whether or not it is fissionable or fissile, has only a small impact on the amount of energy released. This can be easily seen by examining the curve of binding energy image below , and noting that the average binding energy of the actinide nuclides beginning with uranium is around 7. Looking further left on the curve of binding energy, where the fission products cluster, it is easily observed that the binding energy of the fission products tends to center around 8. The fission of U by a slow neutron yields nearly identical energy to the fission of U by a fast neutron. This energy release profile holds true for thorium and the various minor actinides as well. The energy of nuclear fission is released as kinetic energy of the fission products and fragments, and as electromagnetic radiation in the form of gamma rays ; in a nuclear reactor, the energy is converted to heat as the particles and gamma rays collide with the atoms that make up the reactor and its working fluid , usually water or occasionally heavy water or molten salts. Animation of a Coulomb explosion in the case of a cluster of positively charged nuclei, akin to a cluster of fission fragments. Hue level of color is proportional to larger nuclei charge. Electrons smaller on this time-scale are seen only stroboscopically and the hue level is their kinetic energy When a uranium nucleus fissions into two daughter nuclei fragments, about 0. For uranium total mean fission energy Also, an average of 2. The latter figure means that a nuclear fission explosion or criticality accident emits about 3. However, in nuclear reactors, the fission fragment kinetic energy remains as low-temperature heat, which itself causes little or no ionization. So-called neutron bombs enhanced radiation weapons have been constructed which release a larger fraction of their energy as ionizing radiation specifically, neutrons , but these are all thermonuclear devices which rely on the nuclear fusion stage to produce the extra radiation. For example, in uranium this delayed energy is divided into about

6. In a reactor that has been operating for some time, the radioactive fission products will have built up to steady state concentrations such that their rate of decay is equal to their rate of formation, so that their fractional total contribution to reactor heat via beta decay is the same as these radioisotopic fractional contributions to the energy of fission. Under these conditions, the 6. It is this output fraction which remains when the reactor is suddenly shut down undergoes scram. For this reason, the reactor decay heat output begins at 6. However, within hours, due to decay of these isotopes, the decay power output is far less. See decay heat for detail. The remainder of the delayed energy 8. Neutrino radiation is ordinarily not classed as ionizing radiation, because it is almost entirely not absorbed and therefore does not produce effects although the very rare neutrino event is ionizing. Almost all of the rest of the radiation 6. Some processes involving neutrons are notable for absorbing or finally yielding energy â€" for example neutron kinetic energy does not yield heat immediately if the neutron is captured by a uranium atom to breed plutonium, but this energy is emitted if the plutonium is later fissioned. On the other hand, so-called delayed neutrons emitted as radioactive decay products with half-lives up to several minutes, from fission-daughters, are very important to reactor control , because they give a characteristic "reaction" time for the total nuclear reaction to double in size, if the reaction is run in a " delayed-critical " zone which deliberately relies on these neutrons for a supercritical chain-reaction one in which each fission cycle yields more neutrons than it absorbs. Without their existence, the nuclear chain-reaction would be prompt critical and increase in size faster than it could be controlled by human intervention. In this case, the first experimental atomic reactors would have run away to a dangerous and messy "prompt critical reaction" before their operators could have manually shut them down for this reason, designer Enrico Fermi included radiation-counter-triggered control rods, suspended by electromagnets, which could automatically drop into the center of Chicago Pile If these delayed neutrons are captured without producing fissions, they produce heat as well. However, no odd-even effect is observed on fragment mass number distribution. This result is attributed to nucleon pair breaking. Origin of the active energy and the curve of binding energy[ edit ] The "curve of binding energy": A graph of binding energy per nucleon of common isotopes. Nuclear fission of heavy elements produces exploitable energy because the specific binding energy binding energy per mass of intermediate-mass nuclei with atomic numbers and atomic masses close to 62Ni and 56Fe is greater than the nucleon-specific binding energy of very heavy nuclei, so that energy is released when heavy nuclei are broken apart. The total rest masses of the fission products Mp from a single reaction is less than the mass of the original fuel nucleus M. The variation in specific binding energy with atomic number is due to the interplay of the two fundamental forces acting on the component nucleons protons and neutrons that make up the nucleus. Nuclei are bound by an attractive nuclear force between nucleons, which overcomes the electrostatic repulsion between protons. However, the nuclear force acts only over relatively short ranges a few nucleon diameters , since it follows an exponentially decaying Yukawa potential which makes it insignificant at longer distances. For the same reason, larger nuclei more than about eight nucleons in diameter are less tightly bound per unit mass than are smaller nuclei; breaking a large nucleus into two or more intermediate-sized nuclei releases energy. Extra neutrons stabilize heavy elements because they add to strong-force binding which acts between all nucleons without adding to protonâ€"proton repulsion. Fission products have, on average, about the same ratio of neutrons and protons as their parent nucleus, and are therefore usually unstable to beta decay which changes neutrons to protons because they have proportionally too many neutrons compared to stable isotopes of similar mass. This tendency for fission product nuclei to beta-decay is the fundamental cause of the problem of radioactive high level waste from nuclear reactors. Fission products tend to be beta emitters , emitting fast-moving electrons to conserve electric charge , as excess neutrons convert to protons in the fission-product atoms. See Fission products by element for a description of fission products sorted by element. Chain reactions[ edit ] A schematic nuclear fission chain reaction. A uranium atom absorbs a neutron and fissions into two new atoms fission fragments , releasing three new neutrons and some binding energy. One of those neutrons is absorbed by an atom of uranium and does not continue the reaction. Another neutron is simply lost and does not collide with anything, also not continuing the reaction. However, the one neutron does collide with an atom of uranium, which then fissions and releases two neutrons and some binding energy. Both of those neutrons collide with uranium

atoms, each of which fissions and releases between one and three neutrons, which can then continue the reaction. Nuclear chain reaction Several heavy elements, such as uranium , thorium , and plutonium , undergo both spontaneous fission , a form of radioactive decay and induced fission, a form of nuclear reaction. Elemental isotopes that undergo induced fission when struck by a free neutron are called fissionable ; isotopes that undergo fission when struck by a slow-moving thermal neutron are also called fissile. A few particularly fissile and readily obtainable isotopes notably U, U and Pu are called nuclear fuels because they can sustain a chain reaction and can be obtained in large enough quantities to be useful. All fissionable and fissile isotopes undergo a small amount of spontaneous fission which releases a few free neutrons into any sample of nuclear fuel. Some neutrons will impact fuel nuclei and induce further fissions, releasing yet more neutrons. If enough nuclear fuel is assembled in one place, or if the escaping neutrons are sufficiently contained, then these freshly emitted neutrons outnumber the neutrons that escape from the assembly, and a sustained nuclear chain reaction will take place. An assembly that supports a sustained nuclear chain reaction is called a critical assembly or, if the assembly is almost entirely made of a nuclear fuel, a critical mass. The word "critical" refers to a cusp in the behavior of the differential equation that governs the number of free neutrons present in the fuel: The actual mass of a critical mass of nuclear fuel depends strongly on the geometry and surrounding materials. Not all fissionable isotopes can sustain a chain reaction. For example, U, the most abundant form of uranium, is fissionable but not fissile: However, too few of the neutrons produced by U fission are energetic enough to induce further fissions in U, so no chain reaction is possible with this isotope. Instead, bombarding U with slow neutrons causes it to absorb them becoming U and decay by beta emission to Np which then decays again by the same process to Pu; that process is used to manufacture Pu in breeder reactors. In-situ plutonium production also contributes to the neutron chain reaction in other types of reactors after sufficient plutonium has been produced, since plutonium is also a fissile element which serves as fuel. It is estimated that up to half of the power produced by a standard "non-breeder" reactor is produced by the fission of plutonium produced in place, over the total life-cycle of a fuel load. Fissionable, non-fissile isotopes can be used as fission energy source even without a chain reaction. Bombarding U with fast neutrons induces fissions, releasing energy as long as the external neutron source is present. This is an important effect in all reactors where fast neutrons from the fissile isotope can cause the fission of nearby U nuclei, which means that some small part of the U is "burned-up" in all nuclear fuels, especially in fast breeder reactors that operate with higher-energy neutrons. That same fast-fission effect is used to augment the energy released by modern thermonuclear weapons , by jacketing the weapon with U to react with neutrons released by nuclear fusion at the center of the device. But the explosive effects of nuclear fission chain reactions can be reduced by using substances like moderators which slow down the speed of secondary neutrons. Critical fission reactors are the most common type of nuclear reactor. In a critical fission reactor, neutrons produced by fission of fuel atoms are used to induce yet more fissions, to sustain a controllable amount of energy release. Devices that produce engineered but non-self-sustaining fission reactions are subcritical fission reactors. Such devices use radioactive decay or particle accelerators to trigger fissions. Critical fission reactors are built for three primary purposes, which typically involve different engineering trade-offs to take advantage of either the heat or the neutrons produced by the fission chain reaction: The better known fast breeder reactor makes Pu a nuclear fuel from the naturally very abundant U not a nuclear fuel. Thermal breeder reactors previously tested using Th to breed the fissile isotope U thorium fuel cycle continue to be studied and developed. While, in principle, all fission reactors can act in all three capacities, in practice the tasks lead to conflicting engineering goals and most reactors have been built with only one of the above tasks in mind. There are several early counter-examples, such as the Hanford N reactor , now decommissioned. Power reactors generally convert the kinetic energy of fission products into heat, which is used to heat a working fluid and drive a heat engine that generates mechanical or electrical power. The working fluid is usually water with a steam turbine, but some designs use other materials such as gaseous helium. Research reactors produce neutrons that are used in various ways, with the heat of fission being treated as an unavoidable waste product. Breeder reactors are a specialized form of research reactor, with the caveat that the sample being irradiated is usually the fuel itself, a mixture of U and U.

# DOWNLOAD PDF CHAIN REACTIONS LARGE AND SMALL

## Chapter 7 : Chain Reaction - Anaheim, CA : Chain Reaction

*Vaude Big Bike Bag. Storage and transport bag for frame and wheels. VAUDE has changed its logo in Since the production of products up to one year lead time was that there is still at VAUDE products with the old and the new logo.*

## Chapter 8 : Chain reaction - Wikipedia

*The chain reactions don't have to be just machines - they can tell a story, too. Goals of the Workshop Get inspired to make a large construction out of many parts that all work together for a shared goal.*

## Chapter 9 : Water bottle cages - Chain Reaction Cycles

*LEGO Domino Chain Reaction If you are studying force and motion, a domino chain reaction is a great activity to demonstrate potential and kinetic energy. First, build a small and very large domino out of LEGO Â® bricks or other building blocks.*