MDMA (Ecstasy/Molly)

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DrugFacts

Revised October 2016

What is MDMA?

3,4-methylenedioxy-methamphetamine (MDMA) is a synthetic drug that alters mood and perception (awareness of surrounding objects and conditions). It is chemically similar to both stimulants and hallucinogens, producing feelings of increased energy, pleasure, emotional warmth, and distorted sensory and time perception.

MDMA was initially popular in the nightclub scene and at all-night dance parties ("raves"), but the drug now affects a broader range of people who more commonly call the drug Ecstasy or Molly.

How do people use MDMA?

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People who use MDMA usually take it as a capsule or tablet, though some swallow it in liquid form or snort the powder. The popular nickname Molly (slang for "molecular") often refers to the supposedly "pure" crystalline powder form of MDMA, usually sold in capsules. However, people who purchase powder or capsules sold as Molly often actually get other drugs such as synthetic cathinones ("bath salts") instead (see "Added Risk of MDMA").

Some people take MDMA in combination with other drugs such as alcohol or marijuana.

How does MDMA affect the brain?

MDMA increases the activity of three brain chemicals:

- Dopamine—causes a surge in euphoria and increased energy/activity
- Norepinephrine—increases heart rate and blood pressure, which are particularly risky for people with heart and blood vessel problems
- Serotonin—affects mood, appetite, sleep, and other functions. It also triggers hormones that affect sexual arousal and trust. The release of large amounts of serotonin likely causes the emotional closeness, elevated mood, and empathy felt by those who use MDMA.

Other health effects include:

- nausea
- muscle cramping
- involuntary teeth clenching
- blurred vision

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MDMA's effects last about 3 to 6 hours, although many users take a second dose as the effects of the first dose begin to fade. Over the course of the week following moderate use of the drug, a person may experience:

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- irritability
- impulsiveness and aggression
- depression
- sleep problems
- anxiety
- memory and attention problems
- decreased appetite
- decreased interest in and pleasure from sex

It's possible that some of these effects may be due to the combined use of MDMA with other drugs, especially marijuana.

What are other health effects of MDMA?

High doses of MDMA can affect the body's ability to regulate temperature. This can lead to a spike in body temperature that can occasionally result in liver, kidney, or heart failure or even death.

In addition, because MDMA can promote trust and closeness, its use—especially combined with sildenafil (Viagra®)—may encourage unsafe sexual behavior. This increases people's risk of contracting or transmitting HIV/AIDS or hepatitis.

Read more about drug use and HIV/AIDS in *DrugFacts: HIV/AIDS and Drug Abuse: Intertwined Epidemics* at drugabuse.gov/publications/drugfacts/hivaids-drug-abuse-intertwined-epidemics.

Read more about drug use and hepatitis at drugabuse.gov/related-topics/viral-hepatitis-very-real-consequence-substance-use.

Added Risk of MDMA

Adding to MDMA's risks is that pills, capsules, or powders sold as Ecstasy and supposedly "pure" Molly may contain other drugs instead of or in addition to MDMA. Much of the Molly seized by the police contains additives such as cocaine, ketamine, methamphetamine, over-the-counter cough medicine, or synthetic cathinones ("bath salts"). These substances may be extremely dangerous if the person does not know what he or she is taking. They may also be dangerous when combined with MDMA. People who purposely or unknowingly combine such a mixture with other substances, such as marijuana and alcohol, may be putting themselves at even higher risk for harmful health effects.

Is MDMA addictive?

Research results vary on whether MDMA is addictive. Experiments have shown that animals will self-administer MDMA —an important indicator of a drug's abuse potential—although to a lesser degree than some other drugs such as cocaine.

Some people report signs of addiction, including the following

Research Report

MDMA (Ecstasy) Abuse

Describes the science behind MDMA (ecstasy) abuse, including what it does to the brain, whether it is addictive, and the latest research regarding prevention and treatment of MDMA.

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Offers the latest research findings on hallucinogens and dissociative drugs, describing what they are, how they are abused, and basic facts about different drugs within this classification of drugs.

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- depression
- trouble concentrating

Does MDMA Have Value in Therapy?

MDMA was first used in the 1970s as an aid in psychotherapy (mental disorder treatment using "talk therapy"). The drug didn't have the support of clinical trials (studies using humans) or approval from the U.S. Food and Drug Administration. In 1985, The U.S. Drug Enforcement Administration labeled MDMA as an illegal drug with no recognized medicinal use. Some researchers remain interested in its value in psychotherapy when given to patients under carefully controlled conditions. MDMA is currently in clinical trials as a possible treatment aid for post-traumatic stress disorder and anxiety in terminally ill patients, and for social anxiety in autistic adults.

How can people get treatment for addiction to MDMA?

There are no specific medical treatments for MDMA addiction. Some people seeking treatment for MDMA addiction have found behavioral therapy to be helpful. Scientists need more research to determine how effective this treatment option is for addiction to MDMA.

Points to Remember

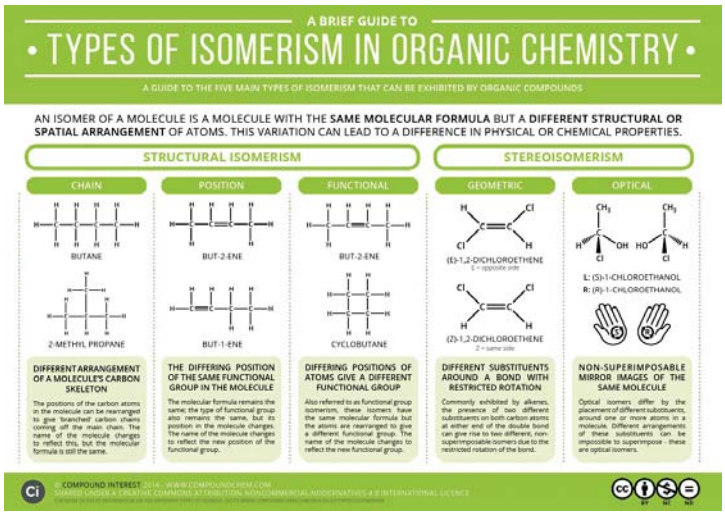
- *3,4-methylenedioxy-methamphetamine* (MDMA) is a synthetic drug that alters mood and perception. It is chemically similar to stimulants and hallucinogens.
- MDMA is commonly called Ecstasy or Molly.
- People who use MDMA typically take it as a capsule or tablet. Many people take it in combination with other drugs.
- MDMA acts by increasing the activity of three brain chemicals: dopamine, norepinephrine, and serotonin.
- Effects include euphoria, increased energy, distorted perception, involuntary teeth clenching, dangerously high body temperature, and depression.
- Many people are unaware that Ecstasy and supposedly "pure" Molly also often contain not only pure MDMA but other drugs that may be particularly dangerous when mixed with MDMA.
- Research results vary on whether MDMA is addictive. Some people report signs of addiction.
- Some people seeking treatment for MDMA addiction have found behavioral therapy to be helpful. There are no specific medical treatments for MDMA addiction.

Learn More

For more information about MDMA, visit:

- drugabuse.gov/drugs-abuse/mdma-ecstasymolly
- drugabuse.gov/drugs-abuse/commonly-abused-drugs-charts#MDMA
- teens.drugabuse.gov/drug-facts/mdma-ecstasy-or-molly

A Brief Guide to Types of Isomerism in Organic Chemistry



In organic chemistry, isomers are molecules with the same molecular formula (i.e. the same number of atoms of each element), but different structural or spatial arrangements of the atoms within the molecule. The reason there are such a colossal number of organic compounds – more than 10 million – is in part down to isomerism. This graphic looks at the 5 main types of isomerism in organic molecules, with a more detailed explanation of each given below, as well as the reason why isomerism is important in our day-to-day lives.

STRUCTURAL ISOMERISM

Isomers can be split into two broad groups – structural (or constitutional) isomers, and stereoisomers. We'll consider structural isomers first, which can be split again into three main subgroups: chain isomers, position isomers, and functional group isomers. Structural isomerism can quickly get quite out of hand in terms of the number of possible isomers; butane (four carbons) has two possible isomers, decane (ten carbons) has seventy-five, and a simple hydrocarbon containing 40 carbon atoms has an estimated 62,000,000,000 structural isomers.

Chain Isomers

Chain isomers are molecules with the same molecular formula, but different arrangements of the carbon 'skeleton'. Organic molecules are based on chains of carbon atoms, and for many molecules this chain can be arranged differently: either as one, continuous chain, or as a chain with multiple side groups of carbons branching off. The name of the molecule can be changed to reflect this, but we'll save the naming of molecules

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for another post. Obviously, there's often more than one way of branching off groups of carbons from the main chain, which leads to the large numbers of possible isomers as the number of carbons in the molecule increases.

Position Isomers

Position isomers are based on the movement of a 'functional group' in the molecule. A functional group in organic chemistry is the part of a molecule that gives it its reactivity. There are a range of different functional groups, the more common of which were summarised in a previous post here. Nothing else about the molecule changes, simply where the functional group in it is, and the name simply alters slightly to indicate whereabouts in the molecule it is located.

Functional Isomers

Also referred to as functional group isomers, these are isomers where the molecular formula remains the same, but the type of functional group in the atom is changed. This is possible by rearranging the atoms within the molecule so that they're bonded together in different ways. As an example, a standard straight-chain alkane (containing only carbon and hydrogen atoms) can have a functional group isomer that is a cycloalkane, which is simply the carbons bonded together in such a way that they form a ring. Different functional group isomers are possible for different functional groups.

STEREOISOMERISM

There are two main types of stereoisomerism – geometric isomerism, and optical isomerism. These, as the difference in name suggests, aren't to do with any large scale rearrangements of the structure of molecules; instead, they involve different arrangements of parts of the molecule in space. They're a little more complicated to think about than the structural isomers, so let's have a look at each of them in turn.

Geometric Isomers

Geometric isomerism is actually a term that is 'strongly discouraged' by IUPAC (the International Union of Pure & Applied Chemistry), who prefer 'cis-trans', or 'E-Z' in the specific case of alkenes. However, 'geometric isomerism' is still consistently used in many A Level courses to refer to both, so for that reason I've used that name here.

should not be assumed that they comprehensively cover any portion of required content for particular qualifications.

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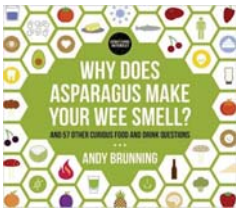

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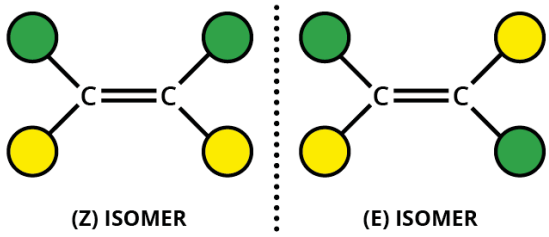
This type of isomerism most frequently involves carbon-carbon double bonds (shown by two lines joining each carbon instead of one). Rotation of these bonds is restricted, compared to single bonds, which can rotate freely. This means that, if there are two different atoms, or groups of atoms, attached to each carbon of the carbon carbon double bond, they can be arranged in different ways to give different molecules. These atoms or groups can be given 'priorities', with atoms with higher atomic numbers given higher priorities. If the highest priority groups for each carbon are on the same side of the molecule, that molecule is denoted as the 'cis' or 'Z' isomer. If they're on opposite sites, it's denoted as the 'trans' or 'E' isomer.



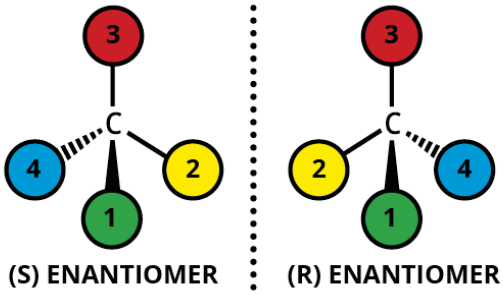
The two different nomenclatures are a little confusing – cis/trans is now less commonly used, with E/Z instead being favoured. E stands for 'entgegen' ('opposite' in german) whilst Z stands for 'zusammen' ('together' in german). The letter is simply added in brackets at the start of the molecule's name in order to indicate which isomer it is.

Optical Isomers

Optical isomers are so named due to their effect on plane-polarised light, about which you can read more here, and come in pairs. They usually (although not always) contain a chiral centre – this is a carbon atom, with four different atoms (or groups of atoms) attached to it. These atoms or groups can be arranged differently around the central carbon, in such a way that the molecule can't be rotated to make the two arrangements align. Since one arrangement can't line up to look exactly like the other, we refer to them as 'non-superimposable mirror images' – one of the isomers is the mirror image of the other. Think of it like your hands – you can't exactly superimpose one hand on top of the other, because your thumbs will stick out in opposite directions.

These can be allocated an identifying letter, in much the same way as with geometric isomerism. The groups around the carbon are given priorities, then the lowest priority group is oriented

decrease in priority going in an anti-clockwise direction, it's the S isomer (from the Latin 'sinister', meaning 'left'). If they decrease in priority going in a clockwise direction, it's the R isomer (from the Latin 'rectus', meaning 'right'). Again, this letter is simply added in front of the isomer's name in order to indicate which one it is.



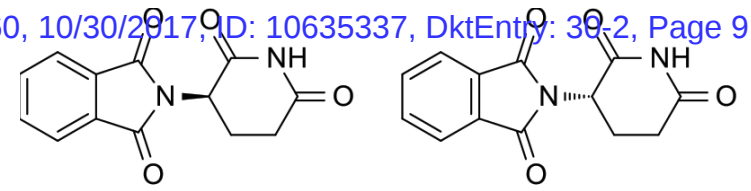
There are other ways in which optical isomerism can be exhibited, but this is the simplest.

The Importance of Isomerism

As previously mentioned, isomers of the same molecule have the potential to have different physical or chemical properties. These differences can have some important implications.

Let's look particularly at the case of optical isomerism. The two possible isomers can also be referred to as 'enantiomers' of each other. A prime, and well cited example of enantiomers with differing properties is that of the compound 'carvone'. In its (R) form, it is found in mint leaves, and is the principle contributor to the aroma. However, in its S form, it is found in caraway seeds, and has a very different smell.

There can also be less benign differences. By far the most well known example here is that of thalidomide. This drug was prescribed in the 1950s and 60s to treat morning sickness in pregnant women; however, unknown then was that the (S) enantiomer could be transformed in the body into compounds that caused deformities in embryos. The two enantiomers also interconvert in the body, meaning that even if just the (R) enantiomer could be isolated, it would still produce the same effects. This emphasised the importance of testing all of the optical isomers of drugs for effects, and is part of the reason why present-day pharmaceuticals have to go through years of rigorous tests, to ensure that they are safe.



The two enantiomers of thalidomide (Fuse809, Wikimedia Commons)

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- Isomerism – ChemGuide

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