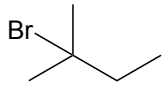
Pop-quiz. 12/8/25

Name: _____

EID: _____

FIll in the products based on the NMR specra provided at the bottom of the page. If you get one of these structures correct we will add 0.5% to your score on your final, if you get both correct we will add 1.0% to your score on the final.

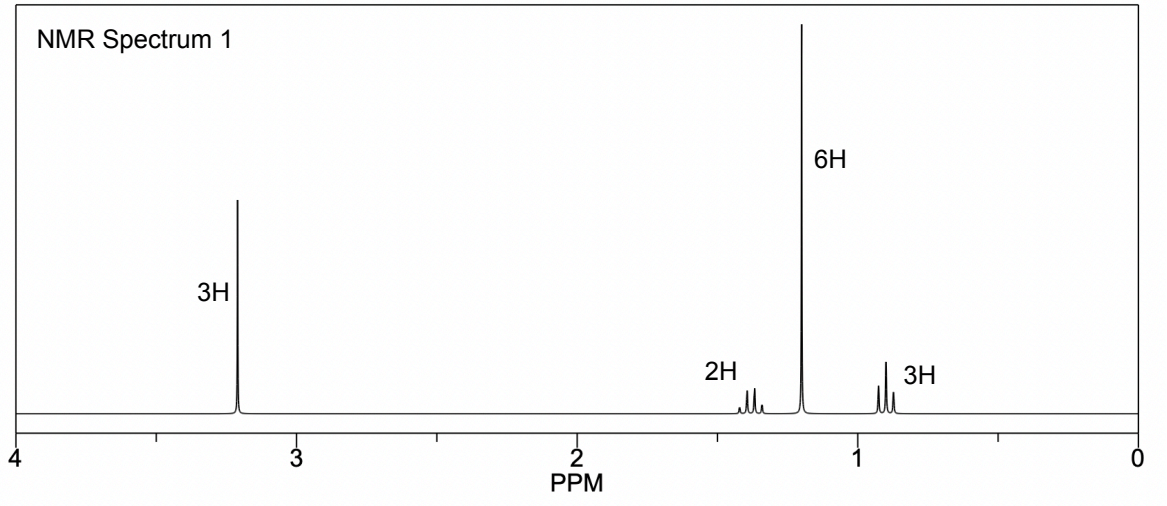


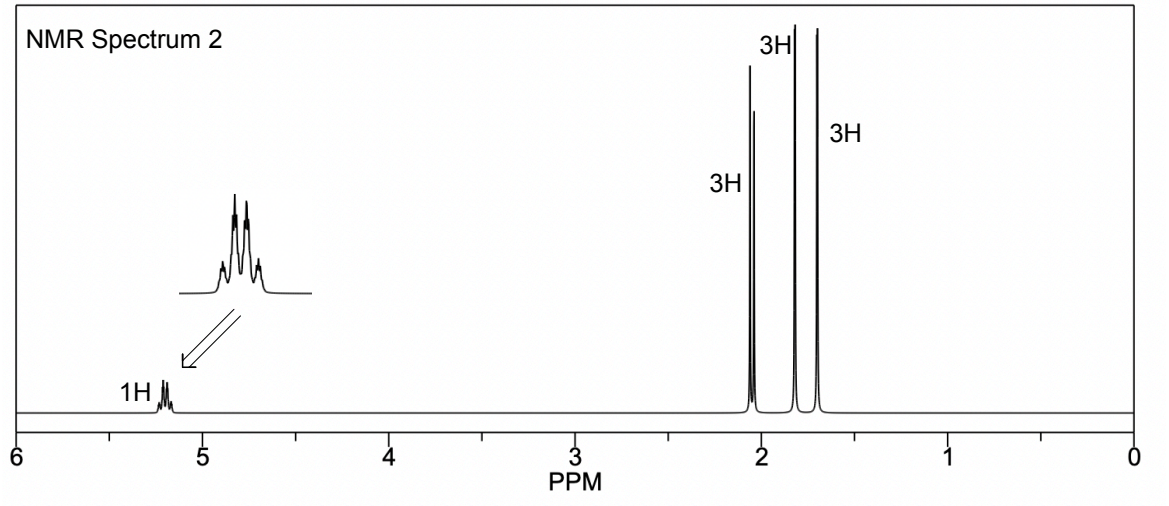
$\xrightarrow[\text{heat}]{CH_3OH}$

Product corresponding to NMR Spectrum 1

+

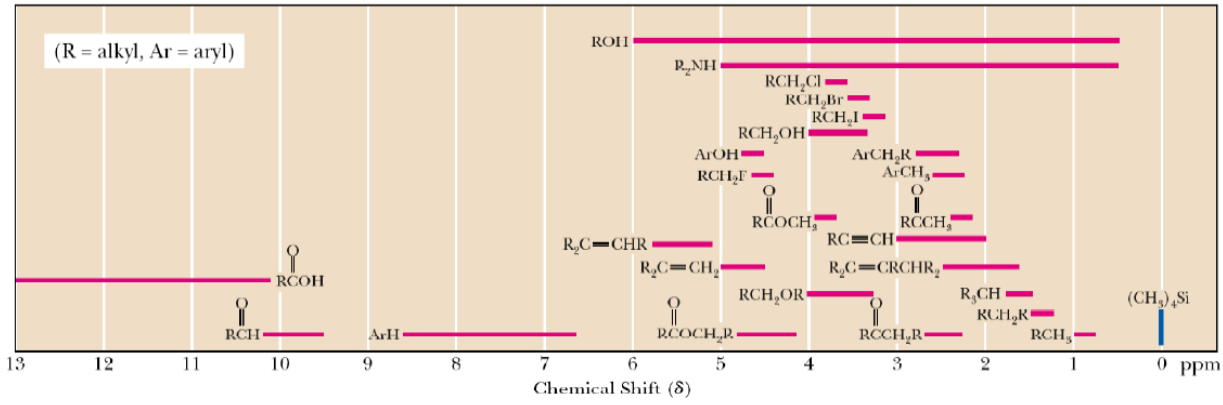
Product corresponding to NMR Spectrum 2





Type of Hydrogen (R = alkyl, Ar = aryl)	Chemical Shift (δ)*	Type of Hydrogen (R = alkyl, Ar = aryl)	Chemical Shift (δ)*
		RCH_2OH	3.4-4.0
R_2NH	0.5-5.0	RCH_2Br	3.4-3.6
ROH	0.5-6.0	RCH_2Cl	3.6-3.8
RCH_3	0.8-1.0		
RCH_2R	1.2-1.4	$RCOCH_3$	3.7-3.9
R_3CH	1.4-1.7	$RCOCH_2R$	4.1-4.7
$R_2C{=}CRCHR_2$	1.6-2.6	RCH_2F	4.4-4.5
$RC{\equiv}CH$	2.0-3.0	$ArOH$	4.5-4.7
$RCCH_3$	2.1-2.3	$R_2C{=}CH_2$	4.6-5.0
$RCCH_2R$	2.2-2.6	$R_2C{=}CHR$	5.0-5.7
$ArCH_3$	2.2-2.5	$H_2C{-}CH_2$	3.3-4.0
RCH_2NR_2	2.3-2.8	RCH	9.5-10.1
RCH_2I	3.1-3.3		
RCH_2OR	3.3-4.0	$RCOH$	10-13

* Values are relative to tetramethylsilane. Other atoms within the molecule may cause the signal to appear outside these ranges.



Pop-quiz. 12/8/25

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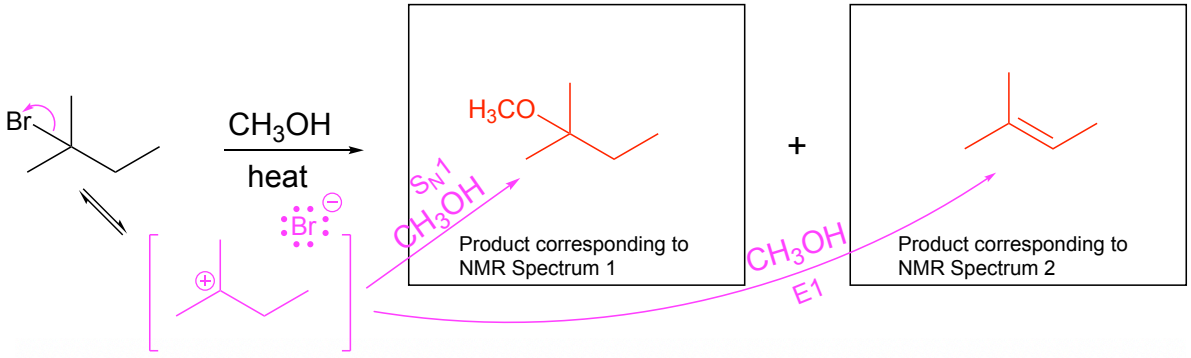
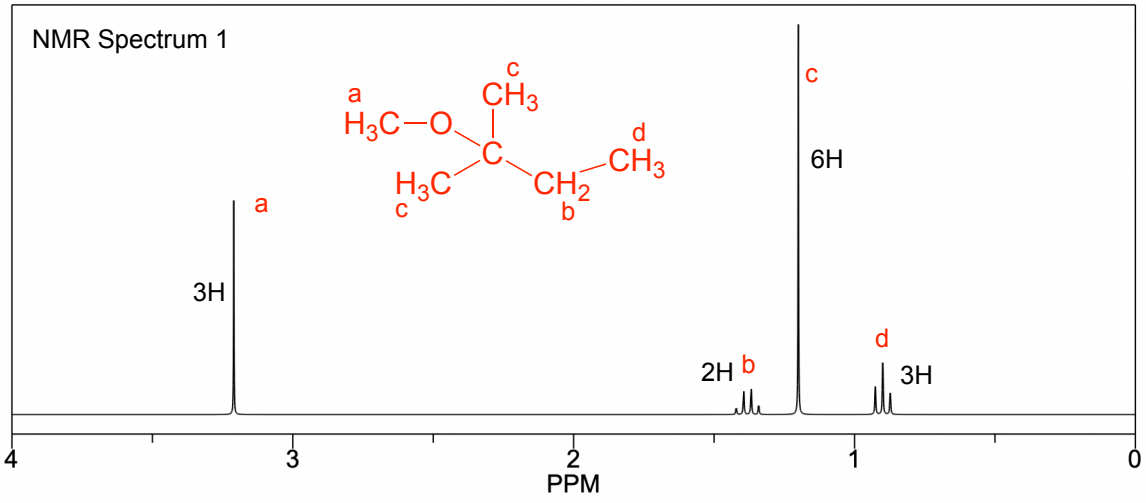
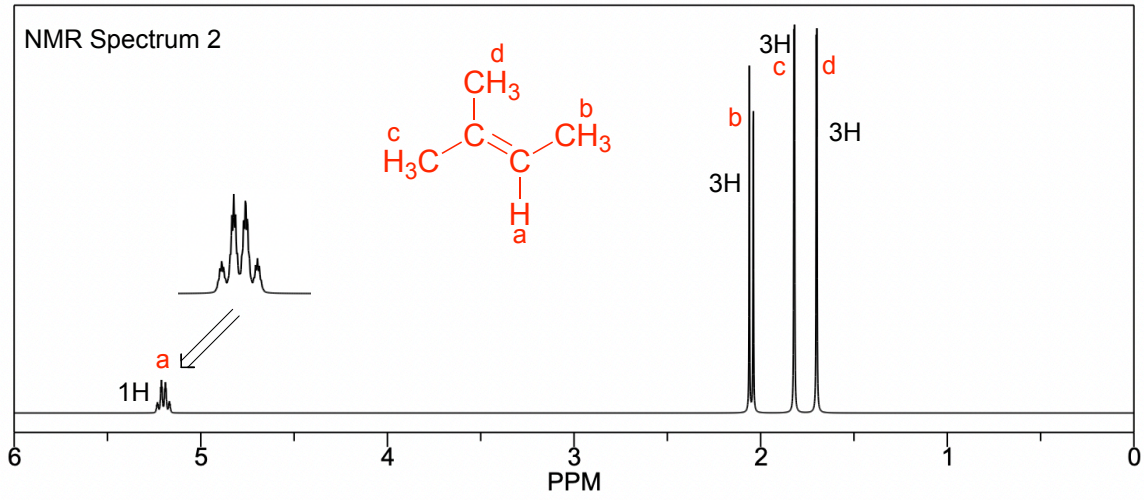






The Amide Bond Shows Up in Medical School
Monday, August 25

Hi Dr. Iverson,
I just wanted to share a little story from my first week of medical school:

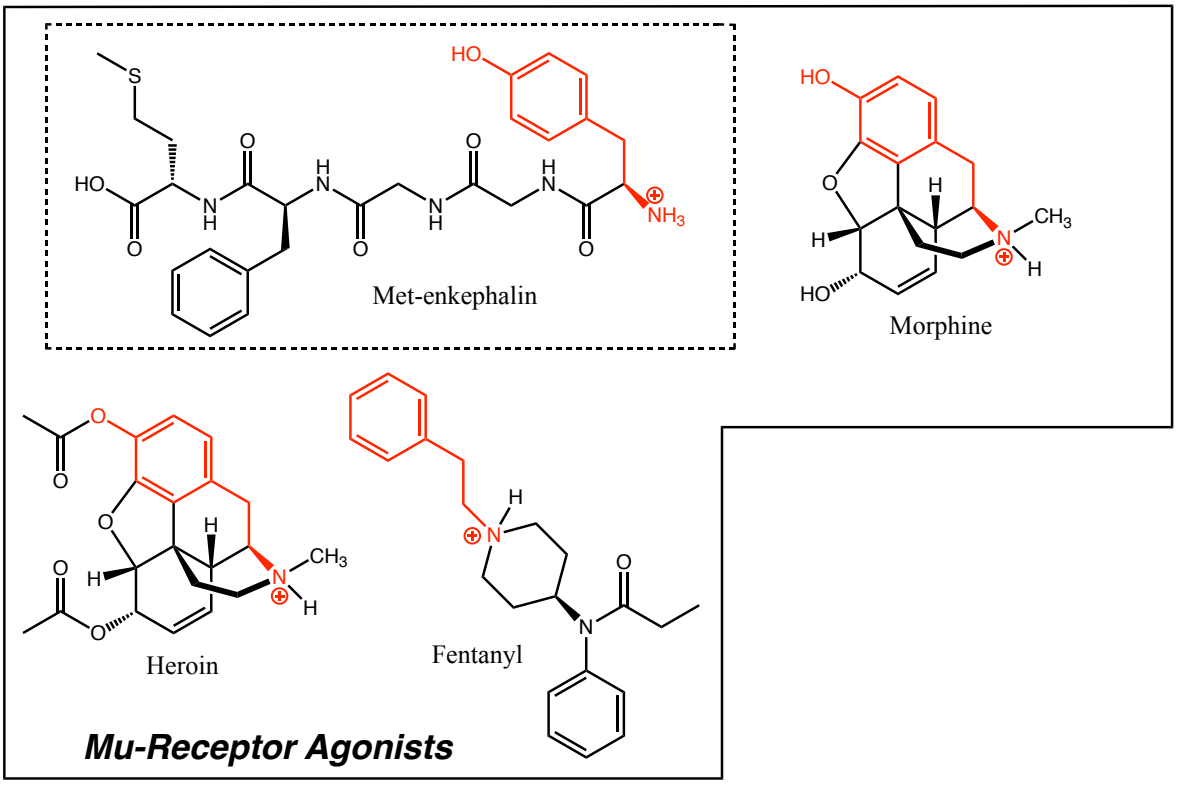
The other day in my biochemistry lecture, the professor mentioned factors that gave proteins stability, including the double bond nature of the peptide bonds. That idea sounded strangely familiar until I realized I'd already memorized it earlier when you made us write out all the contributing structures of amides on every exam!

In just the first week of med school I've had several moments like this where topics mentioned in your class have helped speed up my understanding (MRI, enzyme mechanisms, etc.). I never expected so many details of an organic chemistry course to play small but important roles in medical sciences.

Thank you for taking the time to make your class relevant for all the pre-health professions students in your class!


m- m...
he's about to say his first words
The popular medical diagnostic technique of magnetic resonance imaging (MRI) is based on the same principles as NMR, namely the flipping (i.e. resonance) of nuclear spins of H atoms by radio frequency irradiation when a patient is placed in a strong magnetic field. Magnetic field gradients are used to gain imaging information, and rotation of the gradient around the center of the object gives imaging in an entire plane (i.e. slice inside patient). In an MRI image, you are looking at individual slices that when stacked make up the three-dimensional image of relative amounts of H atoms, especially the H atoms from water and fat, in the different tissues.


½
½



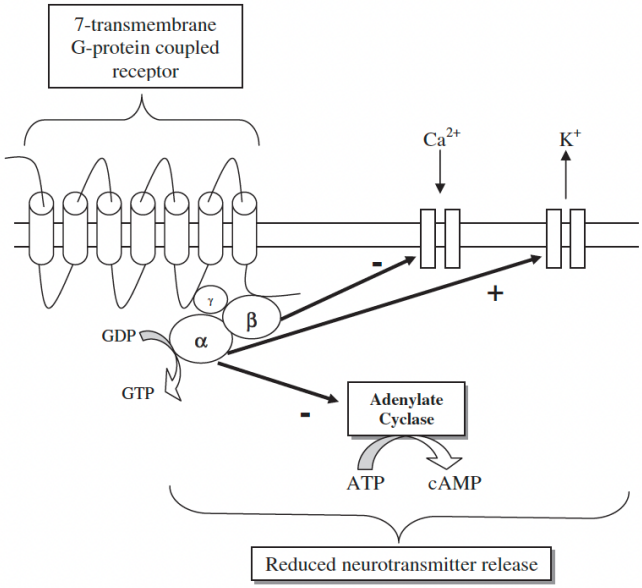


Fig. 1 Seven transmembrane structure of opioid G-protein-coupled receptor. Receptor activation by opioid receptor ligands leads to initiation of intracellular transduction pathways that include stimulation of potassium efflux, inhibition of VSCCs and inhibition of adenylyl cyclase. In this diagram the G-protein is denoted α, β, γ but the α-subunit interacts with K^+/Ca^{2+} channel and adenylate cyclase.

Continuing Education in Anaesthesia, Critical Care & Pain | Volume 5 Number 1 2005 DOI 10.1093/bjaceaccp/mki004

Fentanyl activates μ-opioid receptors (Gi/o-coupled) on GABAergic interneurons in the VTA, decreasing their cAMP levels and suppressing GABA release.

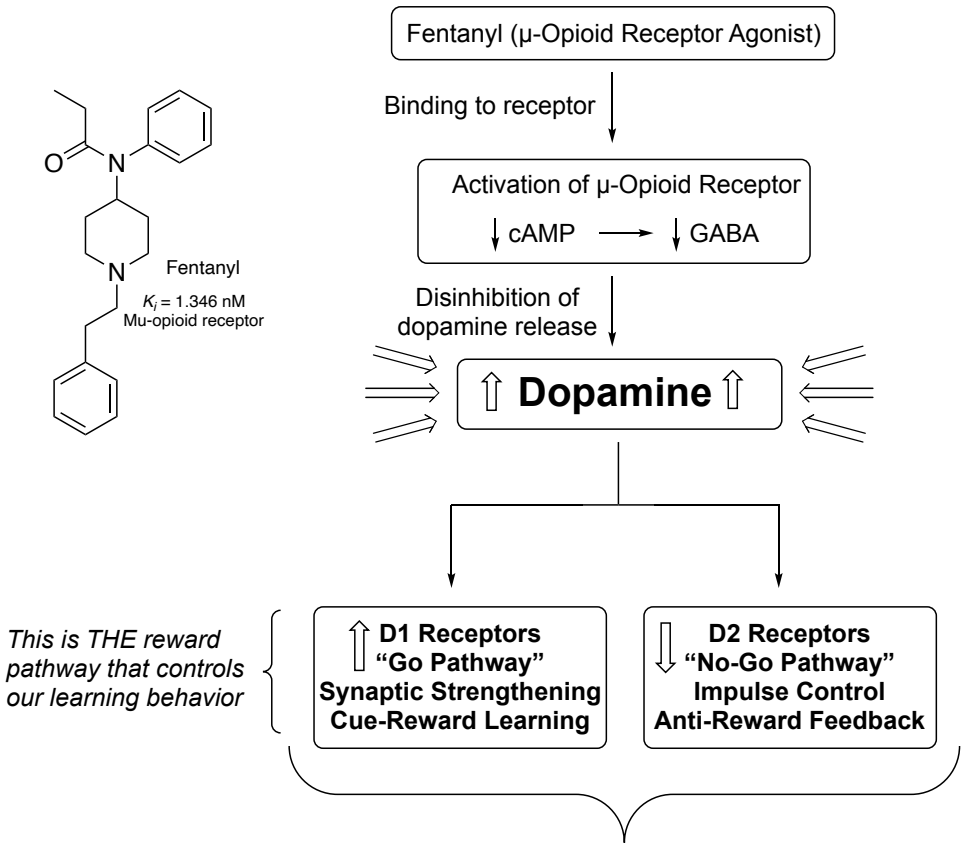
This disinhibits dopamine neurons and drives a surge of dopamine release into the nucleus accumbens.

Dopamine then acts on **D1 receptors** (Gs-coupled) to increase cAMP/PKA/CREB signaling, producing synaptic potentiation and strong reinforcement of fentanyl-associated cues.

In parallel, chronic fentanyl use **downregulates D2 receptor** (Gi/o) signaling, which normally provides inhibitory control and reduces compulsive reward seeking.

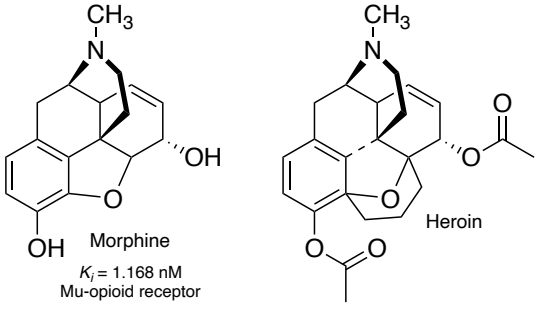
The combined effect—**D1 sensitization plus D2 suppression**—shifts basal ganglia signaling toward reward acquisition, producing the neurochemical basis of fentanyl addiction and relapse vulnerability.

Fentanyl triggers addiction by disrupting the brain's normal reward and control systems. It activates opioid receptors in a part of the brain that normally keeps dopamine release in check, effectively **removing the brakes** and causing a strong surge of dopamine—the chemical that signals pleasure and reward. This dopamine then acts on two types of receptors. **D1 receptors** amplify the brain's "go" signals, strengthening the memory and motivation to use the drug again. **D2 receptors**, which normally help with self-control and resisting impulses, become less active with repeated fentanyl use. As D1 activity becomes stronger and D2 activity becomes weaker, the brain becomes increasingly wired to seek fentanyl while losing the ability to hold back, creating the powerful cycle of addiction.



An individual is driven to pursue the drug and cannot anticipate negative consequences of drug use

---



PRESS RELEASE

13 Arrested in Connection with an LSD, Fentanyl and Methamphetamine Trafficking and Money Laundering Scheme Occurring in the West Campus Area of the University of Texas at Austin

Friday, December 4, 2020

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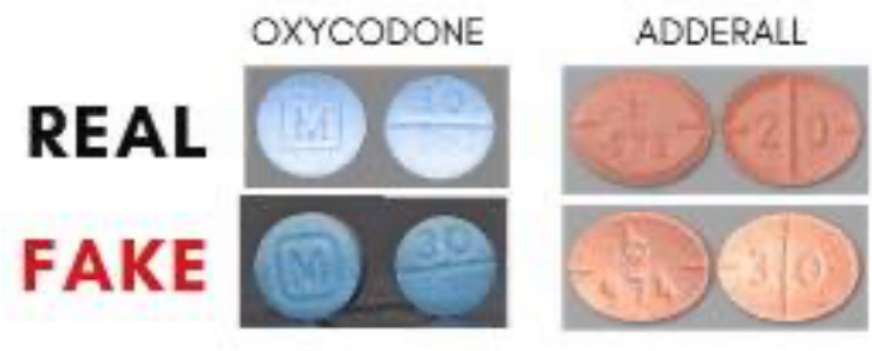
U.S. Attorney's Office, Western District of Texas



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Authentic Xanax® Front and Back

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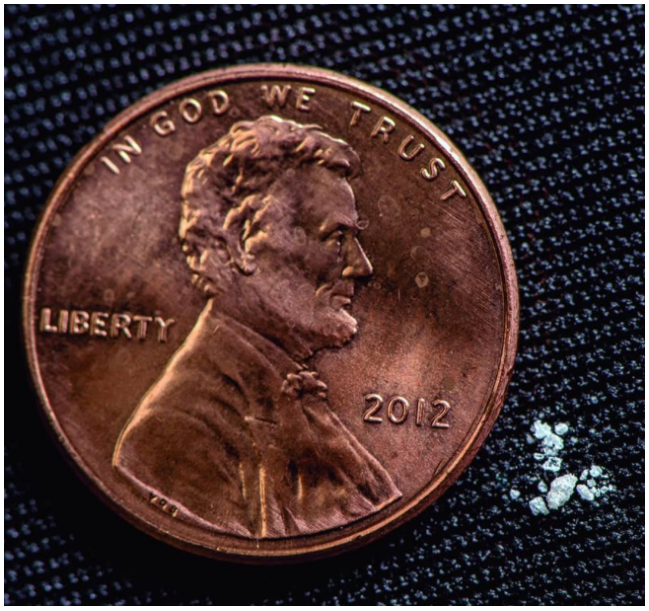
Counterfeit Xanax® Front and Back

This is what a lethal dose of fentanyl looks like.



Austin American-Statesman
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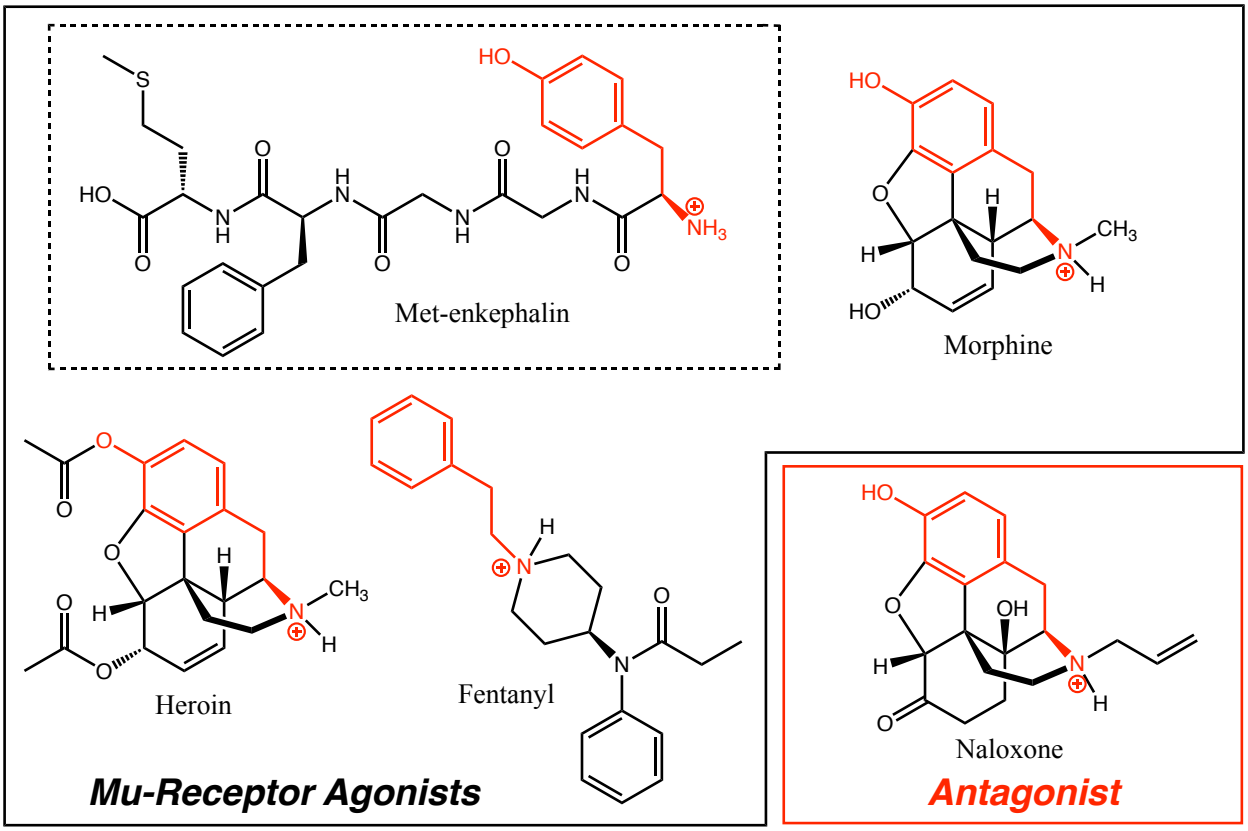
Jake Ehlinger's family releases statement saying Texas player died of accidental overdose

Brian Davis
Hookem

Published 4:56 p.m. CT Oct. 21, 2021 | Updated 3:54 p.m. CT Oct. 22, 2021

Remembering Texas linebacker Jake Ehlinger

Jake Ehlinger, younger brother of former Longhorns quarterback Sam Ehlinger, was found dead on May 6, Austin police said. *Austin American-Statesman*


Met-enkephalin
Morphine
Heroin
Fentanyl
Mu-Receptor Agonists
Naloxone
Antagonist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SHIFT
THE CAMPUS CULTURE

OPERATION NALOXONE

Availability of Narcan on campus:

EMERGENCY USE: Originally placed in all residence halls; carried by UTPD; in the libraries across campus, Sid Richardson Hall, (Strategically covers all areas of our large campus)

DISTRIBUTION: Original site was the main PCL library (late night center of social/academic activity); Anyone can obtain a free box of Narcan Nasal Spray (2 doses) from the security desk no questions asked.

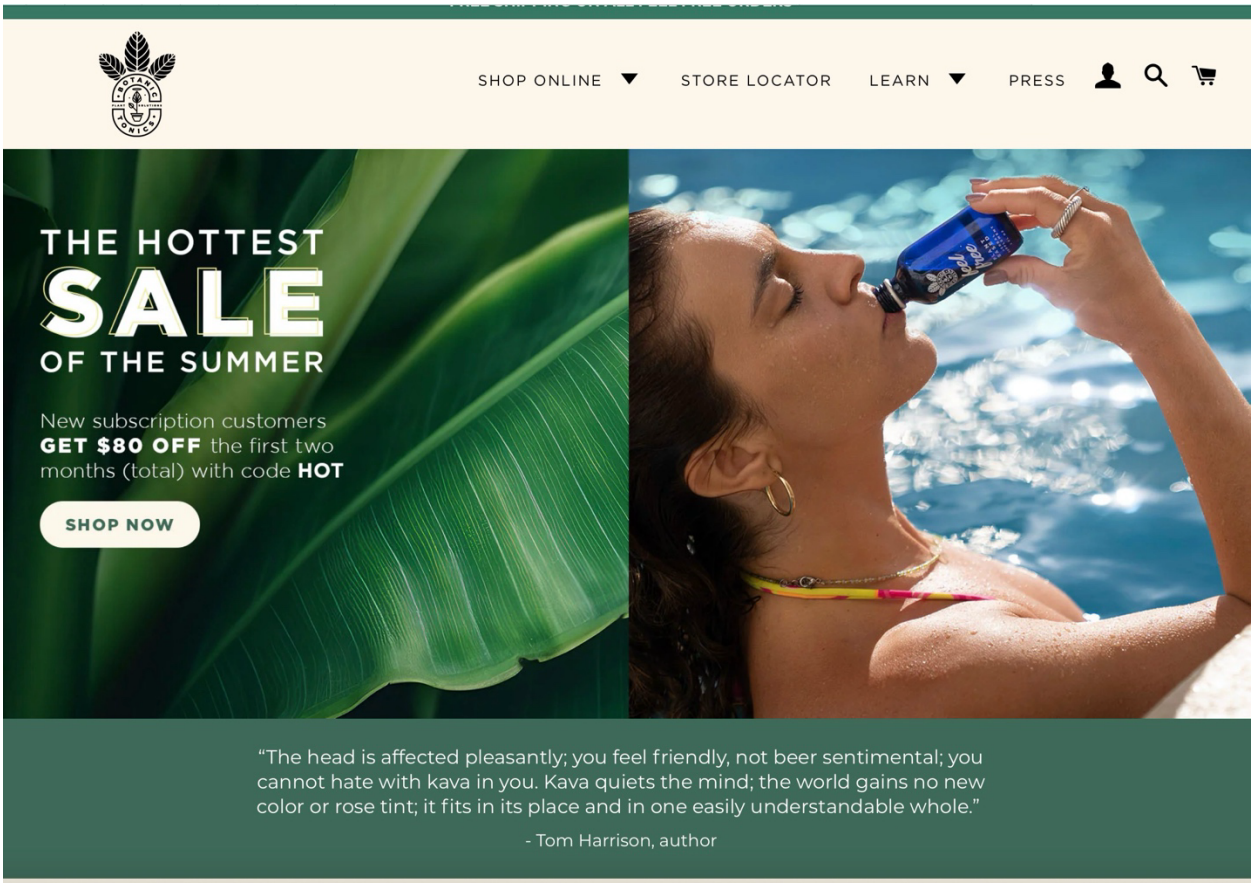
Hi Dr. Iverson,

I graduated with a BSA in Neuroscience in May 2023, and you were my organic chemistry professor during COVID! During your class, you shared about Operation Naloxone at UT Austin which was instrumental in my life when I was in need of Narcan a few years later for my loved one battling addiction...

> Day 1 was the day I found out he was using drugs recreationally since the age of 13. Year 6 was the year I accepted his substance abuse as a progressive illness. The darkness that lured him in changed my life forever when he disappeared one night and under the influence called our mom to let her know he was lost, the call disconnecting shortly after. I was afraid to know the substances he used, but one day with my heart ringing in my ears, I asked. This is how I knew I needed to request narcan from the free distribution services at my university that night. I tracked his last location on our shared family app and without knowing where or to what I was headed my mom and I drove to him. With shaking hands I read the narcan instructions and prepared for the worst. In the distance, I could see my brother's car and I could see his face and head resting back onto the driver's seat. The rest of the event's that night are oddly blurry yet so clearly ingrained in my memory. I remember having to put his car in park, trying to wake him up unsuccessfully, shouting out to my mom to call 911, using the Narcan, his eyes suddenly opening wide and him taking a deep breath in. Today, my brother is recovering after years of battling anxiety, depression, and substance abuse. His experiences from childhood to adulthood have been a driving force in my research endeavors and education in neuroscience.

I am grateful for the impact you have had on my academic journey and wanted to share this part of my story with you. Thank you for your inspiration and guidance!

Best,



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TONIC

Supplement Facts
Serving Size: 1 fl oz (29.6 mL)
Servings Per Container: 2

	Amount Per Serving	%DV
Iron	0.4 mg	4%‡
Kava root (extract)		
Total Kavalactones	260 mg	*
Kratom leaf (ground)		
Total Alkaloids	34 mg	*
Mitragynine	20 mg	*
7-hydroxymitragynine	<0.05 mg	*

‡Daily Value (DV) based on a 2000 calorie diet
*Daily Value (DV) not established

Other ingredients: water, pineapple juice, natural flavors, stevia leaf, citric acid.

CAPSULE BOTTLE

Supplement Facts
Serving Size: 3 capsules
Servings Per Container: 30

	Amount Per Serving	%DV
Iron	0.4 mg	4%‡
Kava root (extract)		
Total Kavalactones	210 mg	*
Kratom leaf (ground)		
Total Alkaloids	28 mg	*
Mitragynine	17 mg	*
7-hydroxymitragynine	<0.05 mg	*

‡Daily Value (DV) based on a 2000 calorie diet
*Daily Value (DV) not established

Other ingredients: vegan capsule, calcium stearate

CAPSULE CASE

Supplement Facts
Serving Size: 3 capsules
Servings Per Container: 24

	Amount Per Serving	%DV
Iron	0.4 mg	4%‡
Kava root (extract)		
Total Kavalactones	210 mg	*
Kratom leaf (ground)		
Total Alkaloids	28 mg	*
Mitragynine	17 mg	*
7-hydroxymitragynine	<0.05 mg	*

‡Daily Value (DV) based on a 2000 calorie diet
*Daily Value (DV) not established

Other ingredients: vegan capsule, calcium stearate

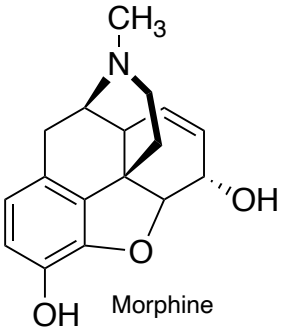
feel free®

Supplement Facts
Serving Size: 1 fl oz (29.6 mL)
Servings Per Container: 2

Amount Per Serving		% Daily Value
Calories	15	
Total Carbohydrate	4 g	1.5%†
Total Sugars	4 g	*
Includes 4 g Added Sugars		8% †
Proprietary Blend	1800 mg	*
Kava root (extract), Kola nut (extract), Lion's Mane Mushroom fruitbody (extract), *Rhodiola rosea* seed (extract)		
Caffeine (from Kola nut)	100 mg	*

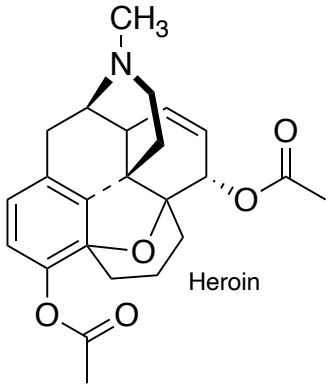
† Percent Daily Values are based on a 2,000 calorie diet
* Daily Value (DV) not established

Other ingredients: water, organic cane sugar, MCT powder, natural flavors, malic acid

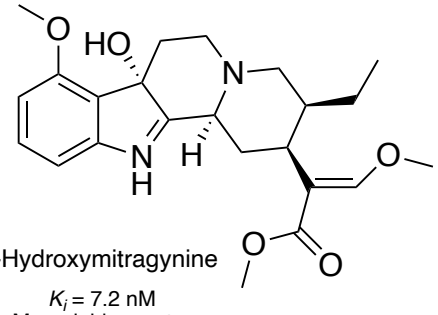


Morphine

K_i = 1.168 nM
Mu-opioid receptor



Heroin



7-Hydroxymitragynine

K_i = 7.2 nM
Mu-opioid receptor

Regulatory Toxicology and Pharmacology
Volume 59, Issue 3, April 2011, Pages 385-390

ACS Chem. Neurosci. 2023, 14, 195–197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Judge awards $11 million to family in death of Boynton Beach woman from kratom
Krystal Talavera, a mother of four who lived in Boynton Beach, died in 2021
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NEVER buy black market

or other pharmaceuticals → it is not black market it is counterfeit and contains Fentanyl ⇒ Could be fatal !!

↓

Xanax

or methamphetamine ⇒ Highly addictive

↓

Adderall

You should know where to find Naloxone (Narcan) in case you need it to save a life!

⇒ RAs, Dorms, Libraries

⇒ Contact SHIFT

Naloxone (Narcan) is an antagonist to opioid receptors

Does not cause a reaction but blocks drugs like fentanyl from binding and activating the receptor

PERSPECTIVE

OBC
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HIV-1 protease: mechanism and drug discovery

Ashraf Brik and Chi-Huey Wong *
Department of Chemistry and the Skaggs Institute for Chemical Biology, The Scripps Research Institute, 10550 North Torrey Pines Road, La Jolla, CA 92037, USA

Received 22nd August 2002
First published as an Advance Article on the web 26th November 2002

1 Introduction

It has now been two decades since acquired immunodeficiency syndrome (AIDS) was first reported by the US Center for Diseases Control (CDC). A few years later, it was found that a retrovirus called human immunodeficiency virus (HIV) is the causative agent in AIDS.[1] In a short time, AIDS increased to epidemic proportions throughout the world, affecting more than 40 million people today and killing so far more than 22 million (UNAIDS, 2001).

Since the outbreak of the AIDS epidemic, tremendous efforts have been directed towards development of antiretroviral therapies that target HIV type 1 in particular (HIV-1). The identification of the HIV retrovirus and the accumulated knowledge about the role of the different elements in its life cycle led researchers around the world to develop inhibitors that target different steps in the life cycle of the virus. One of these targets is HIV-1 protease (HIV PR), an essential enzyme needed in the proper assembly and maturation of infectious virions. Understanding the chemical mechanism of this enzyme has been a basic requirement in the development of efficient inhibitors. In this review, we summarize studies conducted in the last two decades on the mechanism of HIV PR and the impact of their conclusions on the drug discovery processes.

2 The life cycle of HIV

HIV belongs to the class of viruses called retroviruses, which carry genetic information in the form of RNA. HIV infects T cells that carry the CD4 antigen on their surface. The infection of the virus requires fusion of the viral and cellular membranes, a process that is mediated by the viral envelope glycoprotein (gp120, gp41) and receptors (CD4 and coreceptors, such as CCR5 or CXCR4) on the target cell. As the virus enters a cell, its RNA is reverse-transcribed to DNA by a virally encoded enzyme, the reverse transcriptase (RT). The viral DNA enters the cell nucleus, where it is integrated into the genetic material of the cell by a second virally encoded enzyme, the integrase. Activation of the host cell results in the transcription of the viral DNA into messenger RNA, which is then translated into viral proteins. HIV protease, the third virally encoded enzyme, is required in this step to cleave a viral polyprotein precursor into individual mature proteins. The viral RNA and viral proteins assemble at the cell surface into new virions, which then bud from the cell and are released to infect another cell. The extensive cell damage from the destruction of the host's genetic system to the budding and release of virions leads to the death of the infected cells.

3 HIV protease

3.1 HIV protease: a logical target for AIDS therapy

Unless the HIV life cycle is interrupted by specific treatment, the virus infection spreads rapidly throughout the body, which results in the weakness and destruction of the body's immune system. From the analysis of the HIV life cycle, one could conclude that there are several steps that might be interfered with, thus stopping the replication of the virus. For example, there are several commercially available drugs that inhibit the enzyme reverse transcriptase (RT). The first class of RT inhibitors is the nucleoside analogs such as AZT, ddI, ddC and d4T. These dideoxy compounds lack the 3′-hydroxy, causing DNA chain termination when they are incorporated into the growing DNA strand. The second class of inhibitors is the non-nucleoside inhibitors (NNIs); these inhibitors are known to bind in a pocket away from the polymerase active site, and are believed to cause a conformational change of the enzyme active site, and thus inhibit its action. Currently, there are three available non-nucleoside reverse transcriptase inhibitors (nevirapine, delavirdine, and efavirenz) for the treatment of AIDS.

Another critical step in the life cycle of HIV is the proteolytic cleavage of the polypeptide precursors into mature enzymes and structural proteins catalyzed by HIV PR. It has been shown that budded immature viral particles that contain catalytically inactive protease cannot undergo maturation to an infective form.[2] The necessity of this enzyme in the virus life cycle makes it a promising target for therapy of the HIV infection.[3]

3.2 Structure of HIV protease

Navia *et al.* from Merck laboratories were the first group to obtain a crystal structure of HIV PR;[4] a more accurate structure was reported subsequently by Kent and coworker.[5] HIV PR is a 99 amino acid aspartyl protease which functions as a homodimer with only one active site which is C_2-symmetric in the free form. More than 140 structures of the HIV-1 PR, its mutants and enzymes complexed with various inhibitors have been reported so far. A database dedicated to providing structural information about HIV PR has been created at the National Cancer Institute (http://www-fbsc.ncifcrf.gov/HIVdb/). The enzyme homodimer complexed with TL-3[6] is shown in Fig. 1 (PDB ID: 3TLH). Each monomer contains an extended β-sheet region (a glycine-rich loop) known as the flap, that constitutes in part the substrate-binding site and plays an important role in substrate binding, and one of the two essential aspartyl residues, Asp-25 and Asp-25′ which lie on the bottom of the cavity. The substrate binds in its extended conformation, in which its interactions with the different amino

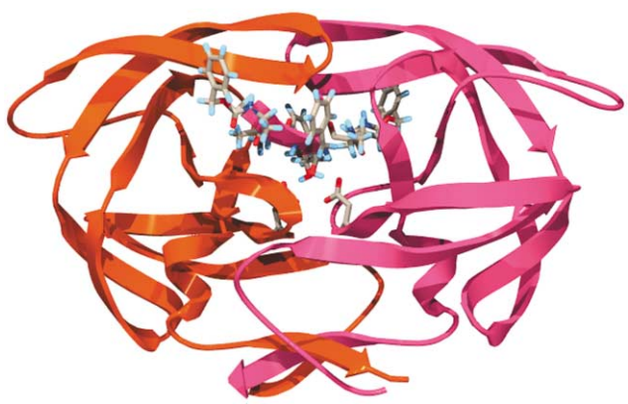
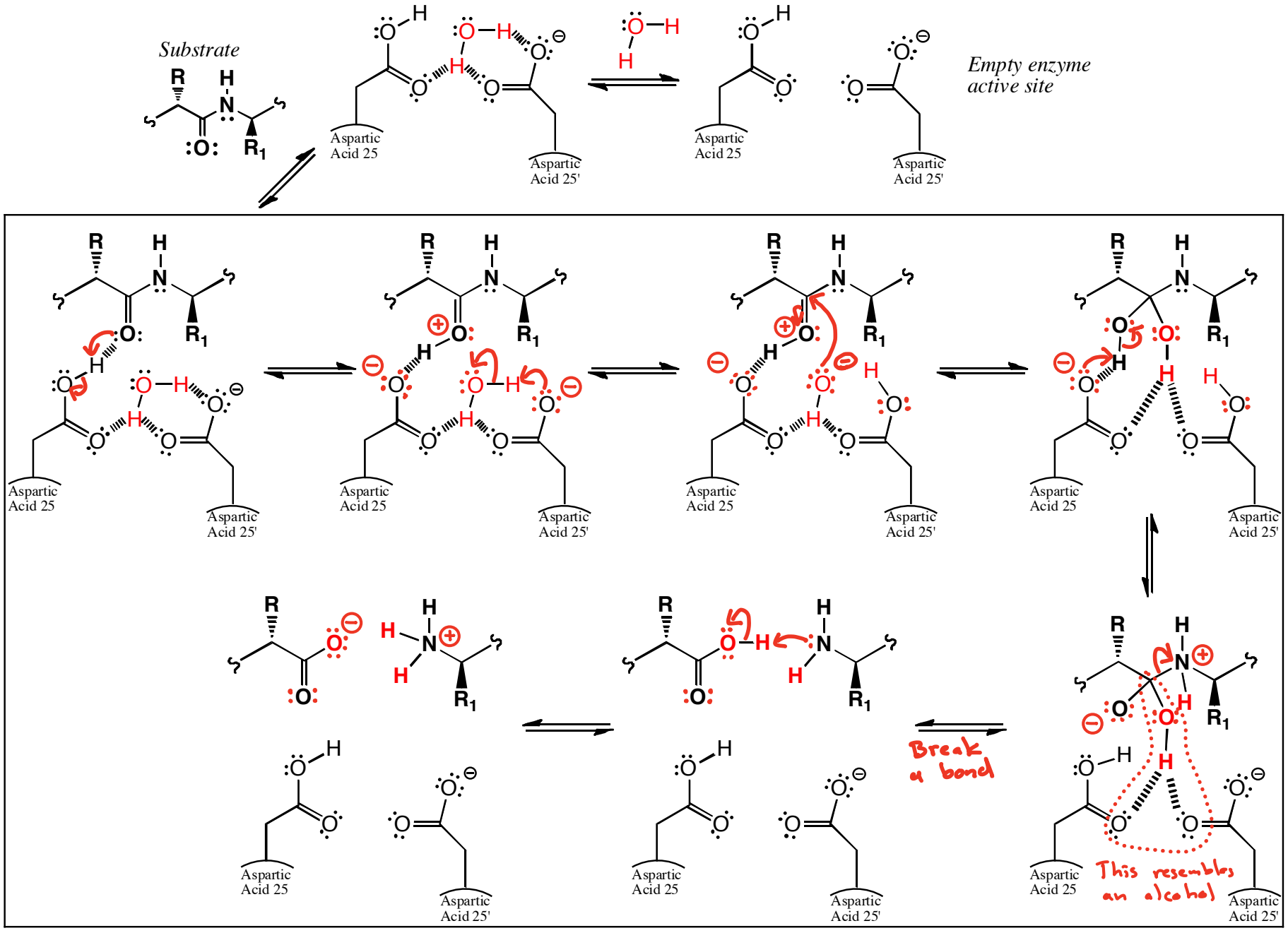


Fig. 1 Structure of HIV PR complexed with TL-3 (PDB: 3TLH).

DOI: 10.1039/b208248a


Substrate
Aspartic Acid 25
Aspartic Acid 25'
Empty enzyme active site
Break a bond
This resembles an alcohol

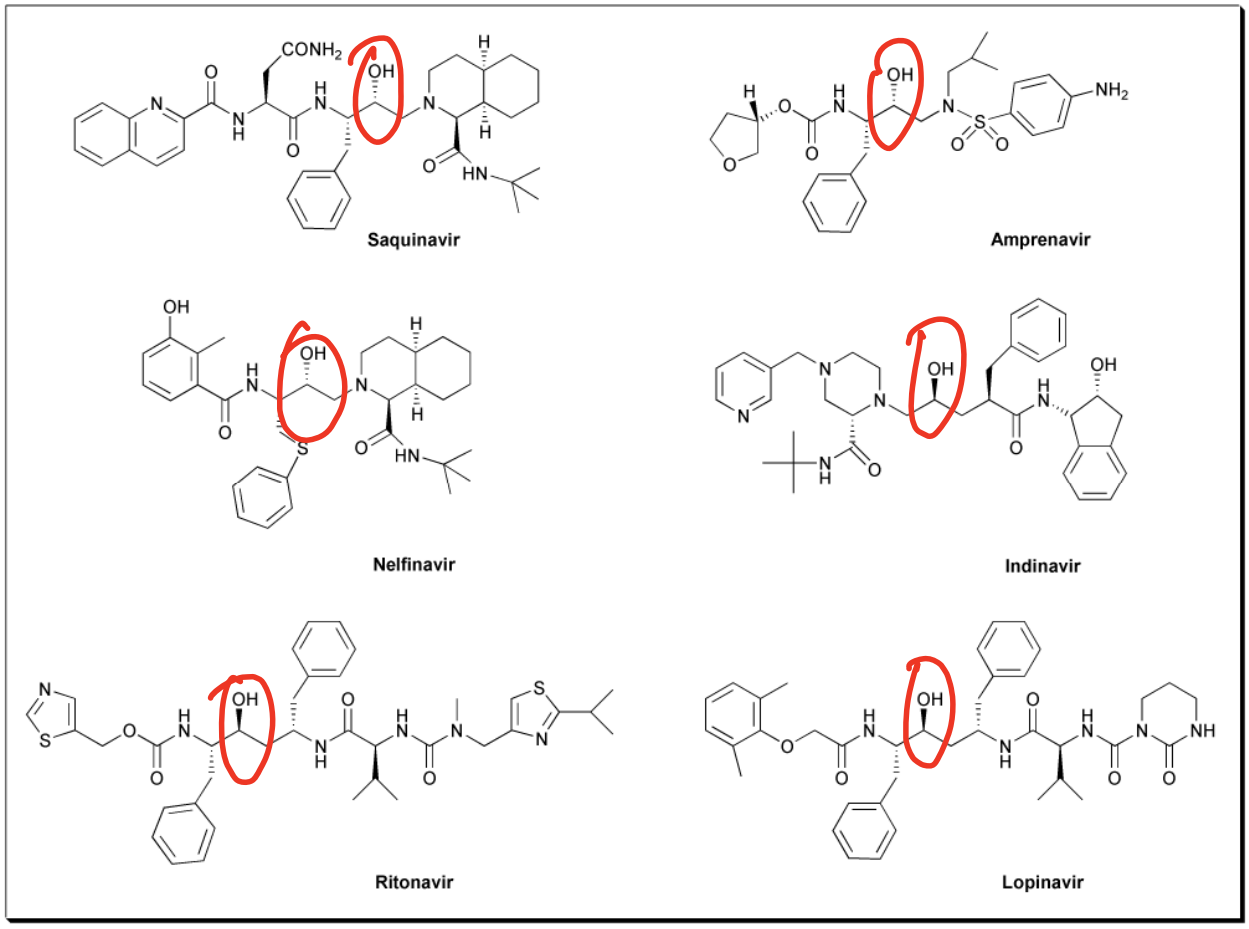


Fig. 10 FDA approved HIV-1 protease inhibitors.

These all have alcohol groups that resemble the -OH of the key tetrahedral intermediate seen in the enzyme reaction.

1991

Magic Johnson announces he is HIV-positive

HISTORY.com Editors

Magic Johnson

Johnson in 2022

Personal information	
Born	August 14, 1959 (age 66) Lansing, Michigan, U.S.
Listed height	6 ft 9 in (2.06 m)
Listed weight	220 lb (100 kg)[1]

<u>Organic Chemistry</u> is the study of carbon-containing molecules.

This class has two points.

The first point of the class is to understand the organic chemistry of living systems. We will teach you how to think about and understand the most amazing things on the planet!!

Water is essential for life, you will learn why water has such special properties. 8/27/25

You will learn the secret structural reason proteins, the most important molecular machines in our bodies, can support the chemistry of life. 9/10/25

You will learn why when you take Advil for pain, exactly half of what you take works, and the other half does nothing. 9/24/25

You will learn how toothpaste works. 10/6/25

You will learn how a single chlorofluorocarbon refrigerant molecule released into the atmosphere can destroy many, many ozone molecules, leading to an enlargement of the ozone hole. 10/29/25

You will learn how medicines like Benadryl, Seldane, and Lipitor work. 11/12/25

You will learn how Naloxone is an antidote for an opioid overdose. 12/8/25

You will learn why Magic Johnson is still alive, decades after contracting HIV. 12/8/25

You will learn how MRI scans work. 12/3/25

The second point of organic chemistry is the synthesis of complex molecules from simpler ones by making and breaking specific bonds.

You will learn how to understand movies of reaction mechanisms like alkene hydration. 10/8/25

You will learn reactions that once begun, will continue reacting such that each product molecule created starts a new reaction until all the starting material is used up. 10/29/25

You will learn reactions that can make antifreeze from vodka. 11/12/25

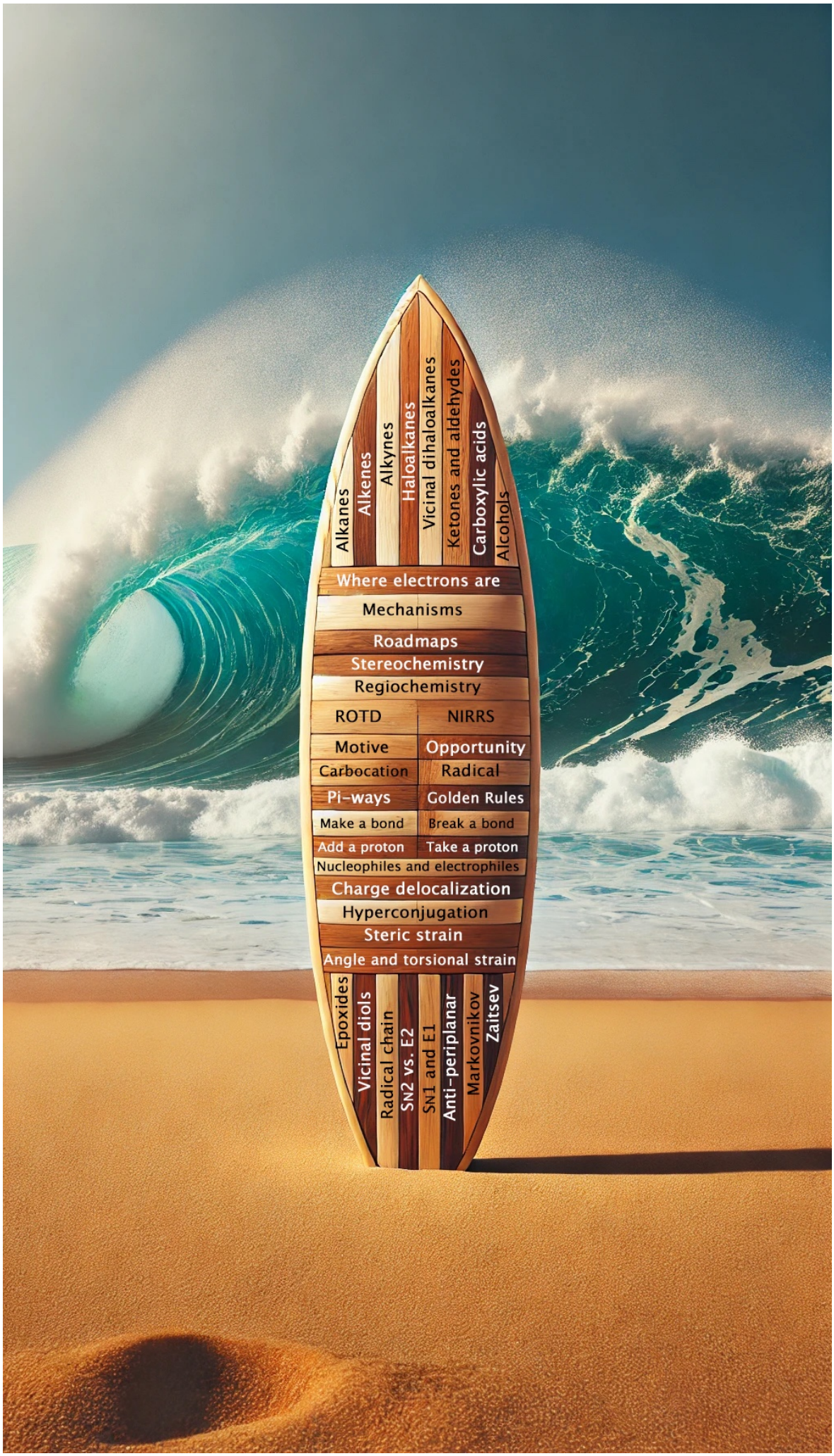
You will learn a reaction that can make nail polish remover from rubbing alcohol. 11/17/25

You will learn how to look at a molecule and accurately predict which atoms will react to make new bonds, and which bonds will break during reactions. 11/19/25

You will learn how to analyze a complex molecule's structure so that you can predict ways to make it via multiple reactions starting with less complex starting molecules. 11/19/25

“You can’t stop the waves, but you can learn to surf”

Jon Kabat-Zinn


Alkanes
Alkenes
Alkynes
Haloalkanes
Vicinal dihaloalkanes
Ketones and aldehydes
Carboxylic acids
Alcohols
Where electrons are
Mechanisms
Roadmaps
Stereochemistry
Regiochemistry
ROTD
NIRRS
Motive
Opportunity
Carbocation
Radical
Pi-ways
Golden Rules
Make a bond
Break a bond
Add a proton
Take a proton
Nucleophiles and electrophiles
Charge delocalization
Hyperconjugation
Steric strain
Angle and torsional strain
Epoxides
Vicinal diols
Radical chain
SN2 vs. E2
SN1 and E1
Anti-periplanar
Markovnikov
Zaitsev

Vladimir Markovnikov

Alkenes are the very best, their reactions are insane.
Alcohols are no match, and neither are alkanes
Electrophiles hit alkenes, without a lot of pain
Use HBr and HCl to make haloalkanes

But then I get confused as to what we're going to see
Which carbon gets which atom? Call it regiochemistry
I hear there's a brilliant man who gave us clarity
What's his name? What's his name? I have to find the key

Well the word got around, they said "this guys insane, man!"
From the 1800's, a Russian dude they say, man.
Got his education and didn't forget from whence he came, man
The world's got to know his name. What's his name, man?

Vladimir Markovnikov
My name is Vladimir Markovnikov
And there's just one thing I did explain
Which carbon gets, the halogen?

The key to understanding products of hydrohalogenation
Is that a carbocation is formed by the HX protonation
Stabilize the plus charge with overlapping orbitalization
The official term of course, is hyperconjugation

The more stable cation forms of lower energy
The halide ion comes in and reacts there naturally
It's the one with more carbons, that's maybe two or three
So X is on more substituted carbons don't you see

Vladimir Markovnikov
My name is Vladimir Markovnikov
And there's just one thing that I did explain
Which carbon gets, the halogen?

So don't be throwing away my rule
Don't be throwing away my rule
Hey yo, its not that convoluted
Halogen on the carbon that's more substituted
So don't be throwing away my rule

Vladimir Markovnikov
My name is Vladimir Markovnikov
And there's just one thing I did explain
Which carbon gets, the halogen.

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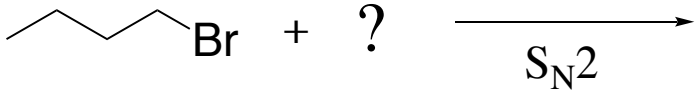
Shape of S_N2



The club ain't the best place to find nucleophiles
So the lab is where I go
Me and my friends in solvent
Moving fast but reacting slow
Come over and start up a reaction with just me
And trust me I'll give it a chance now
Let's react, stop, put your charge over here
And then we start to react, and now I'm singing like
You know I want to make a bond
Your charge was handmade for a reagent like me
Come on now, follow my lead
I'm an electrophile, don't mind me
Say now let's not talk too much
Get through solvent and put your electrons on me
Come on now, follow my lead,
Come, come on now, follow my lead

I'm attracted to the charge of you
We push and pull like charges do
Although my orbitals are reacting too
Come on let's get bonding
Transition state is coming true
Time to finish the S_N2
Creating a bond brand new
Come on let's get bonding
Oh-I-oh-I-oh-I-oh-I
Come on let's get bonding
Oh-I-oh-I-oh-I-oh-I
Come on let's get bonding
Oh-I-oh-I-oh-I-oh-I
Come on let's get bonding
We need to make a bond brand new
Come on now let's S_N2.

" Don't Stop, Believin'

Just a Houston girl,
Living in a Longhorn world.
She took the premed train
Straight to OChem 1

Just a Plano boy,
Born and raised in full burnt orange,
He took the premed train
Straight to OChem 1

They study in a smoky room,
Smell of vapes and Mountain Dew
For an A they study all night
It goes on and on and on and on

Alkanes to alkynes
Up and down the I-35
Two students studying in the night
Roadmaps, reactions
Living just to pass the final
Will they ever get it right

Working hard to get my grade
Everybody wants an "A"
Trying anything to ace this class
Just one more exam
Some will win, some will lose
I don't want to sing the blues
OChem never seems to end
It goes on and on and on and on

Alkanes to alkynes
Up and down the I-35
Two students studying in the night
Roadmaps, reactions
Living just to pass the final
Will they ever get it right

Don't stop believin'
Hold on to that "A" feelin'
Roadmaps, reactions
Ohohohohohoh

Don't stop believin'
Hold on
Roadmaps, reactions
Ohohohohohoh

Don't stop believin'
Hold on to that "A" feelin'
Roadmaps, reactions
Ohohohohohoh

We All Love Organic Chemistry

In the town where I was born,
Lived a man of chemistry.
And he told us of his life
In the organic laboratory.

Making molecules to fight disease
Coming up with their syntheses.
So we sit in 320M
Learning organic chemistry.

Refrain:
We all love organic chemistry
Synthetic chemistry
Molecules with "C"
We all love organic chemistry
Synthetic chemistry
Molecules with "C"

All our friends think we're a bore
Our grade point averages begin with 4.
But we await graduation day
To work in lab for meager pay.

But its OK, who else can say
They're curing cancer or fighting AIDS.
We hope that you in 320M
Respect organic chemistry

Refrain:
We all love organic chemistry
Synthetic chemistry
Molecules with "C"
We all love organic chemistry
Synthetic chemistry
Molecules with "C