Marijuana:
What Does Science Tell Us?

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State Marijuana Policies

- State Laws related to marijuana are rapidly changing

- 24 States and DC have legalized at least some forms of MJ for medicinal use

- 4 States and DC have legalized or voted to legalize MJ for adult recreational use

- Legalization is expected to be on state ballots in 2016

How Can Science Inform the Policy Debate?

- – Drug use trends (epidemiology)
- – Impact of state policies on public health outcomes
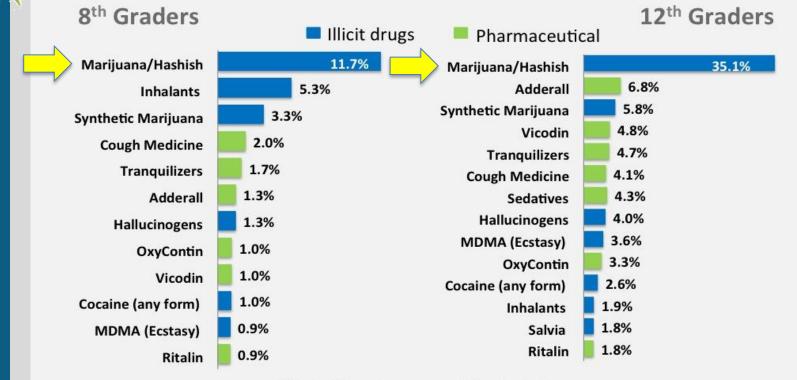- – How marijuana affects the brain (neurobiology)
- – How it affects behavior (e.g. driving)?
- – How it affects life outcomes? Education? Jobs? Happiness? Success?
- – Are the components of marijuana effective medications?

WHAT DOES SCIENCE TELL US ABOUT MARIJUANA USE?

Marijuana is the Most Commonly Used Illicit Drug

Top Drugs among 8th and 12th Graders, Past Year Use

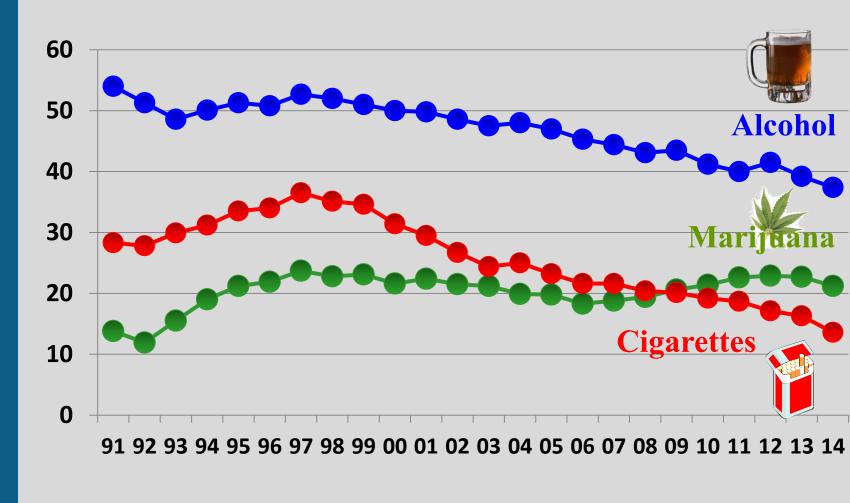**8th Graders**

■ Illicit drugs   ■ Pharmaceutical

8th Graders	%
Marijuana/Hashish	11.7%
Inhalants	5.3%
Synthetic Marijuana	3.3%
Cough Medicine	2.0%
Tranquilizers	1.7%
Adderall	1.3%
Hallucinogens	1.3%
OxyContin	1.0%
Vicodin	1.0%
Cocaine (any form)	1.0%
MDMA (Ecstasy)	0.9%
Ritalin	0.9%

12th Graders

12th Graders	%
Marijuana/Hashish	35.1%
Adderall	6.8%
Synthetic Marijuana	5.8%
Vicodin	4.8%
Tranquilizers	4.7%
Cough Medicine	4.1%
Sedatives	4.3%
Hallucinogens	4.0%
MDMA (Ecstasy)	3.6%
OxyContin	3.3%
Cocaine (any form)	2.6%
Inhalants	1.9%
Salvia	1.8%
Ritalin	1.8%

* Only 12th graders surveyed about sedatives use

Source: University of Michigan, 2014 Monitoring the Future Study

National Institute on Drug Abuse

NIH

How Many Youth are Using?
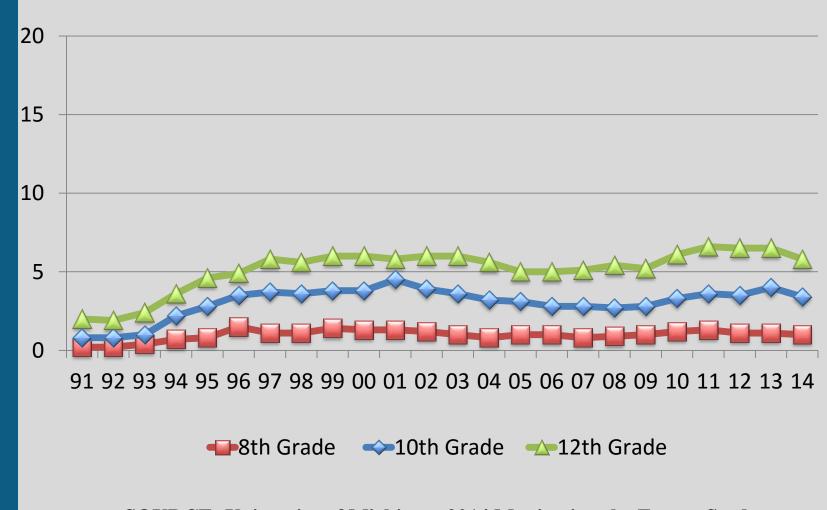## (Past Month, %)

Alcohol

Marijuana

Cigarettes

National Institute on Drug Abuse

SOURCE: University of Michigan, 2014 Monitoring the Future Study.

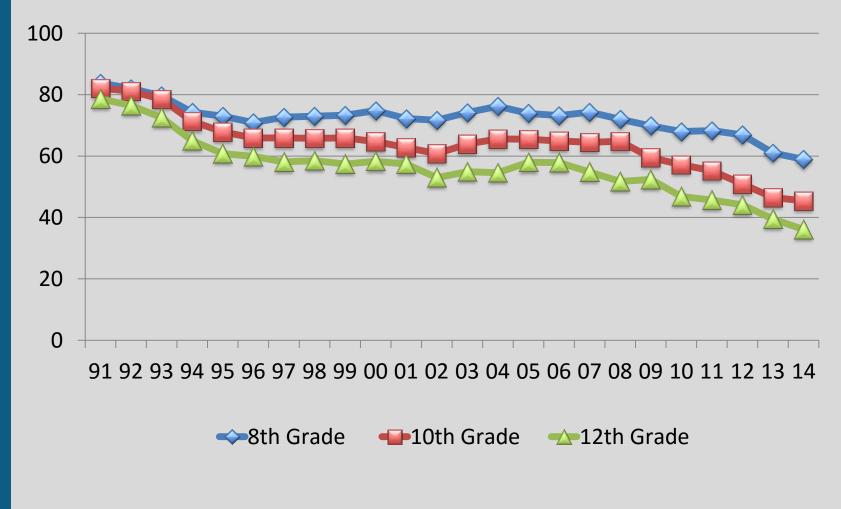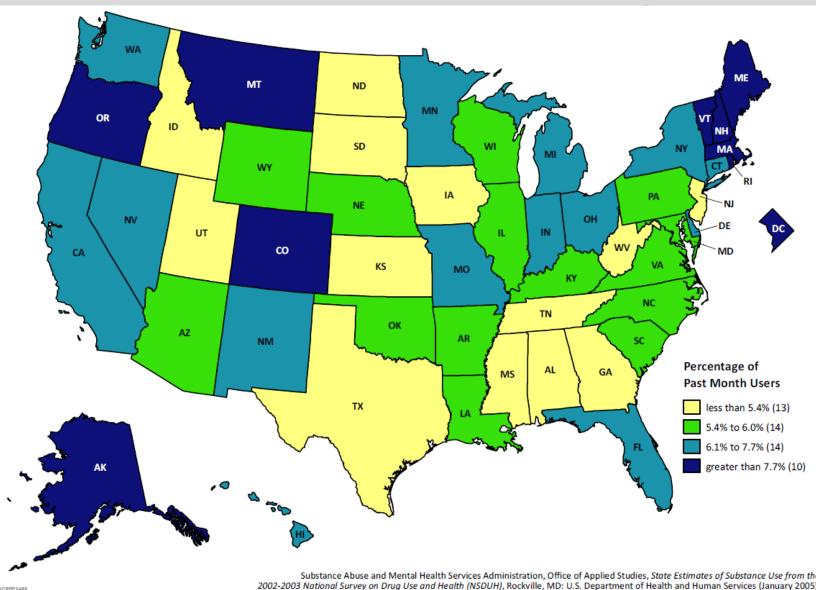# Percentage of High School Seniors Using Marijuana Daily

8th Grade   10th Grade   12th Grade

SOURCE: University of Michigan, 2014 Monitoring the Future Study.

National Institute on Drug Abuse

Decreasing Perception of Harms

SOURCE: University of Michigan, 2014 Monitoring the Future Study.

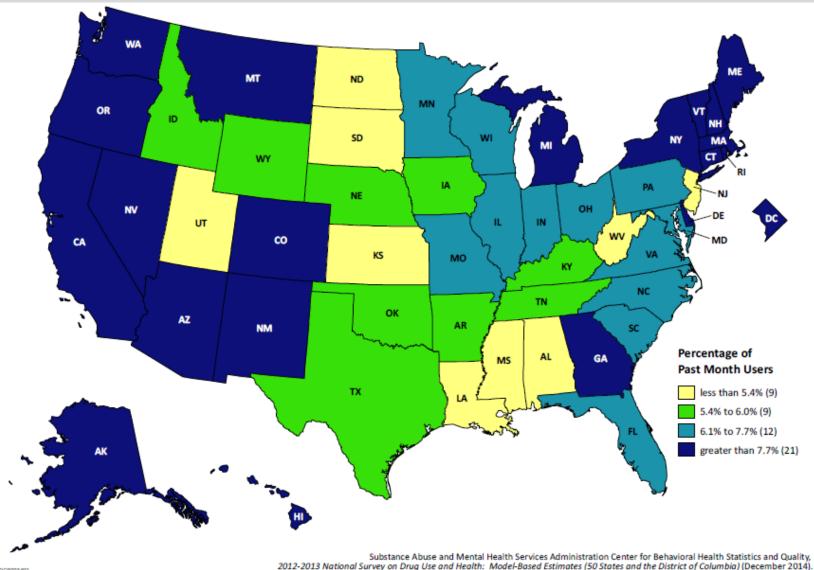# Percentage of Past Month Marijuana Users Aged 12 or Older: Annual Averages, 2002-2003

Percentage of Past Month Users

- less than 5.4% (13)
- 5.4% to 6.0% (14)
- 6.1% to 7.7% (14)
- greater than 7.7% (10)

ONDCP003495

National Institute on Drug Abuse

Percentage of Past Month Marijuana Users Aged 12 or Older: Annual Averages, 2012-2013

National Institute on Drug Abuse

Percentage of Past Month Users

- less than 5.4% (9)
- 5.4% to 6.0% (9)
- 6.1% to 7.7% (12)
- greater than 7.7% (21)

ONDCP003492

Relationship Between Medical Marijuana Laws and Use?

- Study results/conclusions vary
- States that legalized for medical purposes have higher rates of use
- Not necessarily causal
- Policies vary by state
- Need to consider state-level risk factors (e.g., home cultivation, dispensaries)

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Tetrahydrocannabinol (THC)
Active Ingredient in Marijuana

HOW DOES MARIJUANA IMPACT THE BRAIN?

Marijuana Binds Cannabinoid Receptors Located Throughout the Brain

- Brain Development

- Memory & Cognition

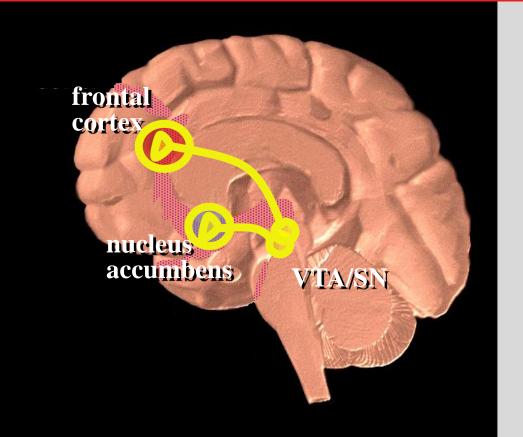- Motivational Systems & Reward

- Appetite

- Immunological Function
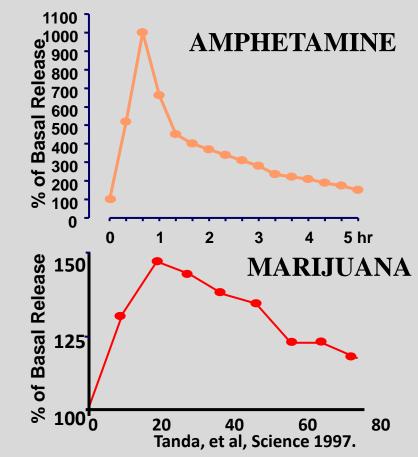
- Reproduction

- Movement Coordination

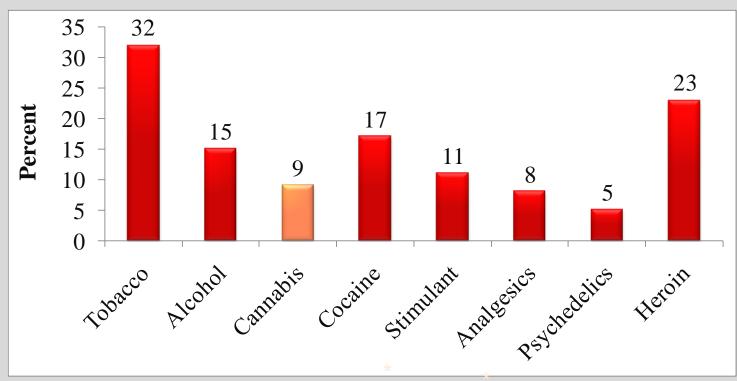- Pain Regulation & Analgesia

The Reward Circuit

frontal cortex

nucleus accumbens

VTA/SN

Drugs of abuse increase dopamine in the Nucleus Accumbens

AMPHETAMINE

% of Basal Release

MARIJUANA

% of Basal Release

Tanda, et al, Science 1997.

Is Marijuana Addictive?

Estimated Prevalence of Dependence Among Users

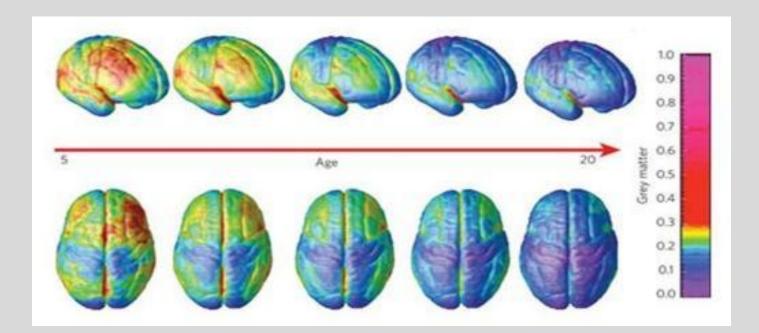**Risk for Addiction is Significantly Higher When Starting in Adolescence: Approximately 16% for Marijuana**

Marijuana and Cognitive Development

The teen brain is **still developing** and it is especially vulnerable to drug use.
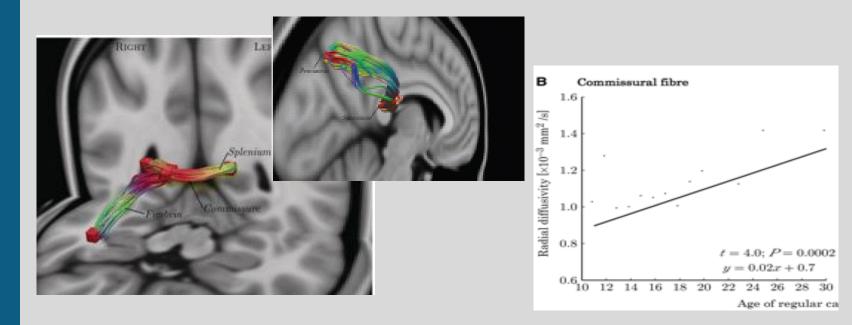

Source: Gogtay et al., PNAS. 2004 101 (21) 8174-8179

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Marijuana and Neural Development

Some Studies Suggest Structural Differences in Brains of Regular Marijuana Users versus Nonusers

Early (<18y) Long-Term Cannabis Use Decreases Axonal Fiber Connectivity

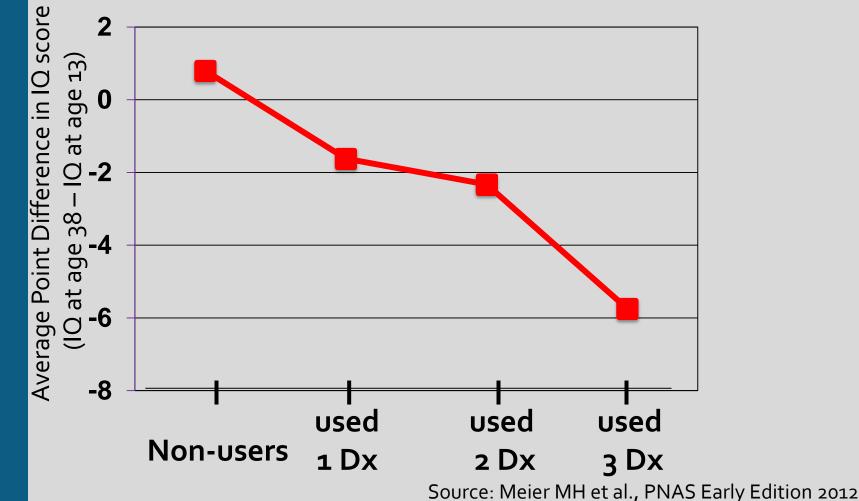Axonal paths with reduced connectivity (diffusion-weighted MRI) in cannabis users than in controls.

Zalesky et al Brain 2012.

Persistent Marijuana Users Show A Significant IQ Drop between Childhood and Midlife

1,037 individuals (0- 38 yrs old); marijuana use reported at 18, 21, 26, 32 and 38 yrs old; IQ at 13 and 38 yrs old
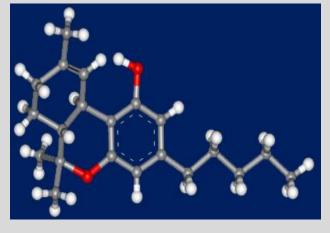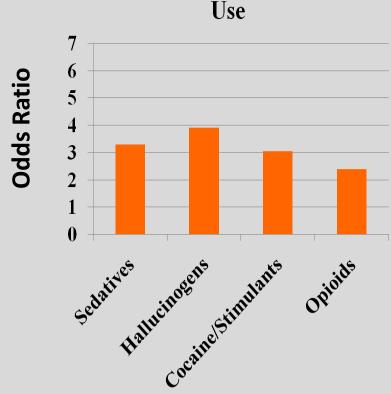

Source: Meier MH et al., PNAS Early Edition 2012

National Institute on Drug Abuse

**Tetrahydrocannabinol (THC)
Active Ingredient in Marijuana**

HOW DOES MARIJUANA IMPACT LIFE OUTCOMES?

Marijuana: Impact on Other Drug Use

Similar to Early Alcohol or Tobacco Use, Early Marijuana Use Increases Likelihood of Using Other Drugs

Use

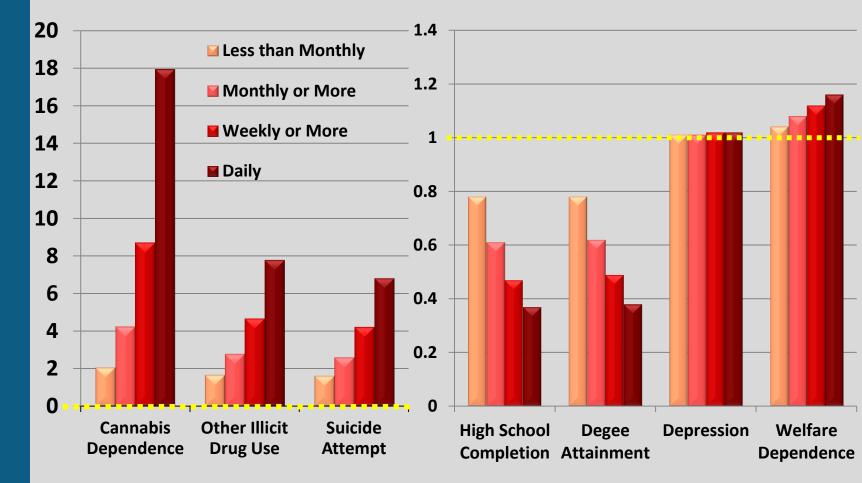**Drug Use in Twin Pairs Discordant for Cannabis Use Before Age 17**

Odds Ratio

Sedatives | Hallucinogens | Cocaine/Stimulants | Opioids

Source: Lynskey, MT et al., JAMA, 289, pp. 427-433, 2003.

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Marijuana: Impact on Outcomes
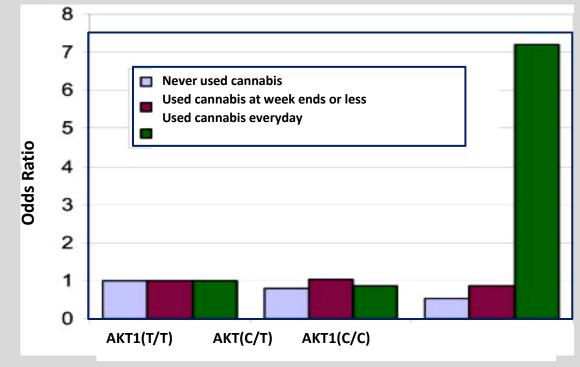
More frequent use in adolescence and adverse outcomes

Silins E et al., The Lancet September 2014.

Marijuana and Mental Illness

Marijuana use increases risk for psychosis in people with specific genetic risk factors

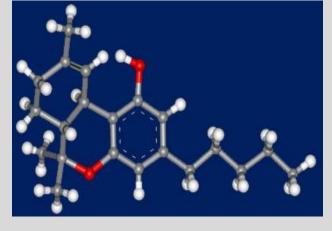**Regular Cannabis Use Increases Schizophrenia Risk in those with AKT1 rs2494732 genotype**

Di Forti et al., Biological Psychiatry, 2012.

Tetrahydrocannabinol (THC)
Active Ingredient in Marijuana

ARE THERE THERAPEUTIC BENEFITS OF MARIJUANA?

Marijuana as Medicine?

- Promise lies in purified ingredients (e.g., CBD) or synthetic compounds with more selectivity, less adverse effects

- Applications: pain, nausea, wasting, obesity, muscle spasticity, addiction, inflammatory conditions, HIV

- NIH research focuses on THC, CBD, and compounds that alter the function of the endocannabinoid system

Adolescent Brain Cognitive Development (ABCD) Study

Ten year longitudinal study of 10,000 children from age 10 to 20 years to assess effects of drugs on individual brain development trajectories

Summary

- Marijuana is the most commonly used illicit drug in US

- Use generally begins in adolescence

- Wide range of effects on brain, body, and behavior

- Policy landscape changing

- Impact of policies need further research

- Science can/should inform policy

National Institute on Drug Abuse

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drugabuse.gov

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