MARIJUANA AND THE ADOLESCENT BRAIN
A coalition of schools, human service agencies, local government, law enforcement, businesses, faith-based organizations, parents and youth that holds the vision that:

Franklin County and the North Quabbin Region be a place where young people are able to reach their full potential and thrive with ongoing support from schools, parents and the community.
Roadmap

• The (remarkable!) adolescent brain
• Substance use and the brain’s reward system
• Adolescence and the roots of addiction
• Marijuana and its acute effects
• Longer-term impact of regular marijuana use on youth development
• Trends in youth substance use
• Prevention
Compared to childhood and adulthood, adolescence is a time of heightened:

- Sensation- and reward-seeking
- Risk-taking and impulsivity
- Peer influence
- Mood swings
- Capacity to learn
- Exuberance
Maturation of the human brain, age 4-21
The imbalance between the prefrontal cortex and the limbic system
Creating neural super-highways

through pruning & myelination
The “use it or lose it” principle

"If a teen is doing music or sports or academics, those are the cells and connections that will be hardwired. If they're lying on the couch or playing video games..., those are the cells and connections that are going to survive.”

Jay N. Giedd, M.D., Chief of Brain Imaging, Child Psychiatry Branch, National Institutes of Health
The heightened importance of rewards

[Image: A cartoon of a mouse with the text: "TEEN-AGE MOUSE" and the thought bubble: "I CAN TOTALLY GET AWAY WITH THIS!".]
The brain’s reward system
Dopamine level, normal brain

Chocolate

Normal baseline

Return to baseline
Natural Rewards Elevate Dopamine Levels

**FOOD**

% of Basal DA Output

Time (min)

NAc shell

Empty Box Feeding

**SEX**

DA Concentration (% Baseline)

Sample Number

Copulation Frequency

Mounts Intromissions Ejaculations

Di Chiara et al., Neuroscience, 1999.

Comparing dopamine levels from natural rewards and drugs of abuse

- Baseline: 100
- Food: 150
- Sex: 200
From the neuron’s point of view (Wow! Yikes!)
So what’s wrong with feeling good?
When the brain’s reward system is repeatedly overstimulated, it adjusts to reduce dopamine levels.
High Dopamine Levels: Normal Pleasure & Interest

Low Dopamine Levels: Lack of Pleasure

Healthy subject

Person w/ substance use disorder
Addiction is a brain disease

These changes in brain chemistry are at the root of addiction. For more on addiction, search YouTube for “Physiology of Addiction by Dr. Ruth Potee.”
The reward system is particularly active in the teen brain.

The centers for logic and reasoning are still developing.
Teens are more likely to start using illicit drugs than other age groups

% of never users who initiated use in the past year
The reward system is particularly active in the teen brain.

Adolescent brains are building super-highways for the pathways used regularly.

The centers for logic and reasoning are still developing.
Early onset of substance use

- People who begin using alcohol, marijuana, or other drugs in adolescence are more likely to develop dependence than those who begin in adulthood.

Addiction is a developmental pediatric disease.
Dependence on substances is highly correlated with early use

40% of those who begin drinking at age 15 will develop an alcohol use disorder.

7% of those who begin drinking at age 21 will develop an alcohol use disorder.

* Photo courtesy of NIAAA and MADD
What is marijuana?
How does it affect the body?
The marijuana plant (Cannabis sativa)

- 480 natural chemical compounds
- 80 cannabinoids, including THC and CBD

Like most drugs, cannabinoids mimic natural brain messengers.

- **Brain's Chemical**: Anandamide
- **Drug**: THC
There are receptors for these natural cannabinoids all over the body...

and throughout the brain...

and THC, CBD and other cannabinoids from marijuana can bind with them and alter natural signals.
So how does marijuana affect the brain and body?

It depends!

What strain of marijuana?
What is the THC content?
The CBD content?
How is it being consumed?
Average THC & CBD levels in the US: 1960 - 2011

Data from the NIDA-sponsored Potency Monitoring program at the University of Mississippi, showing average THC and CBD levels in samples of marijuana seized by federal, state and local governments in each year shown.
Increase in THC vs. CBD

Ways to consume marijuana
Acute effects of using marijuana (during intoxication)

- Altered judgment
- Slowed reaction time
- Euphoria
- Impaired memory
- Increased appetite
- Panic/paranoia/psychosis
- Impaired coordination
- Altered pain sensitivity
- Anti-nausea effects
What about its medicinal properties?

People have used marijuana as a medicine for thousands of years, and animal studies and cell cultures suggest promise for marijuana for the treatment of a variety of conditions, for example:

* Glaucoma * Nausea *
* AIDS-associated wasting syndrome *
* Chronic pain * Inflammation *
* Multiple sclerosis * Epilepsy *

Good clinical studies are needed; the DEA is currently considering whether to reschedule marijuana.
Marijuana and driving

- Marijuana affects skills necessary for driving, such as motor coordination, reaction time & judgment.
- Lab and simulator studies show that marijuana impairs driving skills, and the more THC, the greater the impairment.
- How this impairment of skills affects real world crash risk is unclear.

Colorado DOT campaign
Marijuana and driving

• Marijuana used with alcohol causes greater impairment than either alone.

• In Colorado in 2014, of drivers testing positive for THC, 2/3 had alcohol and/or other drugs in their systems as well as marijuana.
Marijuana and driving

Source: Monitoring the Future
What are the longer-term effects of regular marijuana use on youth development?
Prospective longitudinal studies

Assess during childhood
Monitor marijuana use from onset
Assess again in adulthood
One thing researchers agree on...

Frequent marijuana use during adolescence has more serious consequences than use by adults.
Potential longer-term effects of regular marijuana use on youth development

- Issues with attention, memory and learning
- Poorer educational and life outcomes
- Loss of IQ for persistent heavy users
- Potential for addiction to marijuana and increased risk of addiction to other drugs
- Increased risk of risk of psychosis
Deficits in cognitive functioning among active users

Many studies show that adolescents who use marijuana heavily tend to score worse than non-users on tests of:

- attention
- verbal learning
- memory
- processing speed

... even when they are not high.

Messinis, et al 2006
Deficits in cognitive functioning among active users

• Deficits are larger for those who use more, and for those who begin using younger.

• With sustained abstinence, functioning is largely restored.
Does marijuana use alter brain structure?
Adult life outcomes affected by marijuana use in adolescence

Increasing use of marijuana from age 15-21 was also associated with lower relationship quality and lower life satisfaction at age 25.

Fergusson DM & Boden JM, Cannabis use and later life outcomes. Addiction. 2008 Jun; 103(6):969-76
Loss of adult IQ associated with marijuana dependence in adolescence

The most comprehensive study of marijuana and cognitive function to date:

• Dunedin study followed 1037 individuals from birth to age 38
• assessed IQ at 13 and at 38
• assessed marijuana use and dependence at five points in time from age 18-38
• controlled for use of alcohol and other substances, socio-economic status and years of education
Loss of adult IQ with marijuana dependence in adolescence

Findings:

• Those who developed marijuana dependence before age 18 showed IQ decline in adulthood.

• The longer their dependence persisted, the greater the decline, with a decline of 8 IQ points for the most persistent users.

• Those who began using in adulthood did not show IQ decline.

• Quitting in adulthood did not restore functioning in those who began in adolescence.
Other studies show no association between marijuana use and IQ loss

Mokrysz, et al, 2016:
• Prospective cohort study of 2235 young people in Bristol, UK, considered impact of marijuana use on IQ between age 8 and age 15.
• No association found between teen marijuana use and IQ, after adjusting for various confounders, most notably cigarette smoking.

• Study of 789 pairs of twins followed from preadolescence (age 9-12) to late adolescence (age 17-20).
• Marijuana users experienced declines – as did their non-using twins.
• The authors conclude the decline was related to factors other than marijuana.
Is marijuana addictive?

% of users (of all ages) who develop dependence

- Nicotine: 32%
- Heroin: 23%
- Cocaine: 17%
- Alcohol: 15%
- Marijuana: 9%

And 17% for those who start in their teens.
The consequences of marijuana dependence are not as severe as those for alcohol or opioid dependence, but:

- Like other drugs of abuse, marijuana acts on the reward system and causes dopamine to be released.
- Marijuana is reinforcing: animals will self-administer it.
- People show clinical signs of addiction, e.g.,
  - tolerance
  - withdrawal syndrome
  - using more than intended
  - wanting to cut back on use
- In 2014, the NSDUH found 4.2 million Americans had a marijuana use disorder within the past year.
There is a correlation between use of tobacco, alcohol, and marijuana and use of other drugs of abuse.

What percent of each group use prescription narcotics?

- Of those who smoke cigarettes, 16%
- Of those who do not smoke, 1%
- Of those who drink, 8%
- Of those who do not drink, 1%
- Of those who use mj, 11%
- Of those who do not use mj, 0%

SOURCE: 2015 FC/NQ PNA
Marijuana, psychosis and schizophrenia

Marijuana use at age 18 and later risk of schizophrenia (n=45,570)

Cases of schizophrenia per 1,000

Number of times marijuana used

Andréasson, 1987
Marijuana, psychosis and schizophrenia

Regular marijuana use increases schizophrenia risk in those with gene for schizophrenia

DiForti, 2012
How common is youth marijuana use?
Percentage of **U.S. 12th grade** students reporting past month use of cigarettes, marijuana and alcohol

Percentage of local middle & high school students reporting past month use of cigarettes, marijuana and alcohol

SOURCE: Franklin County/North Quabbin Prevention Needs Assessment.
Percentage of U.S. 12 Grade Students Reporting Daily Marijuana Use vs. Perceived Risk of Regular Marijuana Use

Source: The Monitoring the Future study, the University of Michigan
Perceptions of marijuana among local middle & high school students

- **mj use is risky**: 73% in 2003, decreasing to 60% in 2015
- **it's wrong to use mj**: 62% in 2003, increasing to 43% in 2015
- **it's hard to get mj**: 32% in 2003, increasing to 42% in 2015

*SOURCE: Franklin County/North Quabbin Prevention Needs Assessment.*
Prevention:

Factors in the community, family and schools influencing youth use
Prevention in the community: Laws and norms
Report of the Special Senate Committee on Marijuana

March 8, 2016

Some considerations affecting youth if recreational use is legalized

- Minimum legal sales age
- Use in public
- Driving under the influence
- Types of products allowed
- Packaging and labeling
- Advertising and marketing
- Location and density of vendors
- Use of revenue for prevention
Products & packaging: Like this?
Or this? (Products at the Northampton dispensary)
A dispensary in Colorado ... now painted gray after community complaints that the mural enticed children
The Northampton dispensary
The future Greenfield dispensary
The Northampton dispensary
Advertising/promotions

2 for $45 While supplies last.
$20 1/8th Select Strains

$125 Oz Select Strains While supplies last.
First Time Patients Buy 1 Gram Get One FREE

New Patient Special $140 OZ Any Strain

GREENFIELDS
1798 West Mississippi Ave. Denver, CO 80223

Mind Body Spirit WELLNESS CLINIC
mbswellnessclinic.com • OPEN 7 days a week • ATM on site

STOP BY ON YOUR WAY UP THE MOUNTAIN FOR ALL YOUR RECREATIONAL NEEDS!

SHOW YOUR SKI PASS AND RECEIVE A $1.00 JOINT WITH PURCHASE!
FREE DAB!

BOGO PIPES
12K MASTER CASE 280

Jo Blow's Glass
11500 W Colfax Ave, Lakewood
Prevention in the family

Students’ report on their parents’ attitudes

How wrong do your parents think it is for you to use marijuana?

SOURCE: Franklin County/North Quabbin Prevention Needs Assessment.
MARIJUANA TALK KIT

What you need to know to talk with your teen about marijuana

#MJTalkKit
In this 10-15 minute experience, you will talk to a child about underage drinking.

Watch Get the Story to learn more about your characters. Then select Start Talking to start the conversation.
Prevention in schools
LifeSkills is a substance abuse and violence prevention curriculum for middle school students.

Year 1
6th / 7th
15 classes

Year 2
7th / 8th
10 classes

Year 3
8th / 9th
5 classes
LifeSkills Teaches *Life Skills*:

Self-Image & Self-Improvement
Making Decisions
Coping with Anxiety
Coping with Anger
Communication Skills
Social Skills
Assertiveness
Resolving Conflicts
Media Influences
Advertising
Violence and the Media
Resisting Peer Pressure

...as well as:
Smoking: Myths and Realities
Alcohol: Myths and Realities
Marijuana: Myths and Realities
Drug Abuse and Violence: Causes and Effects
Randomized trials show LifeSkills reduces tobacco, alcohol and marijuana use among participants relative to controls:

- **up to 87%** for tobacco use,
- **up to 60%** for alcohol use, &
- **up to 75%** for marijuana use.

**SOURCE:** Various studies cited at http://www.lifeskillstraining.com/
Screening, Brief Intervention & Referral to Treatment
Communities that Care
Coalition
Status of marijuana legalization in Massachusetts

Massachusetts Regulation and Taxation of Marijuana Initiative is on track to appear on the ballot in November.

• Authorizes marijuana cultivation, possession and use by adults (21+) and regulates commerce
• Legalizes possession, use and home growing when the law goes into effect Dec 15, 2016, with commercial sales to begin January 2018

If it passes, it becomes law – but the legislature can amend it to address policy concerns not covered in the proposed law.
Status of marijuana legalization in Massachusetts

- Senator Rosenberg has proposed that the legislature draft its own ballot measure, with the aim of addressing the concerns of multiple constituencies.
- This is a legitimate procedure, but it has never been done before.
- If the legislature were to do so, there would be two marijuana questions on the November ballot.
- If both pass, legislators could choose which one they would amend.
What municipal leaders can do

• Assess zoning and Board of Health regulations on medical marijuana
• Take a stand on legalization of recreational marijuana use
• Educate the community through meetings, town newsletters, editorials, etc.
• Support the implementation of LifeSkills and SBIRT in the schools
• Stay abreast of legislation on recreational marijuana use.
Resource list

Adolescent brain

• Frances E. Jensen with Amy Ellis Nutt, The Teenage Brain. A Neuroscientist’s Survival Guide to Raising Adolescents and Young Adults, 2015.

Prevention

• Community Action Plan, May 2016, available on the Communities That Care Coalition website CommunitiesThatCareCoalition.org

Addiction

• Dr. Ruth Potee, Physiology of Addiction (video), https://www.youtube.com/watch?v=eySb0etE1PA

Marijuana

• MA Department of Health, Medical Use of Marijuana Program (including Guidance for Municipalities), http://www.mass.gov/eohhs/gov/departments/dph/programs/hcq/medical-marijuana/
• National Organization for the Reform of Marijuana Laws (NORML), http://norml.org/
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