

E-Cigarettes and Vaping in Teenagers

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Harvard Medical School
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HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL



Objectives:

- What are E cigarettes?
- What are the important receptors and neurotransmitters associated with nicotine use?
- What are the neurodevelopmental changes in the brain from nicotine use?
- Effects of nicotine use on mental and physical health
- What is the addiction potential of vaping?



Disclosures

I Have No Actual or Potential Conflicts of Interest Relating to this Presentation.



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ASAM Definition of Addiction

“a *treatable*, chronic medical disease involving complex interactions among brain circuits, genetics, the environment, and an individual’s *life experiences*. People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences”

- ASAM, Quality Care: Definition of Addiction. <https://www.asam.org/quality-care/definition-of-addiction>



Setting Some “Ground Rules”

INSTEAD OF...	TRY PERSON-FIRST LANGUAGE
Drug Abuse	Substance use disorder, addiction
Abuser, addict, junkie, alcoholic	Person with a substance use disorder
Clean	Abstinent, not using Negative test
Dirty	Actively using Positive test
Addicted baby	Baby with Neonatal Abstinence (or Opioid Withdrawal) Syndrome
Medication-Assisted Treatment	Medication or treatment for (substance) use disorder

Being Safe: Harm Reduction

Harm reduction is an approach that emphasizes engaging directly with people who use drugs to prevent overdose and infectious disease transmission, improve the physical, mental, and social wellbeing of those served, and offer low-threshold options for accessing substance use disorder treatment and other health care services.

Harm reduction organizations incorporate a spectrum of strategies that meet people “where they are” on their own terms, and may serve as a pathway to additional prevention, treatment, and recovery services.

Resources:

- CDC (<https://harmreductionhelp.cdc.gov/s/>)
- SAHMSA (<https://www.samhsa.gov/find-help/harm-reduction>)
- National Harm Reduction Coalition (<https://harmreduction.org/>)

Risk Factors for Substance Use



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Recognize Risk Factors

Parent or family substance use

Favorable parent substance-related attitudes

Limited parental monitoring

Trauma

Peer substance use

Mental health disorders

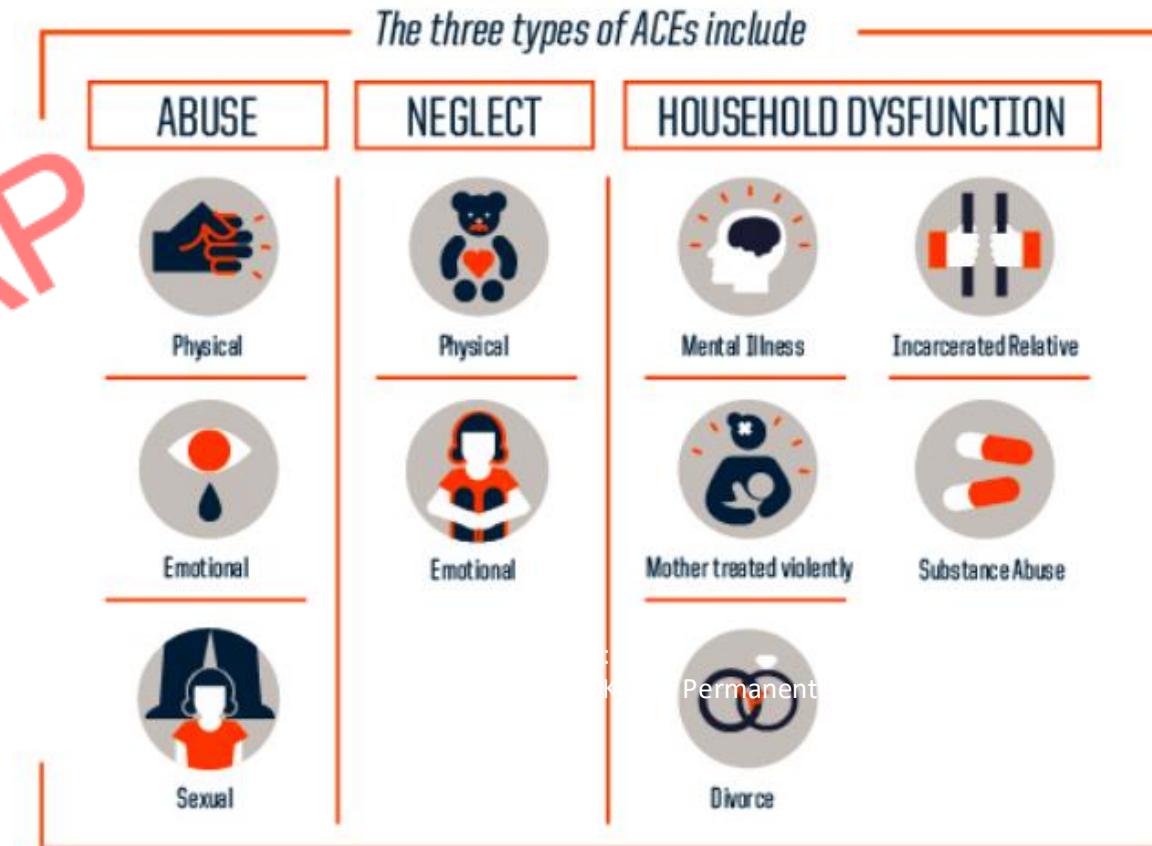
Poor school connectedness

Recognize Risk Factors

9% of kids in the US live with someone with a substance use problem.¹

1.4M kids in the US live with a parent with opioid use disorder.²

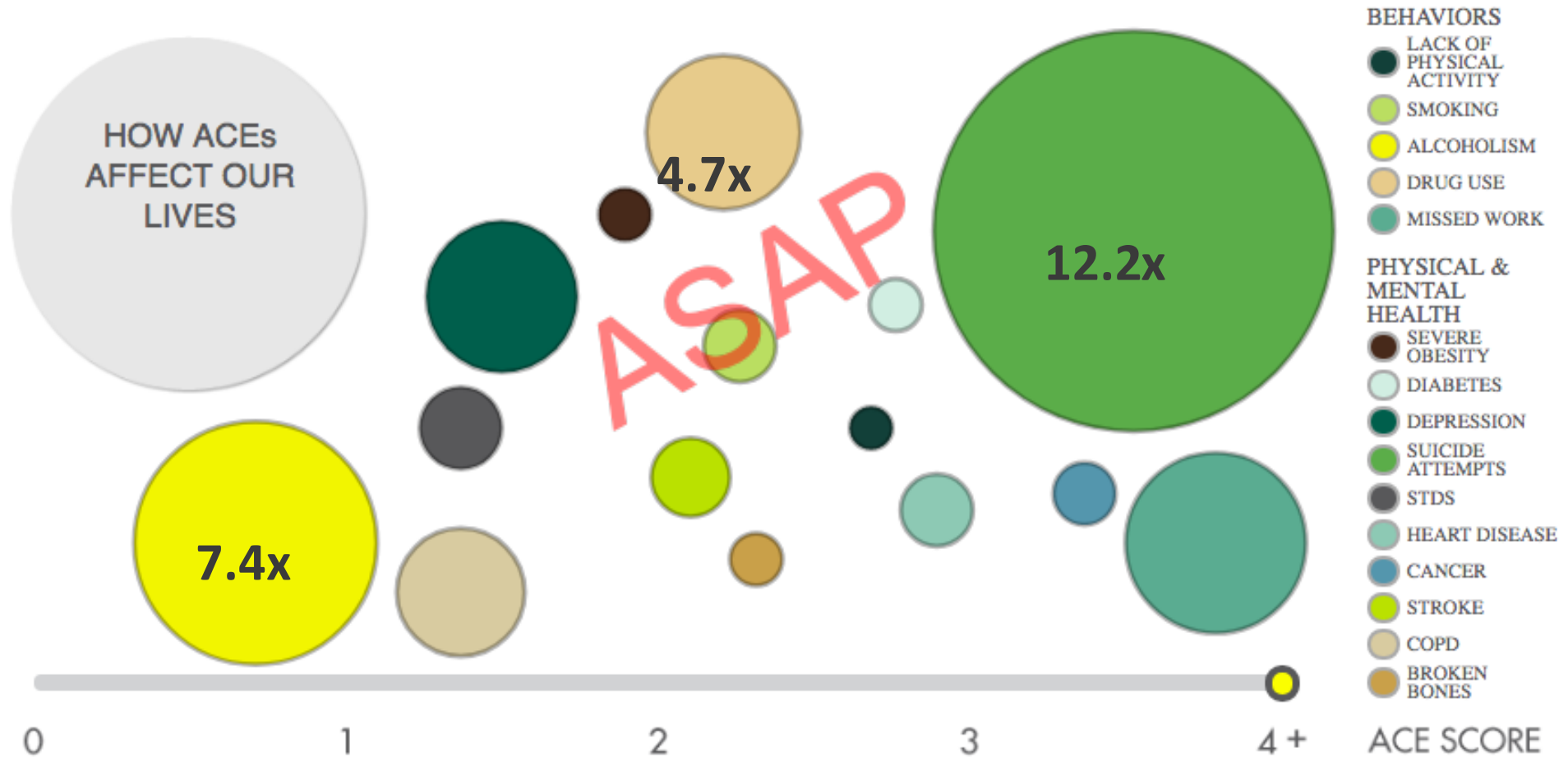
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<https://www.cdc.gov/violenceprevention/aces/>

1. Sacks & Murphey, Child Trends, 2018.
2. United Hospital Fund, "The Ripple Effect", 2018.

ACEs Number & Risks of Adverse Health Outcomes



Brain Development

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Crash Course

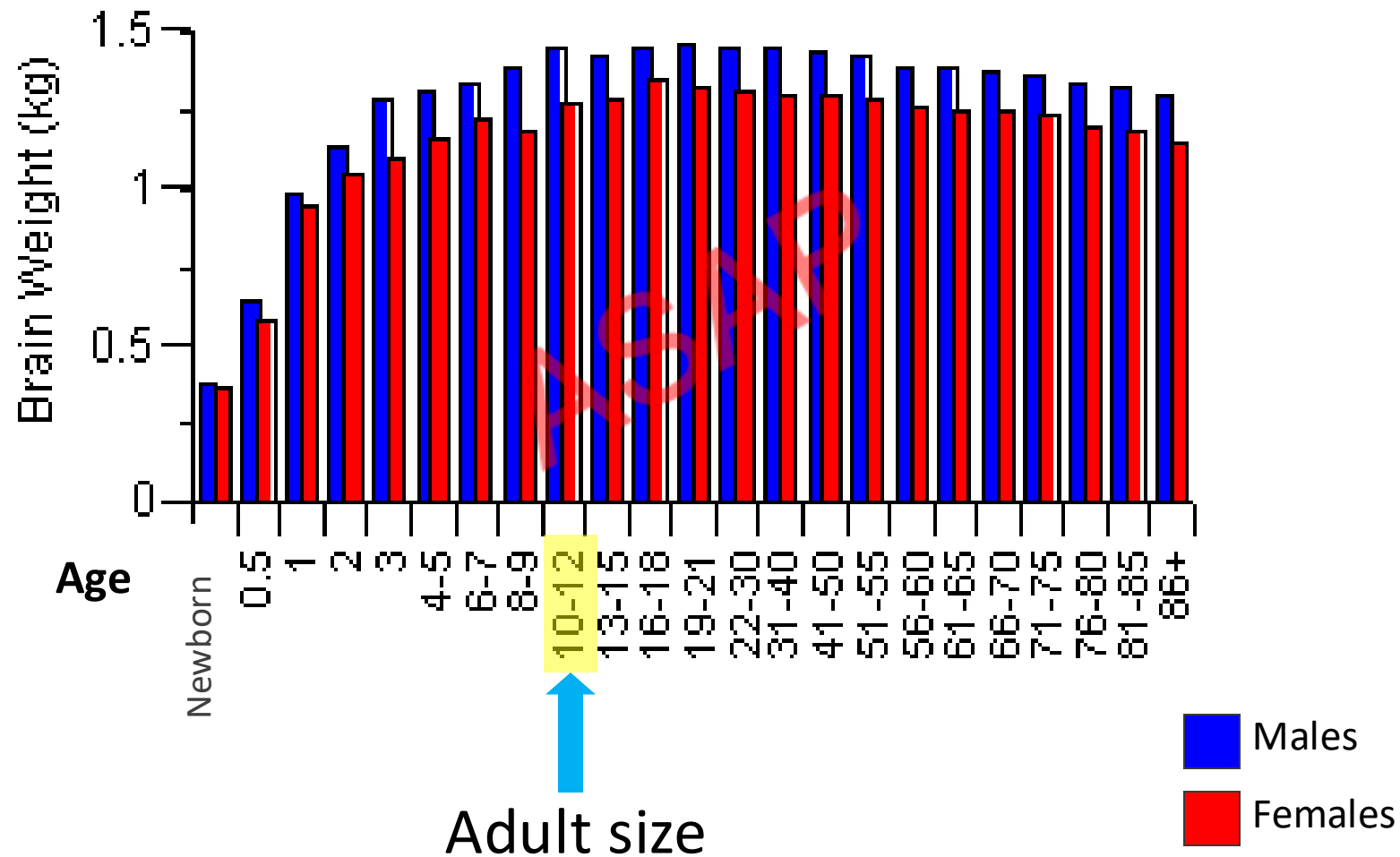


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Brain Weight by Age



Source: Dekaban, A.S. and Sadowsky, D. (1978). *Annals of Neurology*, 4:345-356.

Neuron Growth in Brain Development

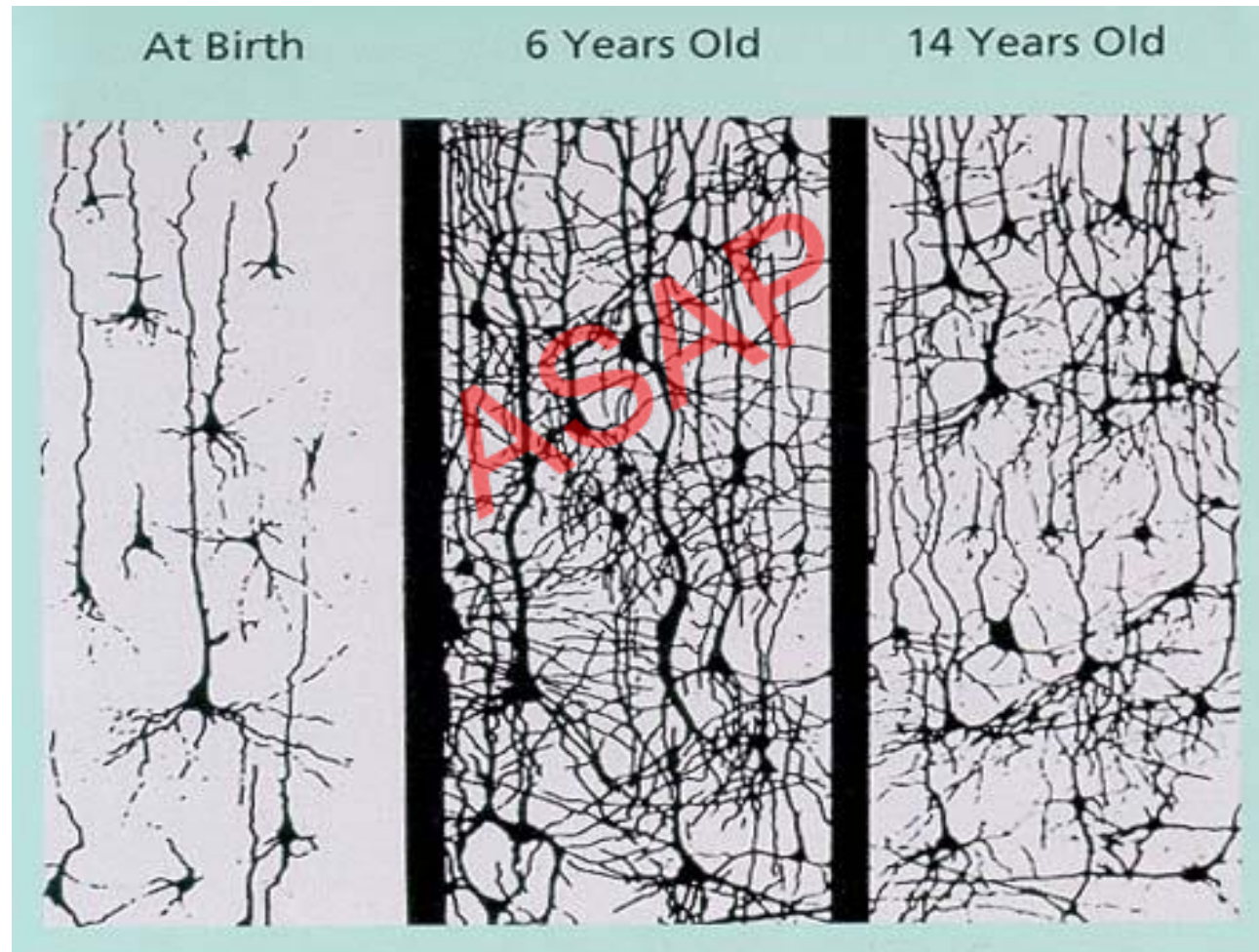
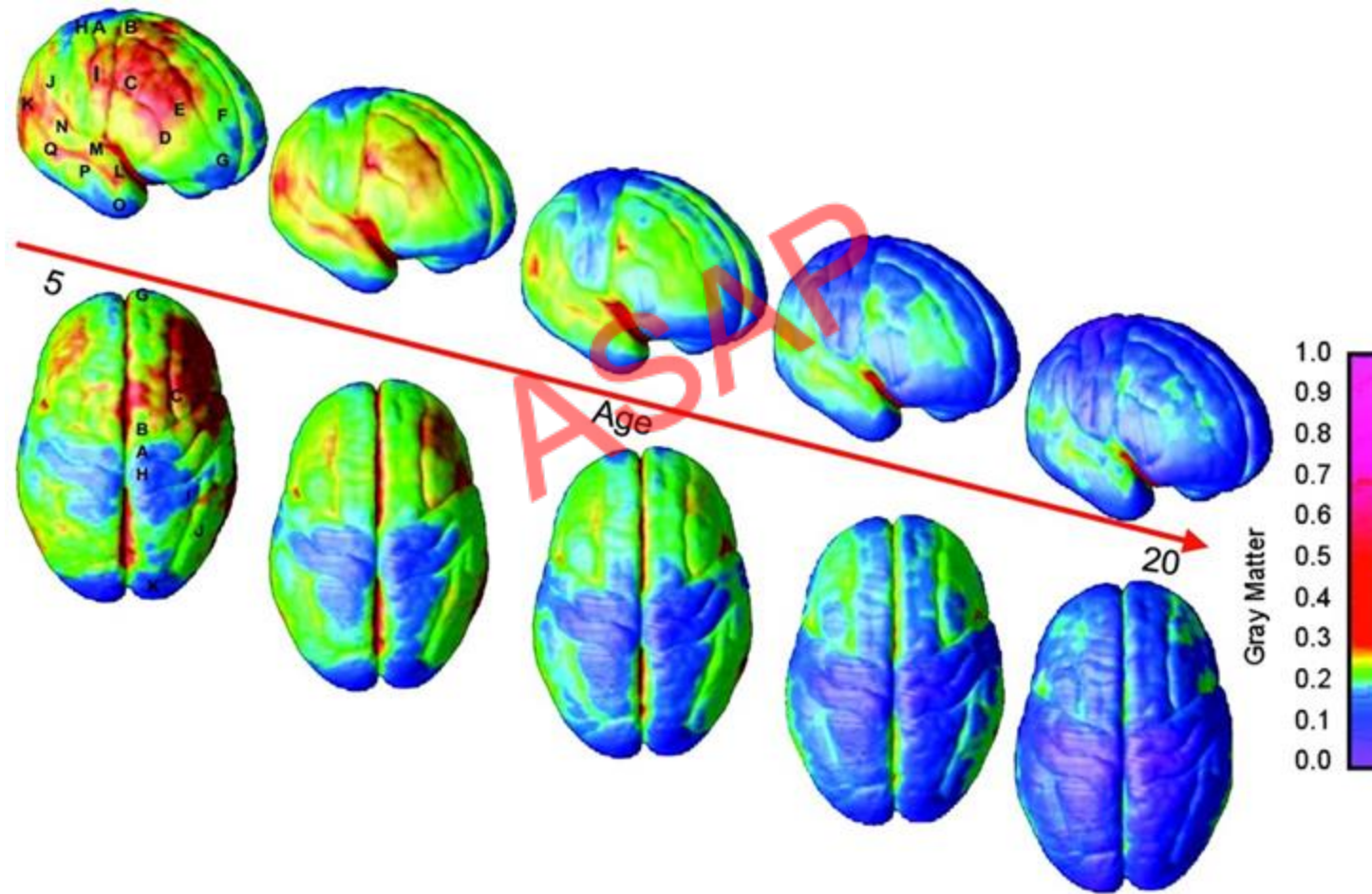
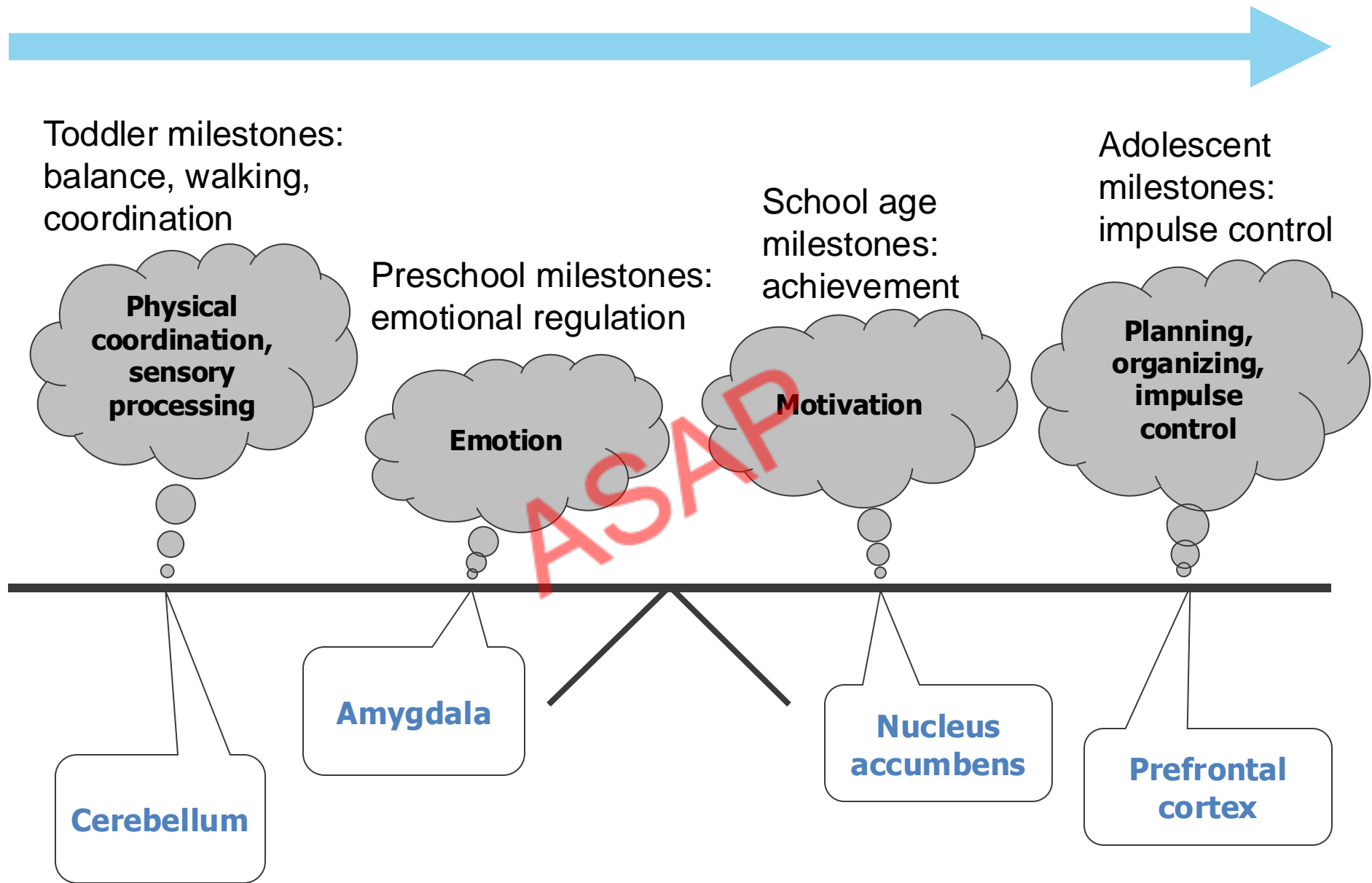
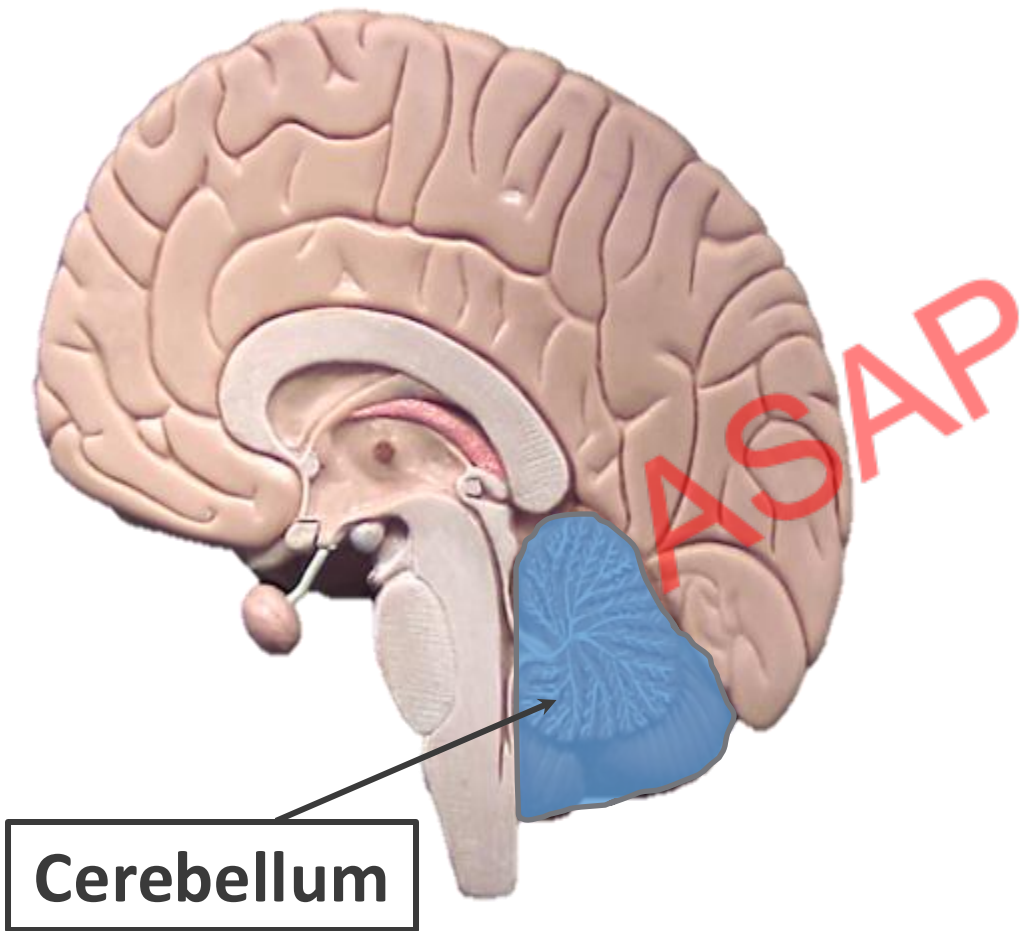


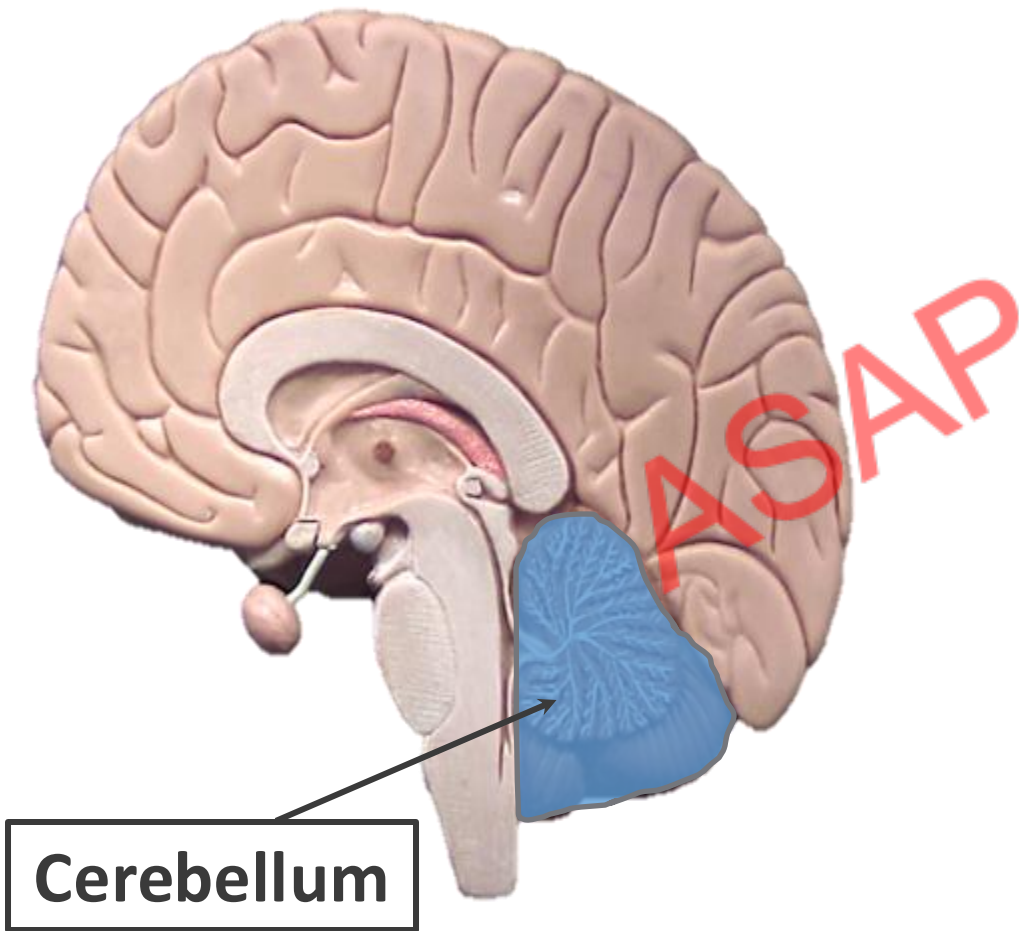
Image retrieved from: http://etec.ctlt.ubc.ca/510wiki/Brain-based_Learning

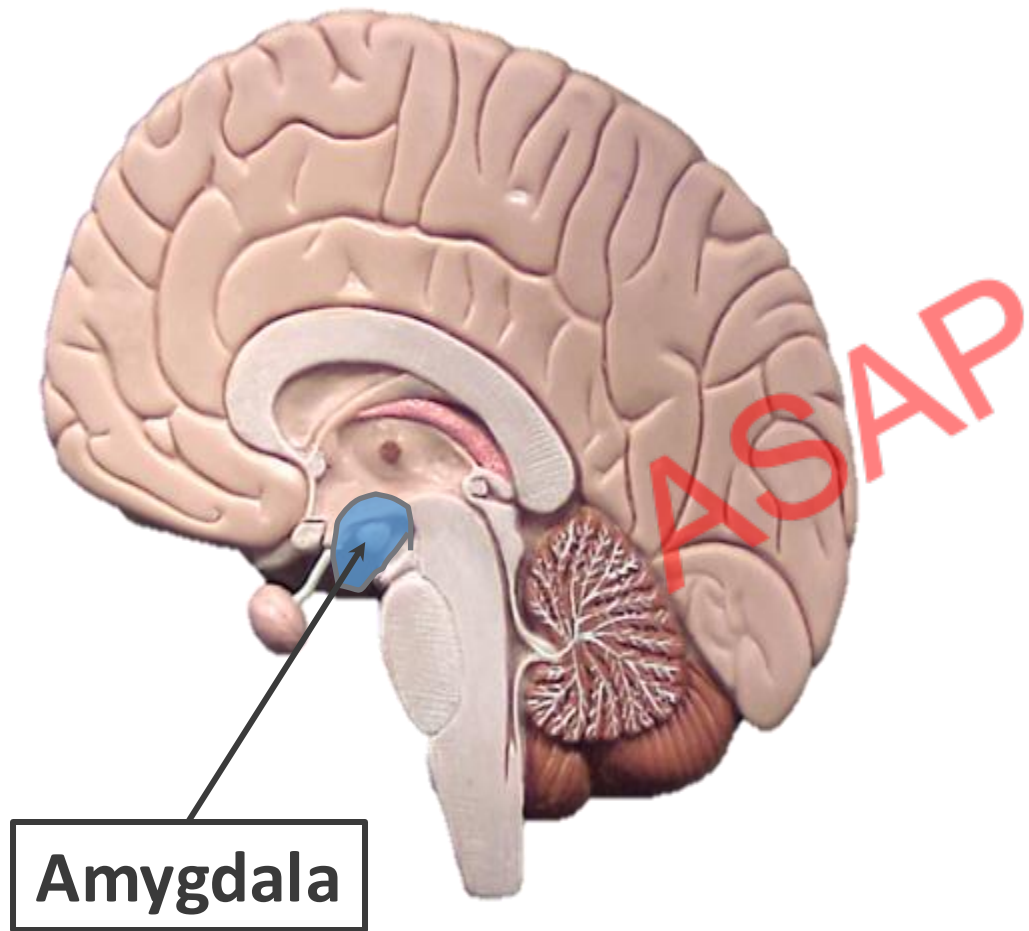
Brain Maturation

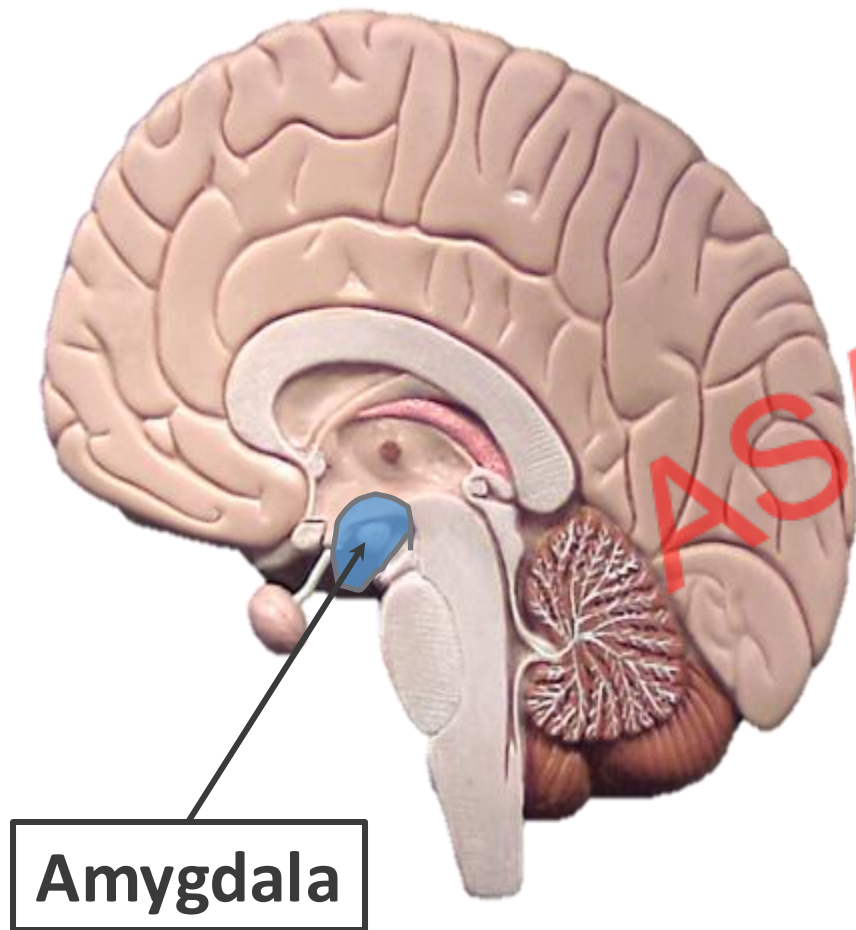


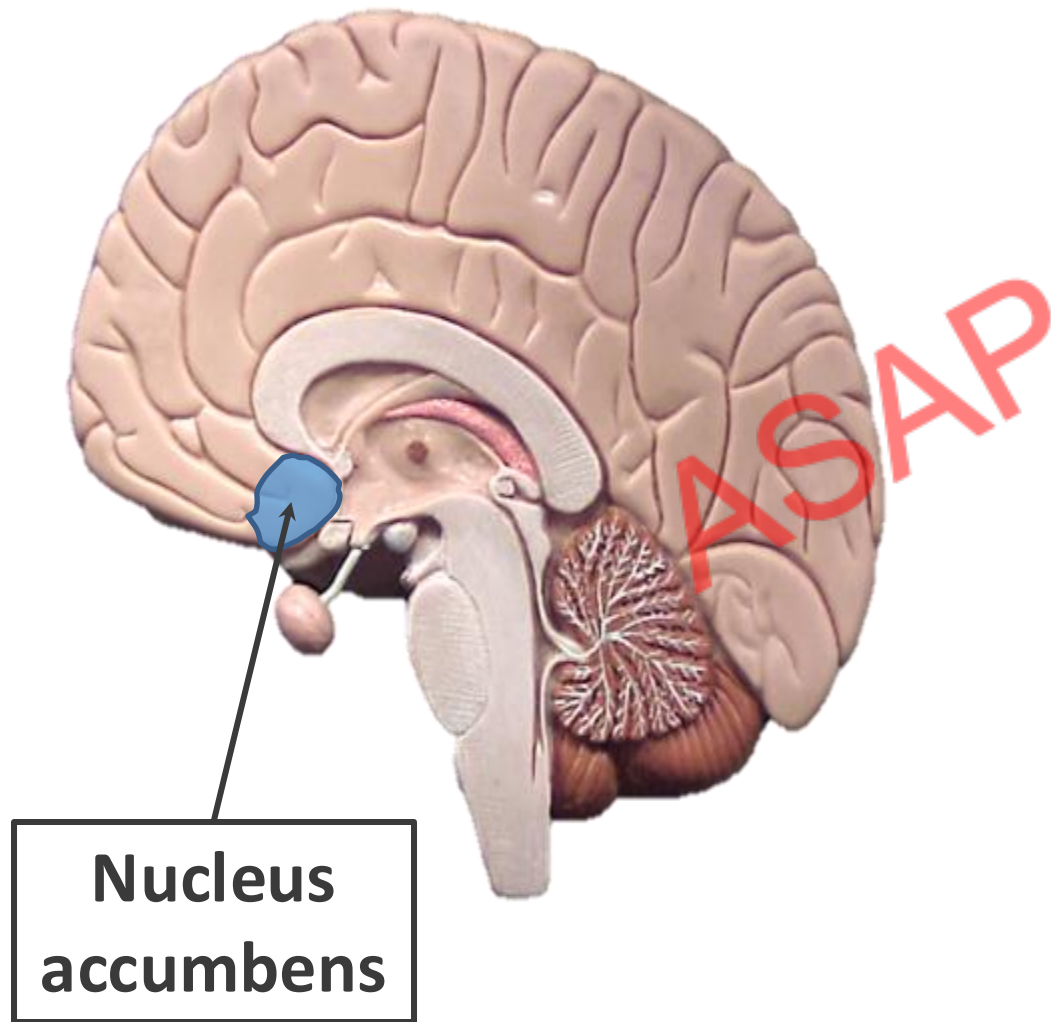


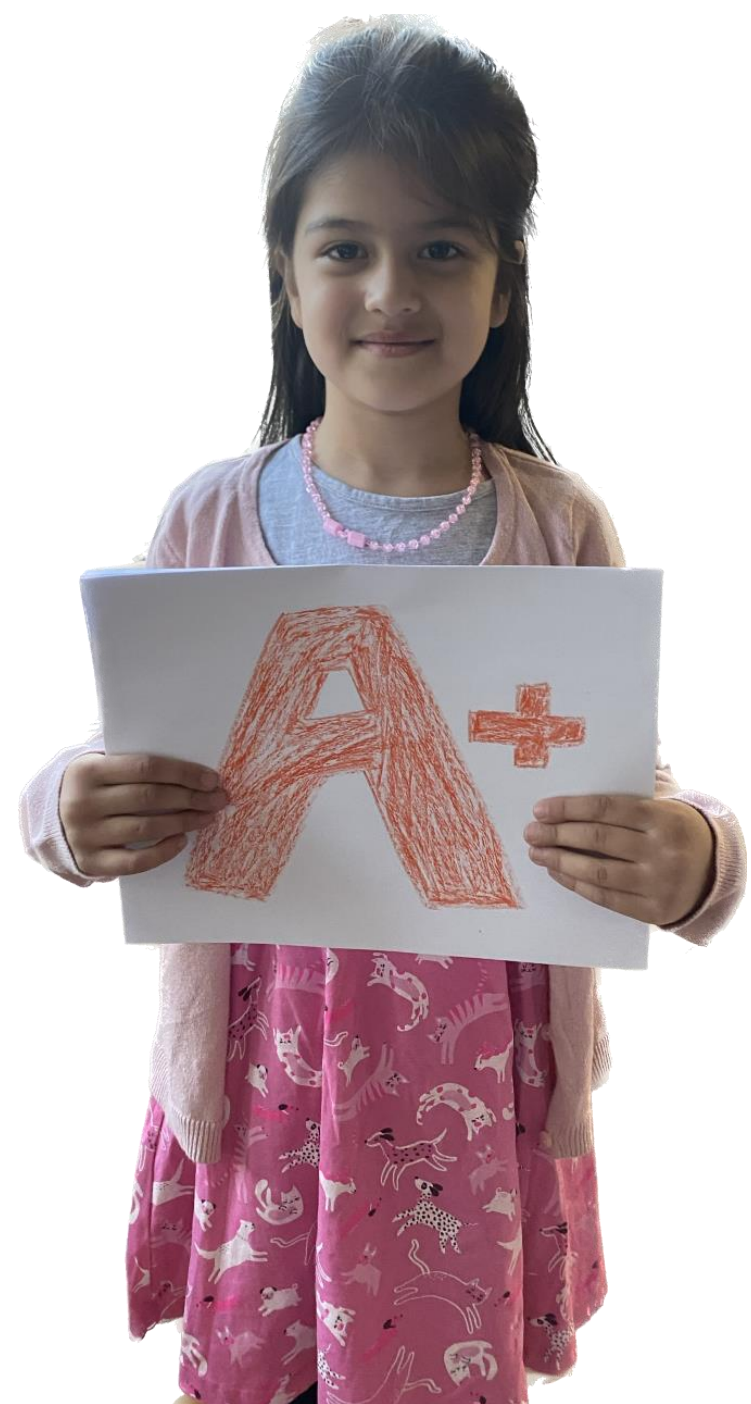
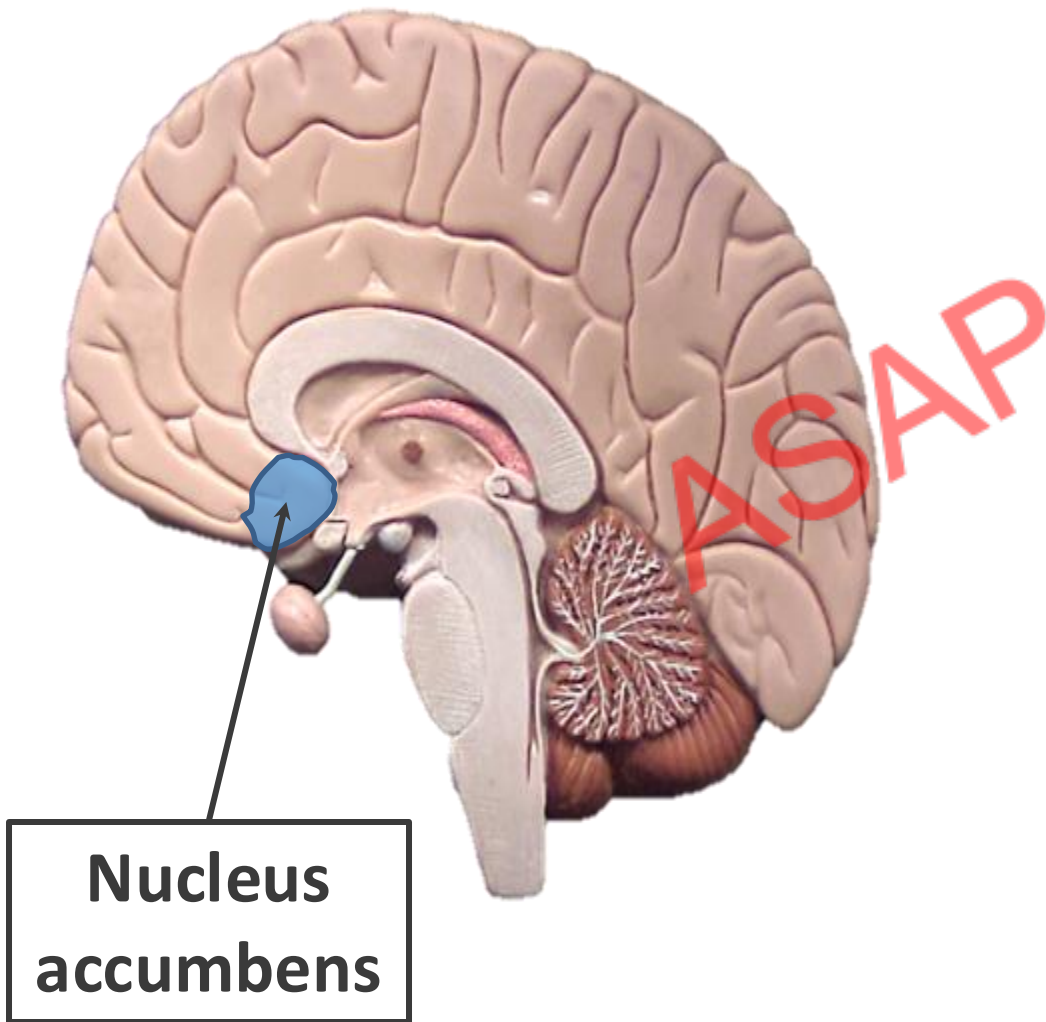


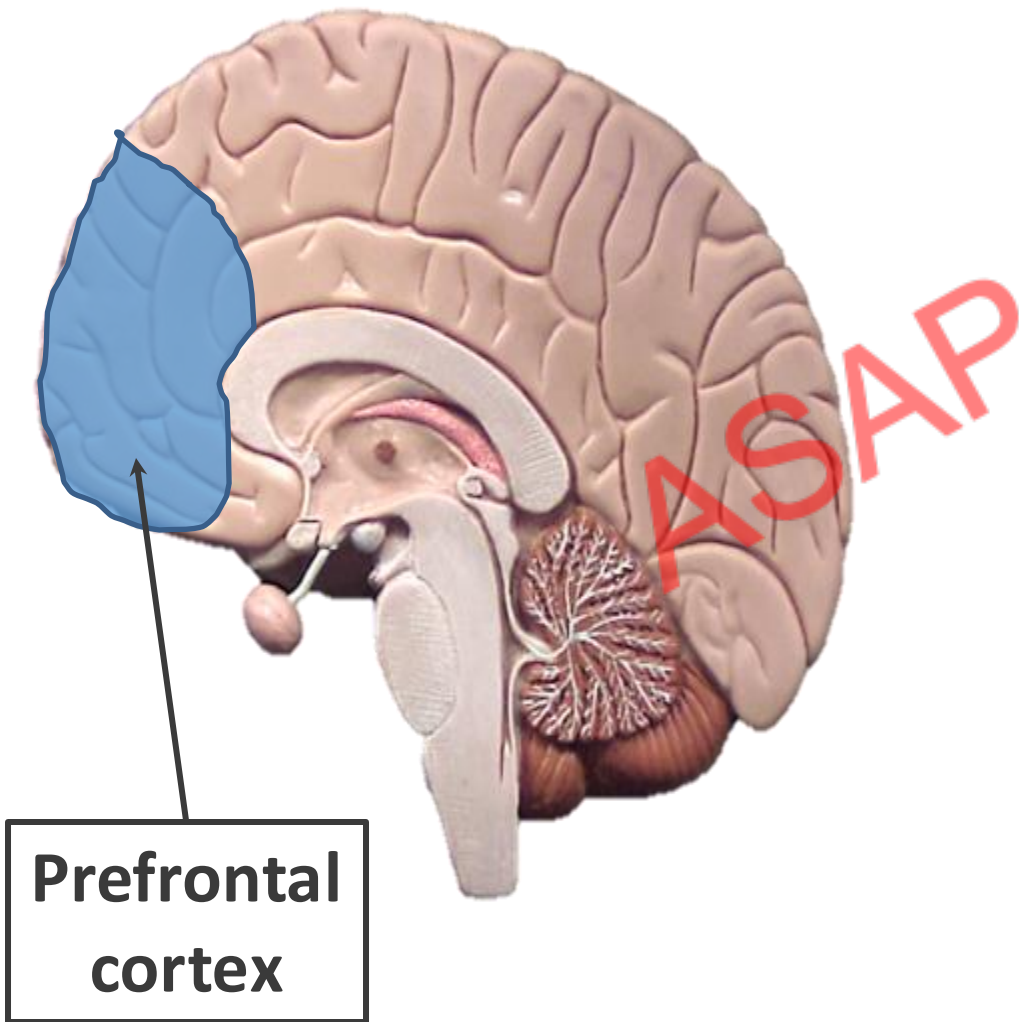


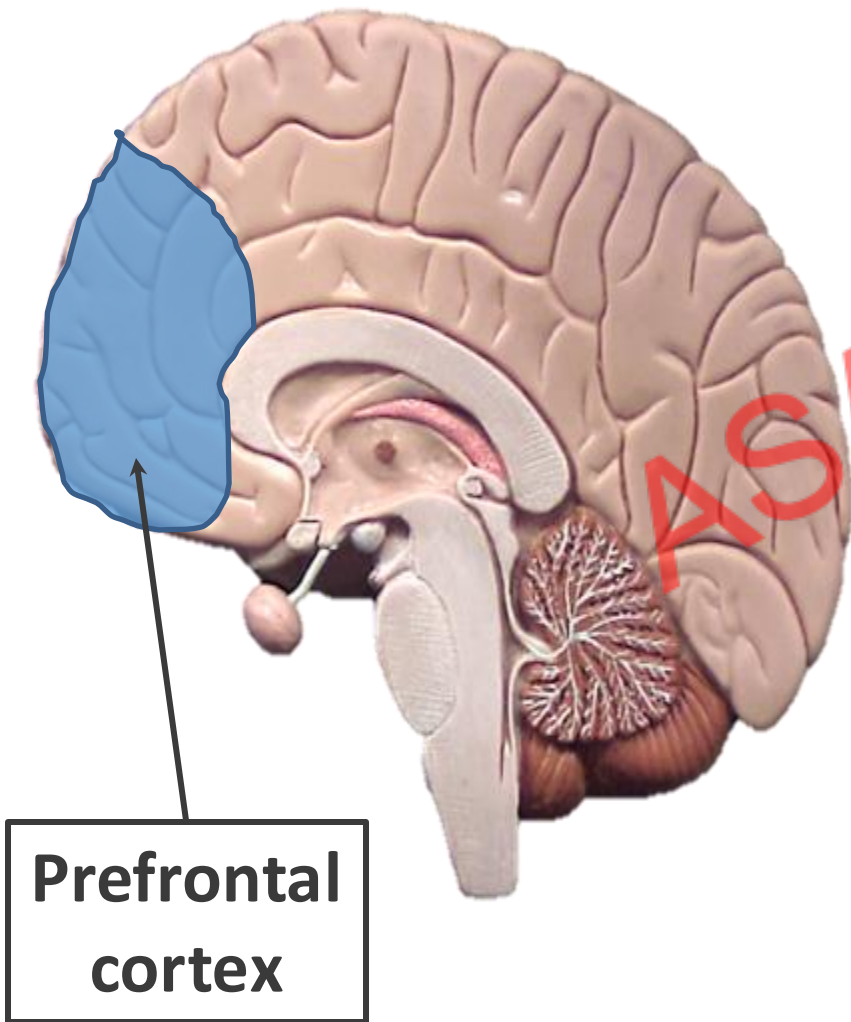


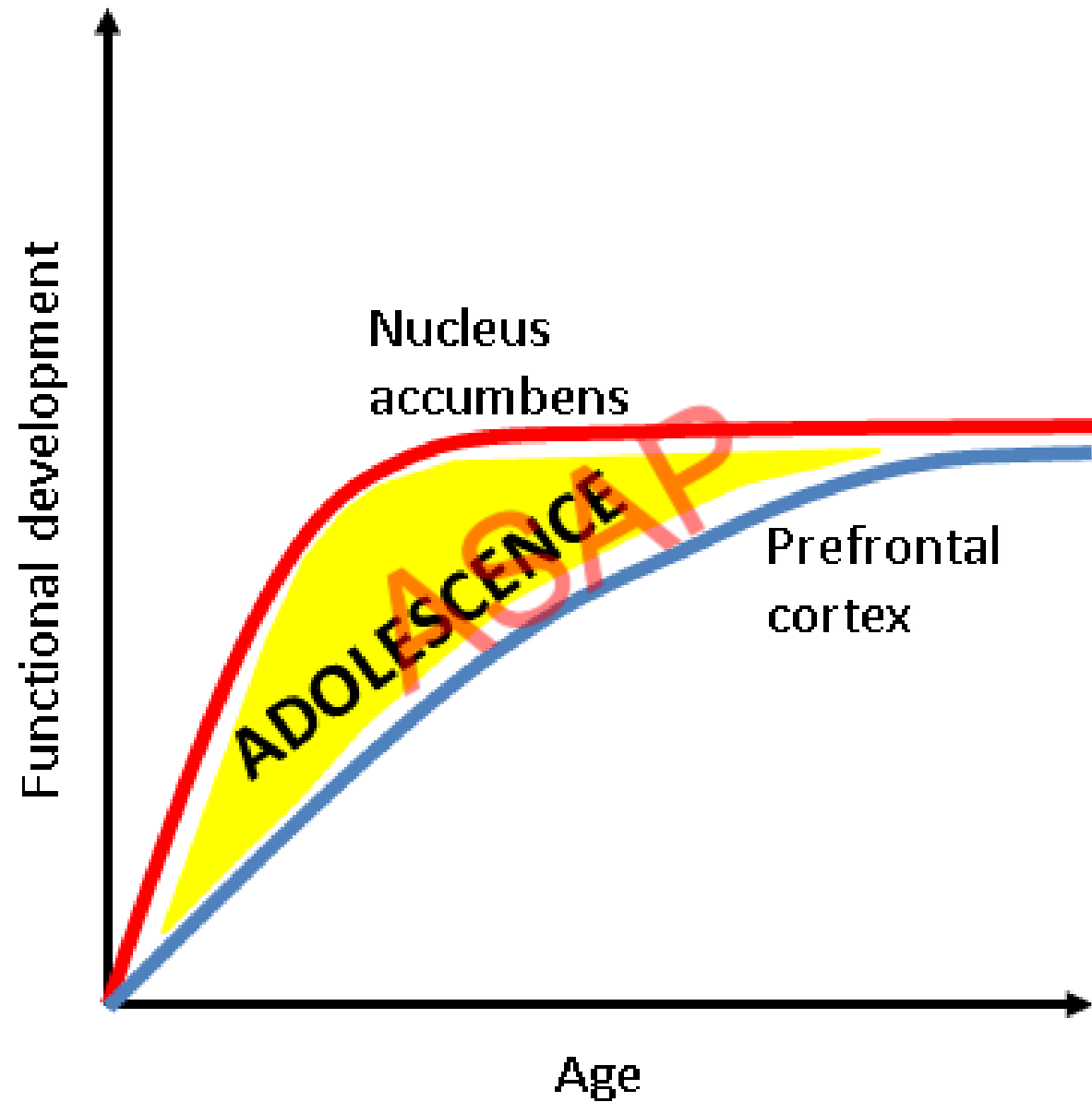


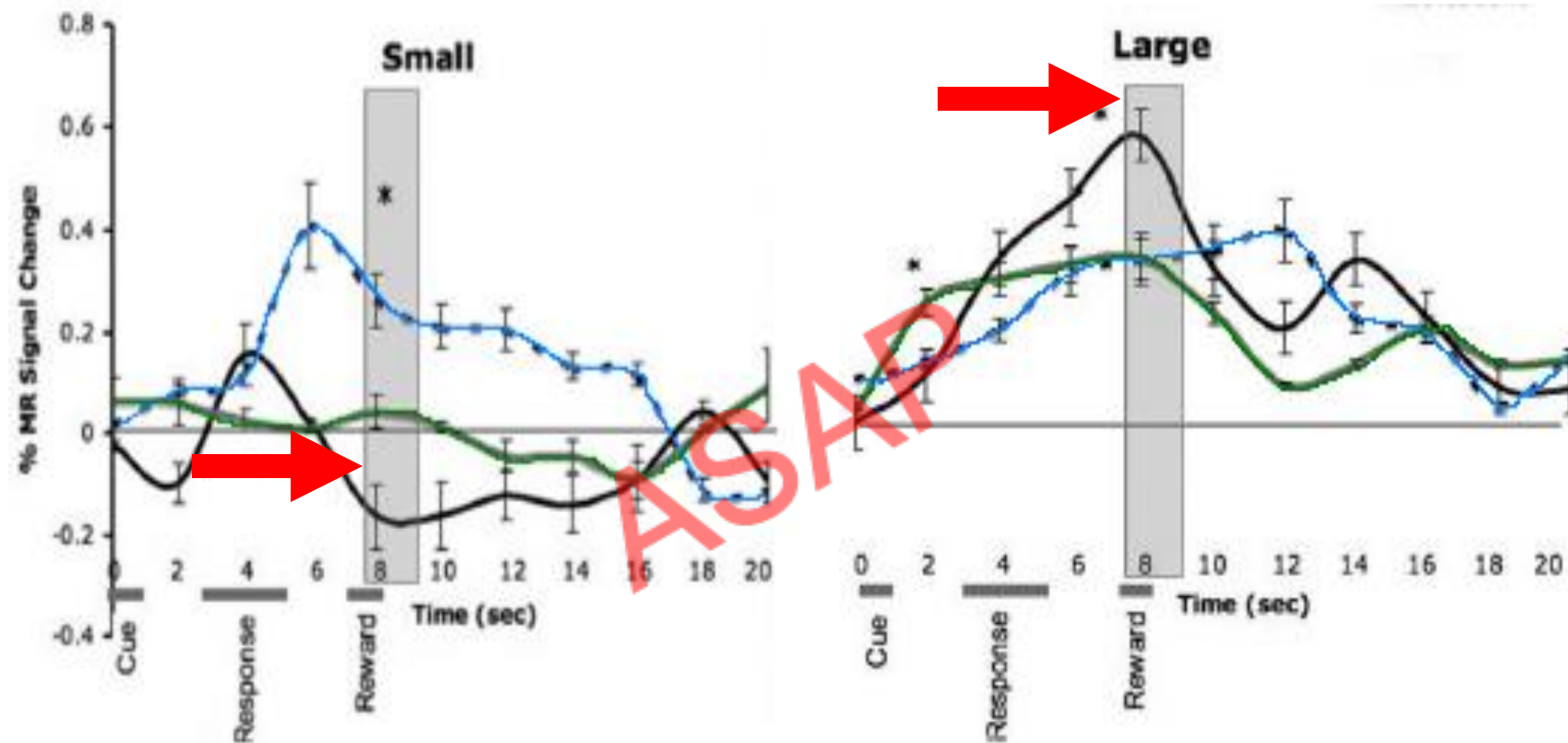










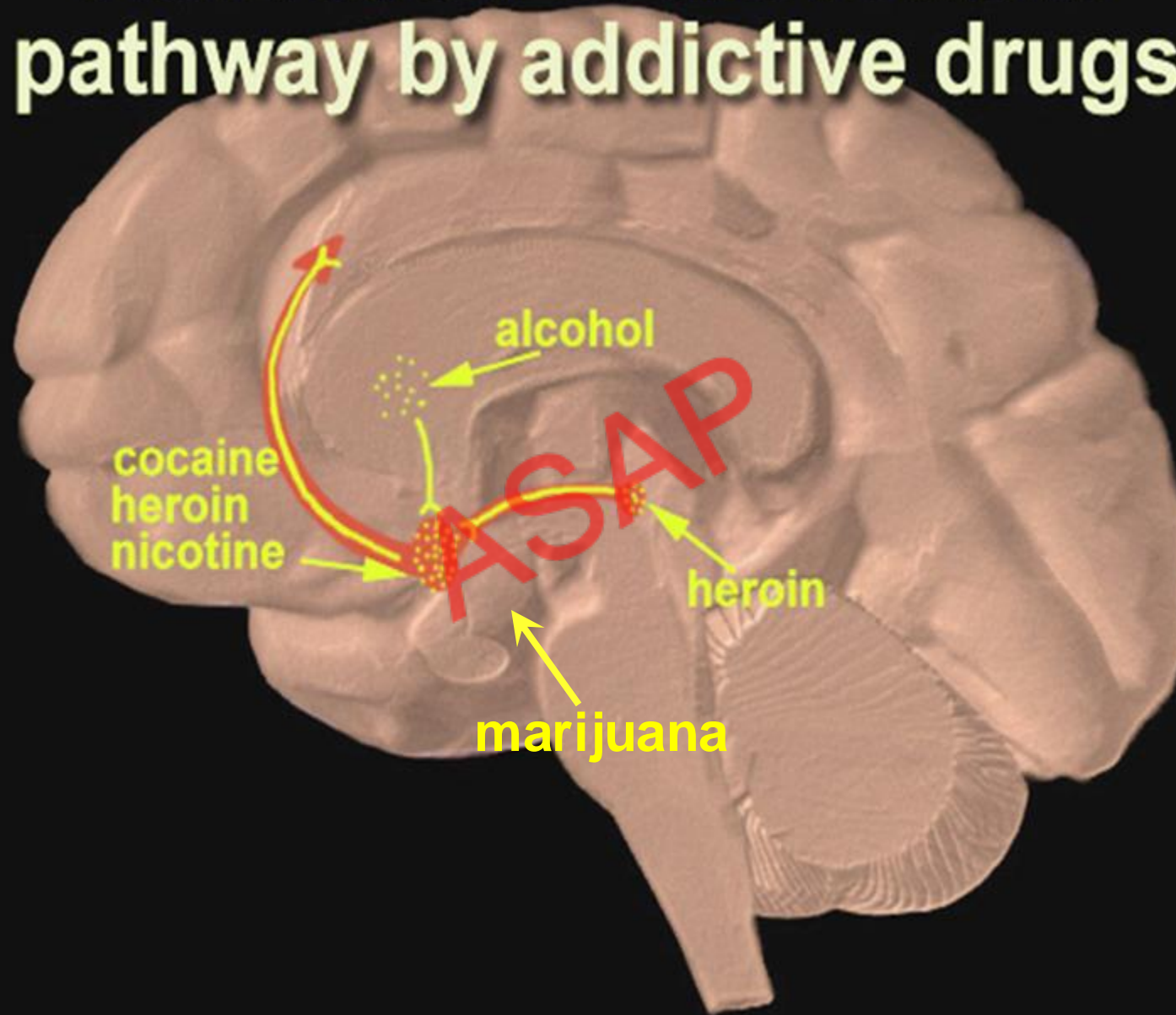


■ Children, ages 7-11

■ Teens, ages 13-17

■ Adults, ages 23-29

Activation of the reward pathway by addictive drugs

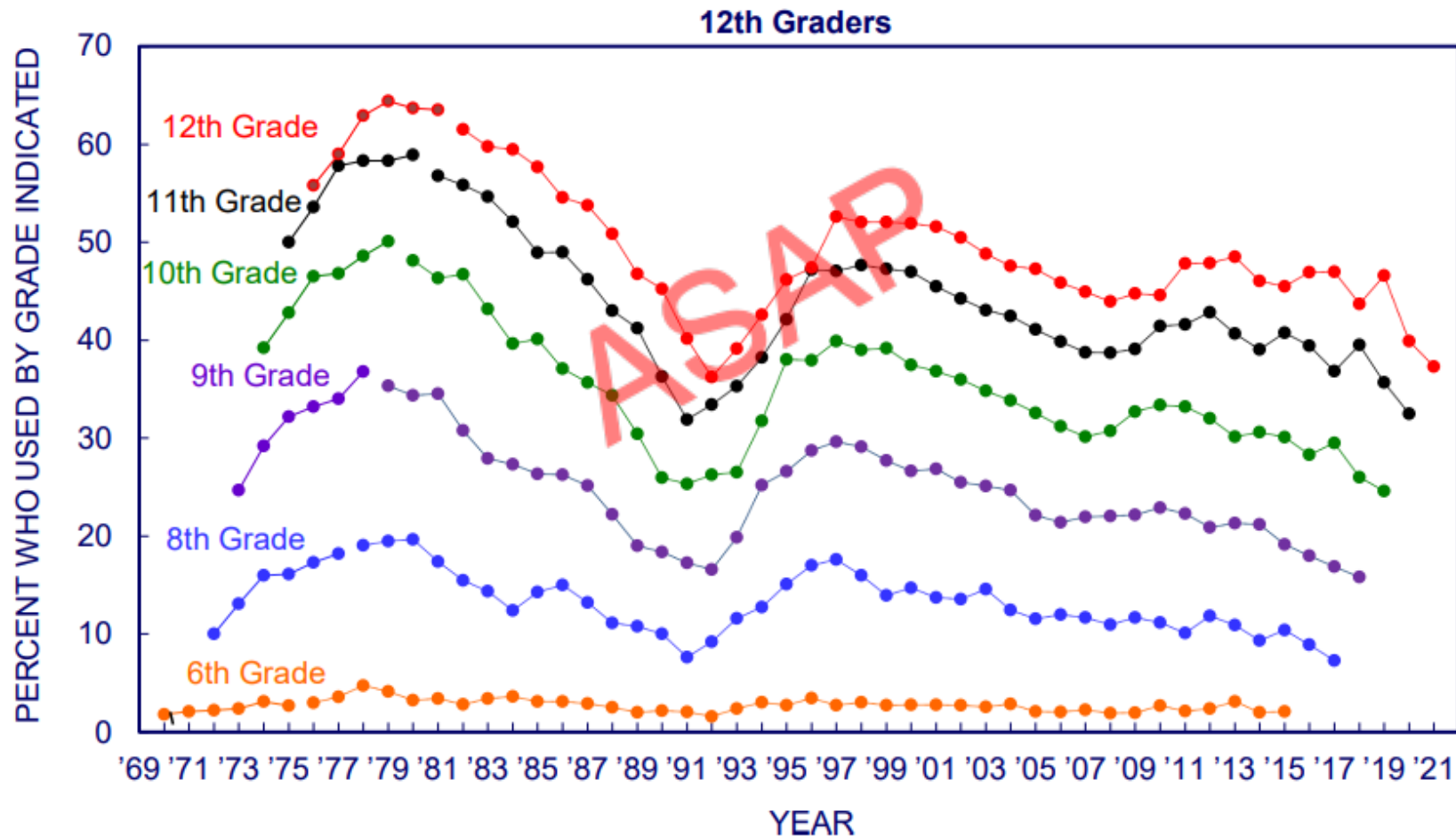


Adolescents are **Developmentally Primed** to Use Drugs



Most Drug Use Starts in Adolescence

Grade of Substance Use Initiation Reported by 12th Graders



Source. The Monitoring the Future study, the University of Michigan.

Adolescents are **Developmentally Vulnerable** to Develop Substance Use Disorders





Summary So Far:

- Adolescent development primes teens for substance use.
- All psychoactive substance use triggers dopamine release. Without the protection of the frontal cortices, adolescents are at greater risk for neurological changes associated with addiction.
- Substances each have unique impacts on other areas of the brain leading to the unique clinical picture resulting from long term use.



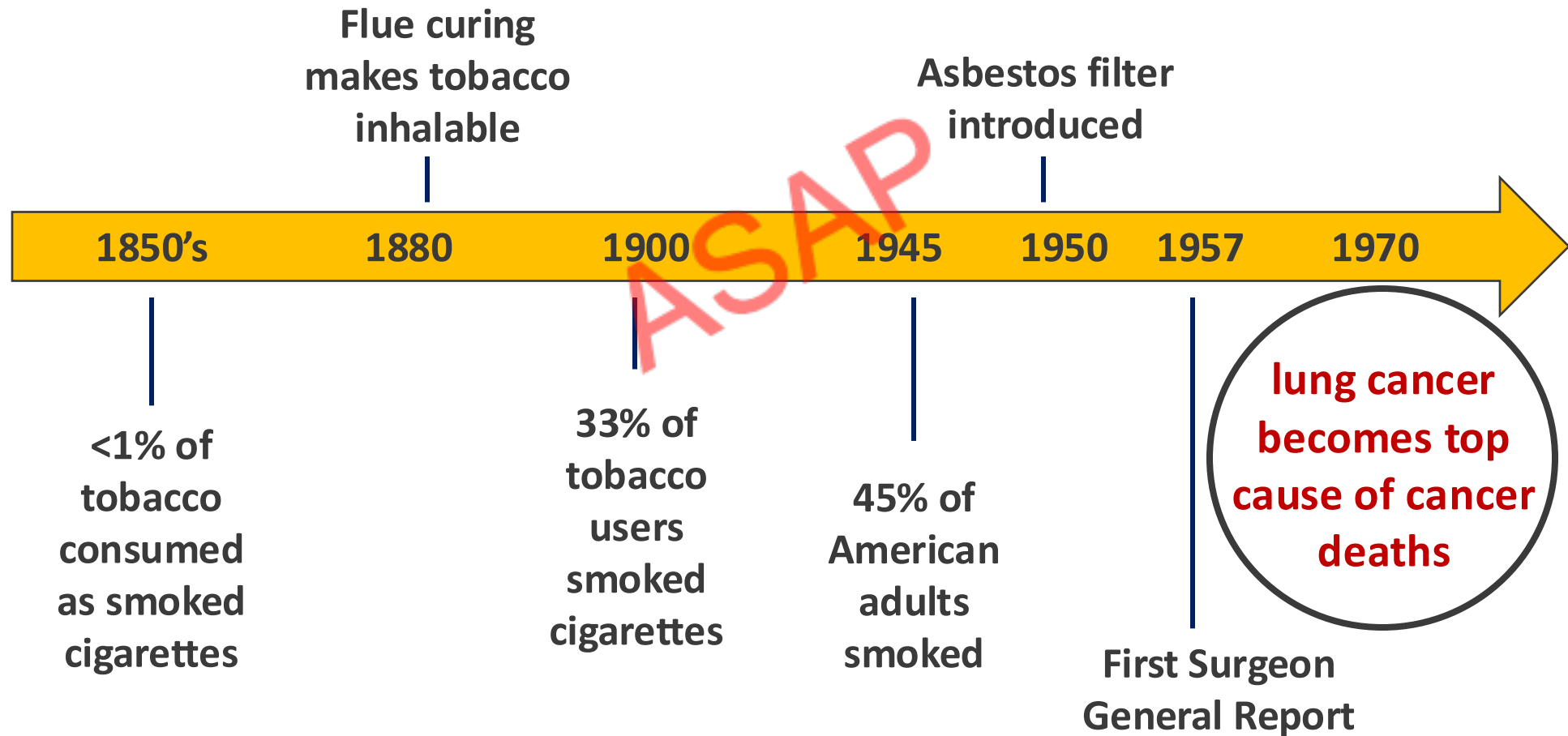
Vaping



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**Master Tobacco
Settlement Agreement**



1998

2000

2003

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**Chinese pharmacist Hon Lik
develops the first
commercially successful e-
cigarette**

E-Cigarettes

E-cigarettes
introduced to
American market



Adults: From Smoking to Vaping



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Hajek P, Phillips-Waller A, Przulj D, Pesola F, Myers Smith K, Bisal N, Li J, Parrott S, Sasieni P, Dawkins L, Ross L, Goniewicz M, Wu Q, McRobbie HJ. A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy. *N Engl J Med*. 2019 Feb 14;380(7):629-637. doi: 10.1056/NEJMoa1808779. Epub 2019 Jan 30. PMID: 30699054.



Adolescents: From Vaping to Smoking and Beyond



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Teens that Vape Use More Alcohol, MJ and Other Drugs



5.8X



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6.5X



3.0X

Source: Curran KA, Burk T, Pitt PD, Middleman AB. Trends and Substance Use Associations With E-Cigarette Use in US Adolescents. 2015. *Clinical Pediatrics*.

Gateway to Opioid Misuse



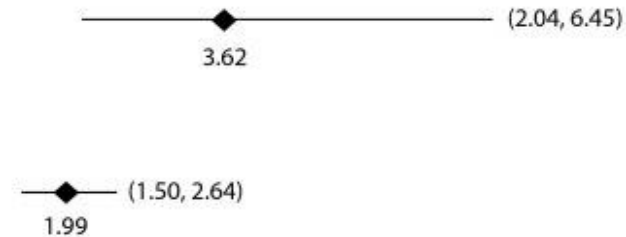
Transition to Cigarettes

Adjusted Odds Ratios of E-Cigarette Use Prediction Intention to Smoke: National Youth Tobacco Survey, United States, 2012

Predicting intention to smoke cigarettes:

Youths who never smoked cigarettes but used e-cigarettes before (vs youths who never smoked cigarettes and never used e-cigarettes before)

Youths who experimented smoking cigarettes and used e-cigarettes before (vs youths who experimented smoking cigarettes but never used e-cigarettes before)



Youth who have vaped are 2-4 times more likely to start smoking cigarettes.

Transition to Cigarettes

“It is important to know as much as possible about teenage smoking patterns and attitudes. Today’s teenager is tomorrow’s potential regular customer and the overwhelming majority of smokers first begin to smoke while in their teens. . . . The smoking patterns of teen-agers are particularly important to Philip Morris.”

- March 31, 1981 market research report on young smokers written by Philip Morris

****Philip Morris manufactures Marlboro Cigarettes and is owned by Altria,
the same company that owns Juul**

E-Cigarettes and Vaping



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Vape Pen



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JUUL is introduced

|

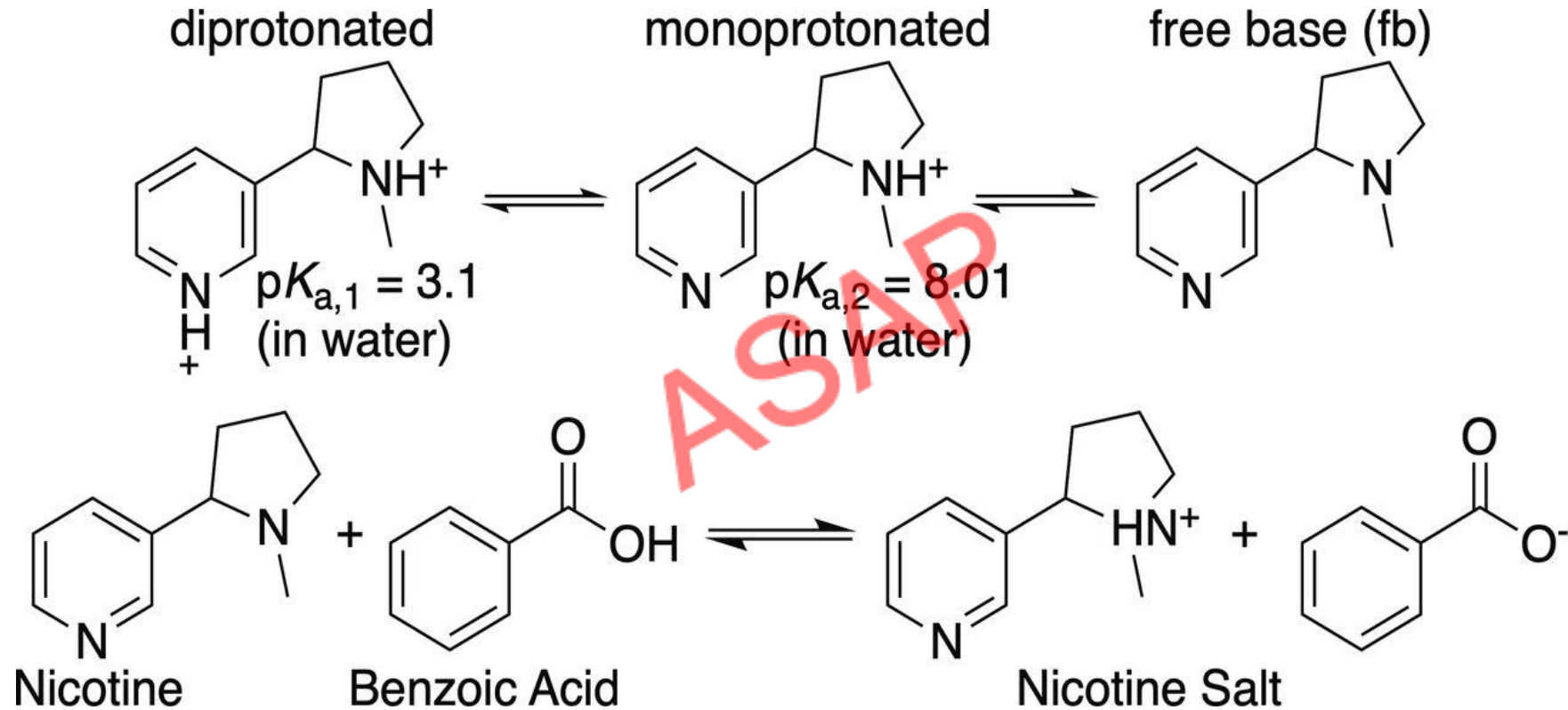
2015



Pod Devices



Innovations to nicotine



Duell AK, Pankow JF, Peyton DH Nicotine in tobacco product aerosols: 'It's déjà vu all over again' Tobacco Control 2020;29:656-662.

Innovations to the base



Vegetable Glycerine



Vaping Dictionary

- Nicked
- French inhale
- Ghosting
- Stacking
- Blinking
- Nic sick



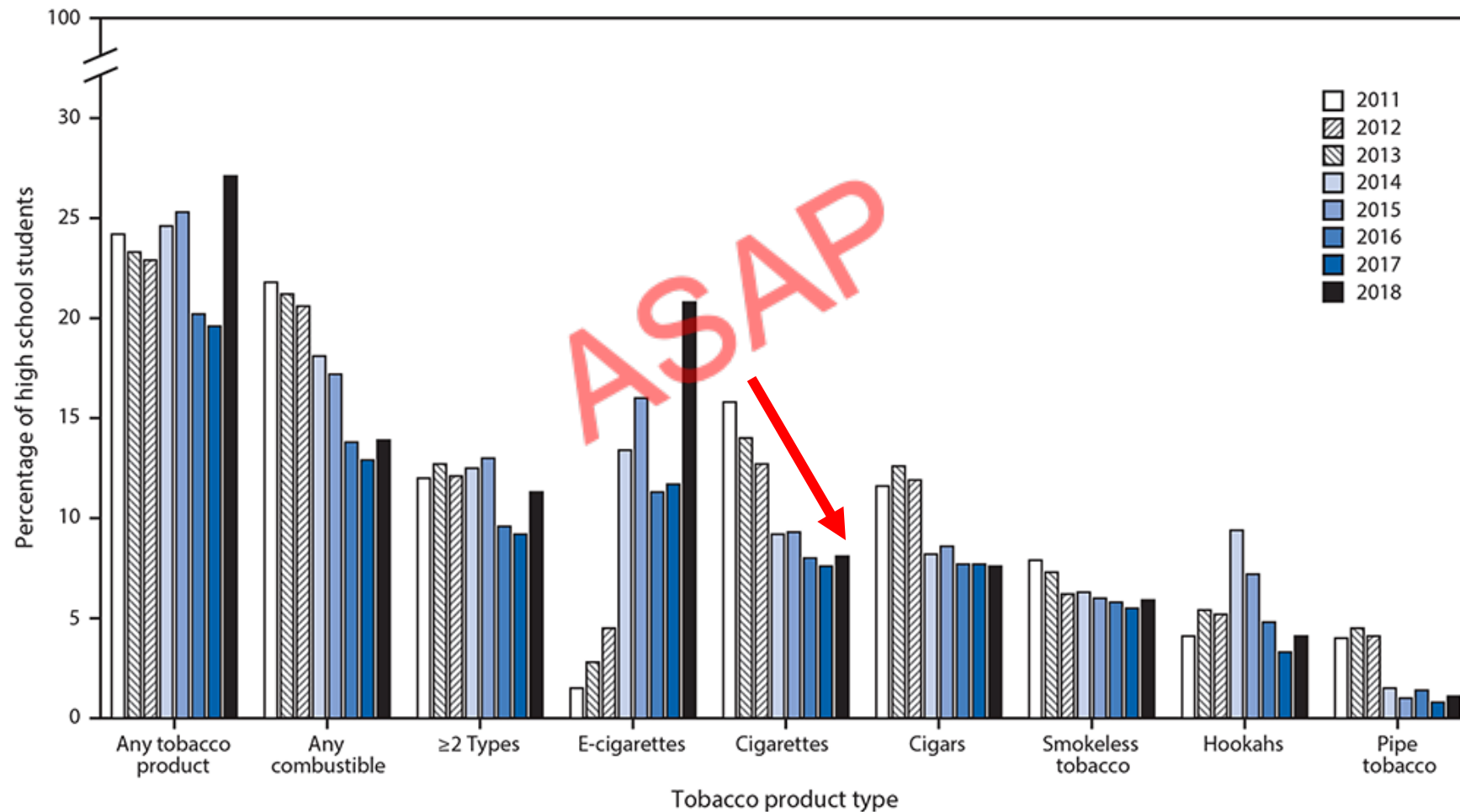
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Marketing



HS student use of tobacco products

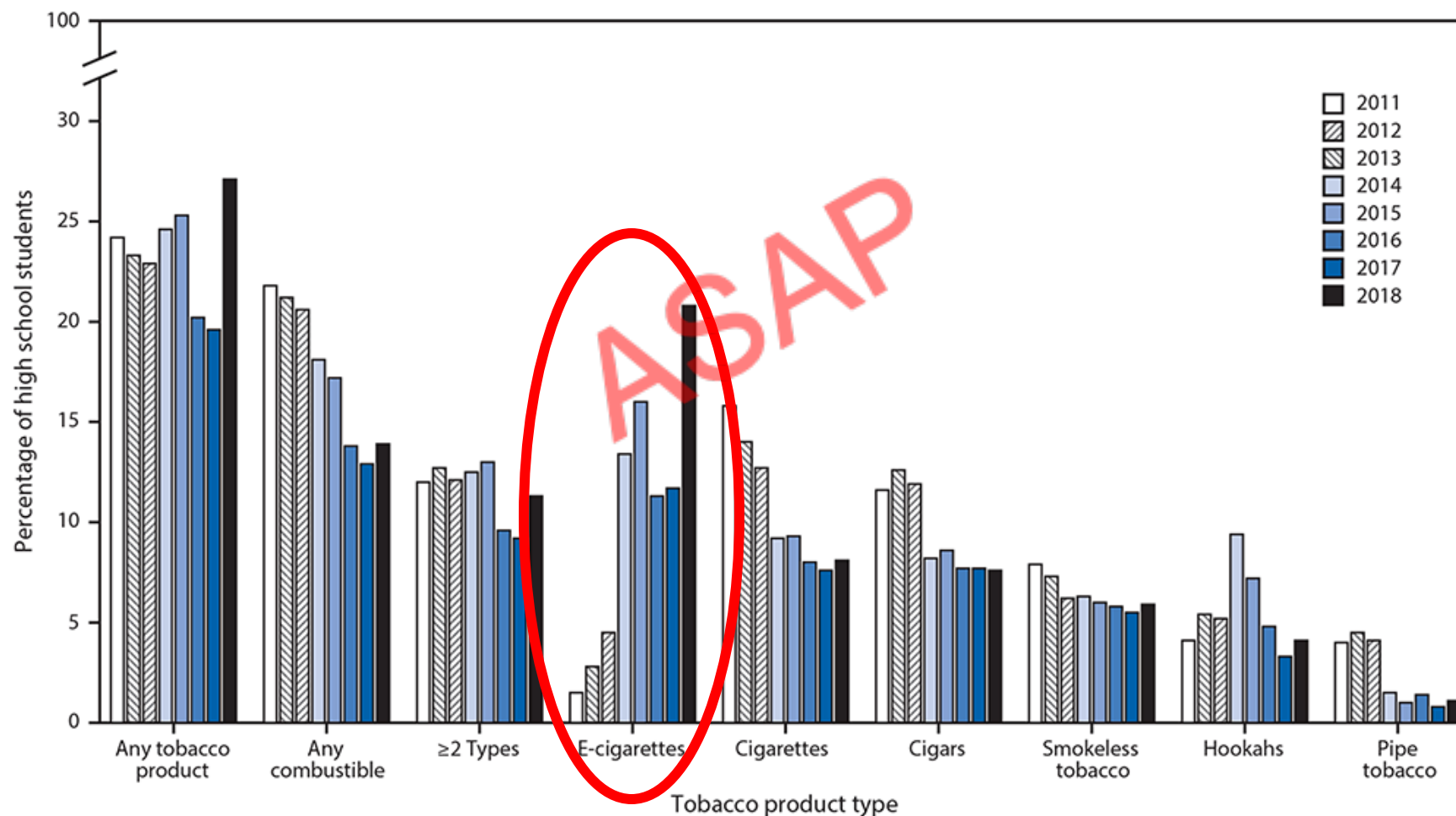
FIGURE 2. Estimated percentage of high school students who currently use any tobacco product,* any combustible tobacco product,[†] ≥2 tobacco product types,[§] and selected tobacco products — National Youth Tobacco Survey, 2011–2018^{¶,**,††}



Source: Gentzke AS, Creamer M, Cullen KA, et al. *Vital Signs: Tobacco Product Use Among Middle and High School Students — United States, 2011–2018*. MMWR Morb Mortal Wkly Rep 2019;68:157–164. DOI: <http://dx.doi.org/10.15585/mmwr.mm6806e1>

HS student use of tobacco products

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Past 30 day vaping **DOUBLED** from 2017-2018

Trends in 30-Day Prevalence of Use of Various Drugs in Grades 8, 10, and 12

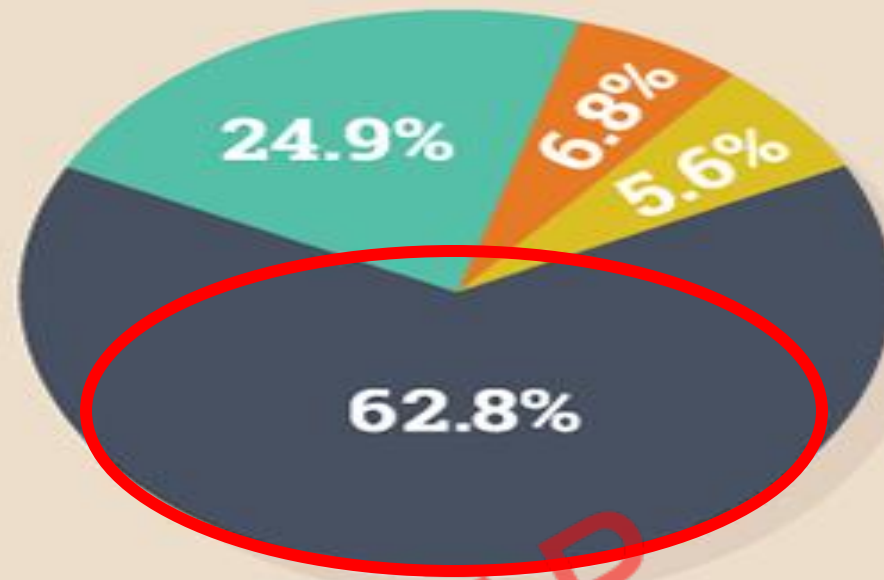
Vaping Nicotine ^{bb}	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2017 – 2018 change</u>
8 th Grade	—	3.5	6.1	+2.6 sss
10 th Grade	—	8.2	16.1	+7.9 sss
12 th Grade	—	11.0	20.9	+10.0 sss

Source: <http://www.monitoringthefuture.org/pubs/monographs/mtf-overview2018.pdf>

700% increase in vaping in US teenagers and young adults



FDA Commissioner Scott Gottlieb declares youth vaping an epidemic



What did 12th graders think was in the mist they inhaled from an e-cigarette? Despite the belief that the liquid used in e-cigs contains only flavoring, it also might contain nicotine.

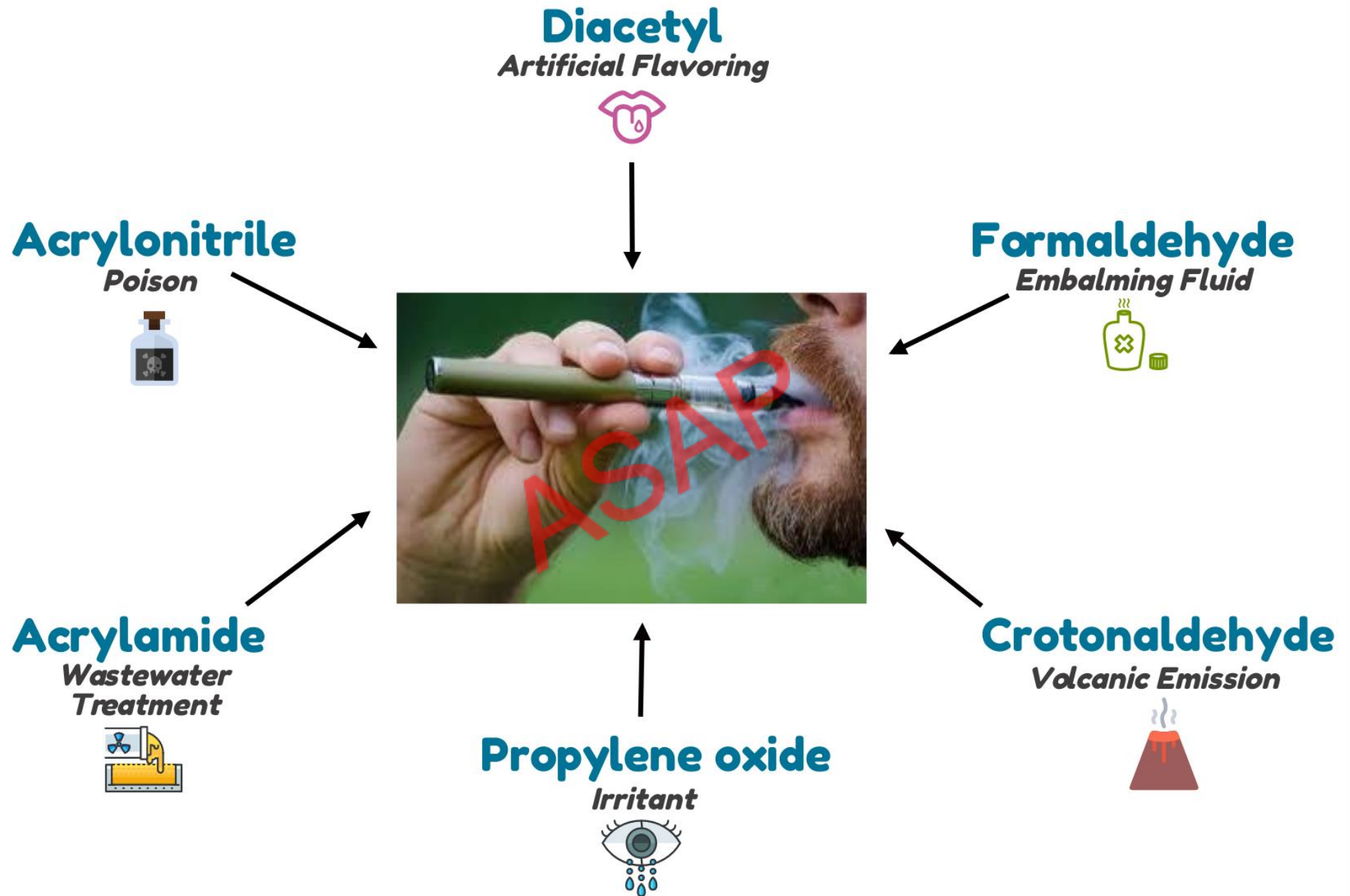


Source: <https://www.drugabuse.gov/related-topics/trends-statistics/infographics/monitoring-future-2016-survey-results>

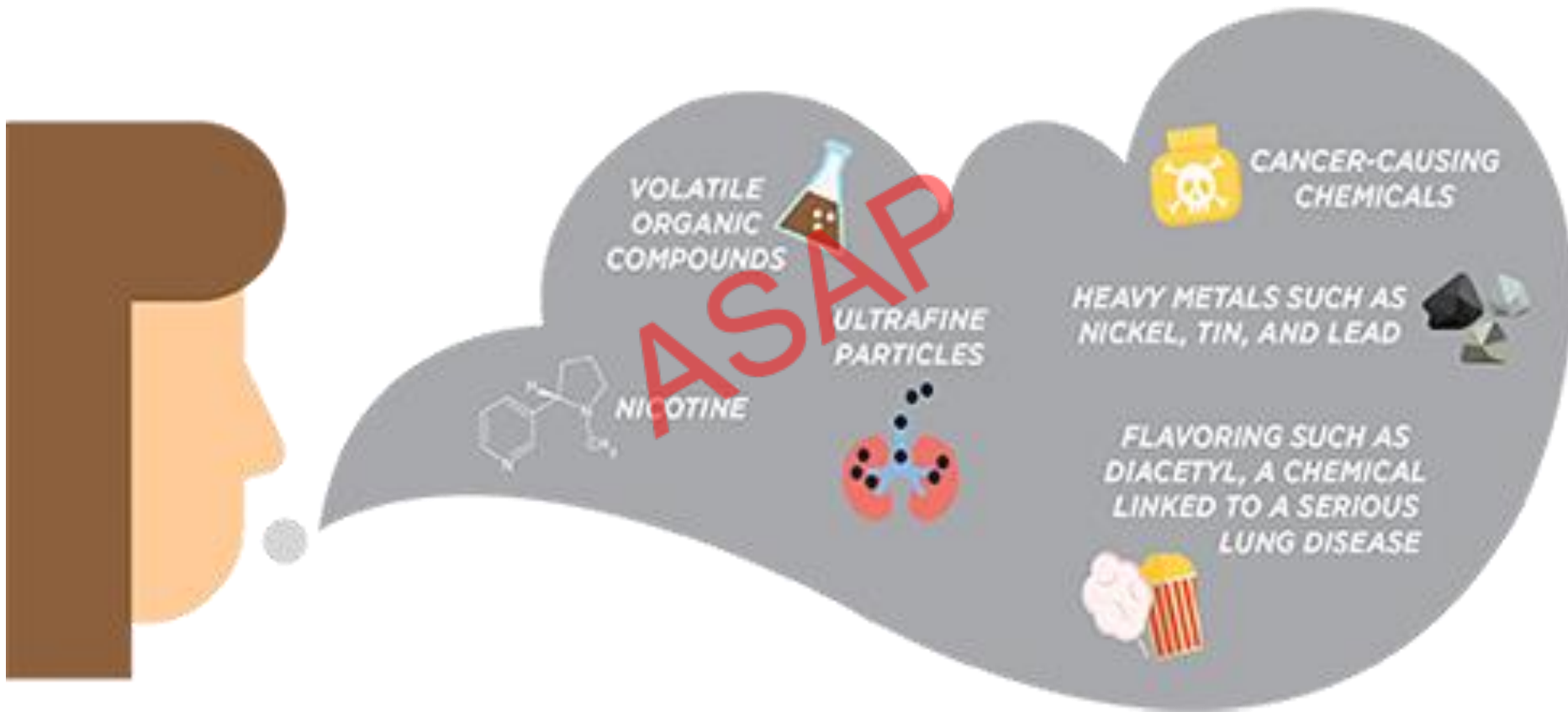
Vaping

Parts of an Electronic Cigarette





Reality: There are Risks of Vaping

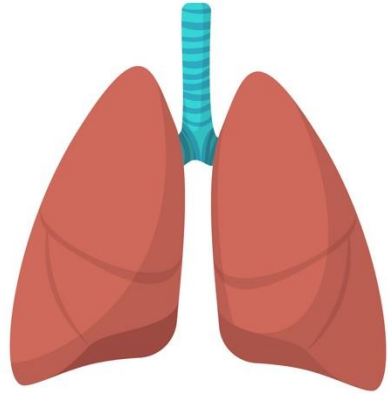




Propylene Glycol

Komura, M., Sato, T., Yoshikawa, H. *et al.* Propylene glycol, a component of electronic cigarette liquid, damages epithelial cells in human small airways. *Respir Res* **23**, 216 (2022). <https://doi.org/10.1186/s12931-022-02142-2>

E-Cigarette/Vaping Associated Lung Injury (EVALI)



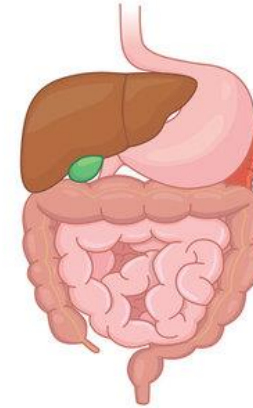
97% respiratory symptoms:

- Shortness of breath
- Chest pain
- Cough
- Coughing up blood



100% generalized symptoms:

- Subjective fever
- Chills
- Weight loss
- Fatigue

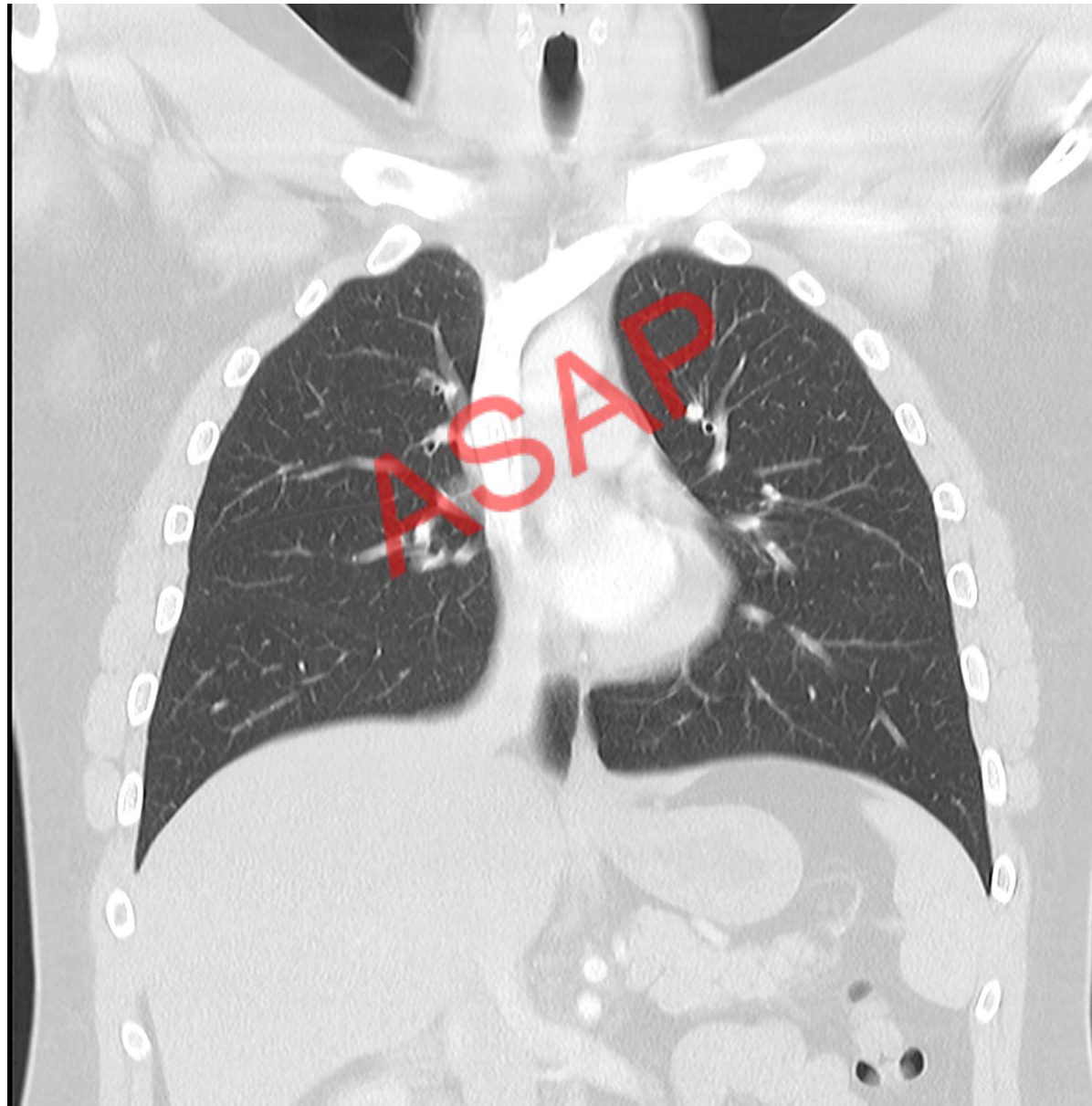


77% GI symptoms:

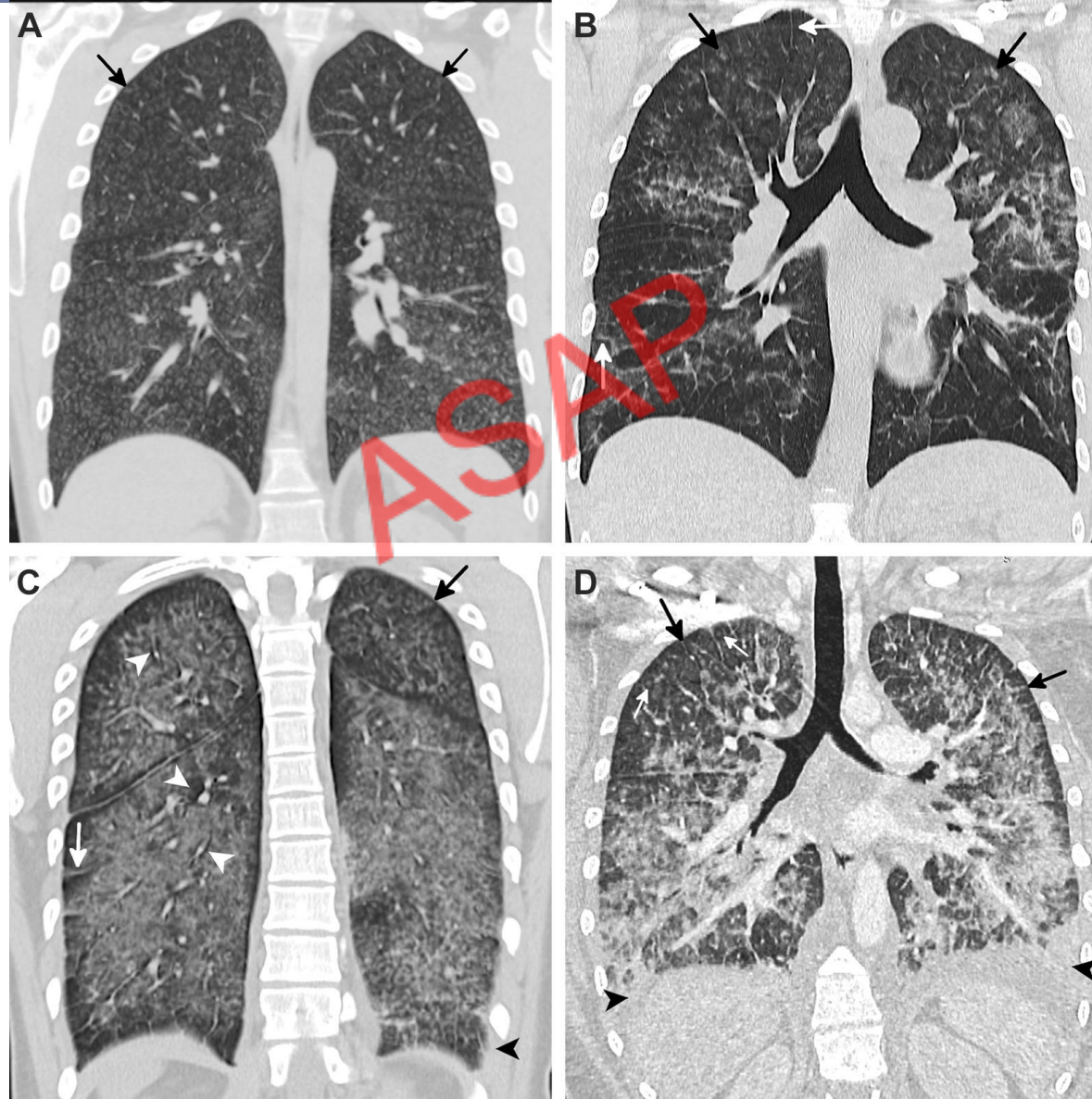
- Nausea
- Vomiting
- Diarrhea
- Abdominal Pain



For Context: Healthy Lungs



E-Cigarette/Vaping Associated Lung Injury



E-Cigarette and Mental Health

Depression
Suicidal Ideation
Suicidal Attempt
Anxiety
Impulse Control

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Javed S, Usmani S, Sarfraz Z, Sarfraz A, Hanif A, Firoz A, Baig R, Sharath M, Walia N, Chérrez-Ojeda I, Ahmed S. A Scoping Review of Vaping, E-Cigarettes and Mental Health Impact: Depression and Suicidality. J Community Hosp Intern Med Perspect. 2022 May 2;12(3):33-39. doi: 10.55729/2000-9666.1053. PMID: 35711397; PMCID: PMC9195082.

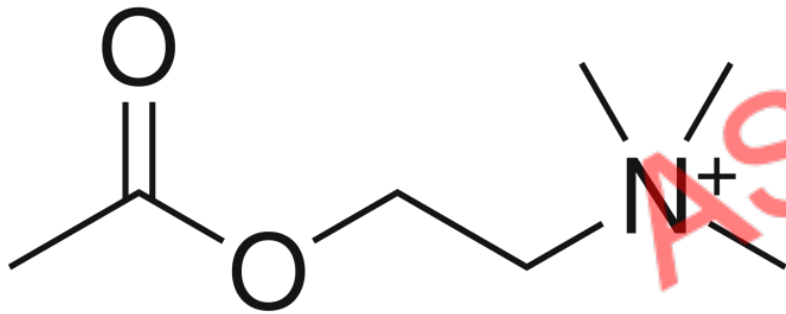
Masaki K, Taketa RM, Nakama MK, Kawamoto CT, Pokhrel P. Relationships Between Depressive Symptoms, Anxiety, Impulsivity and Cigarette and E-cigarette Use Among Young Adults. Hawaii J Health Soc Welf. 2022 Mar;81(3):51-57. PMID: 35261985; PMCID: PMC8899082.



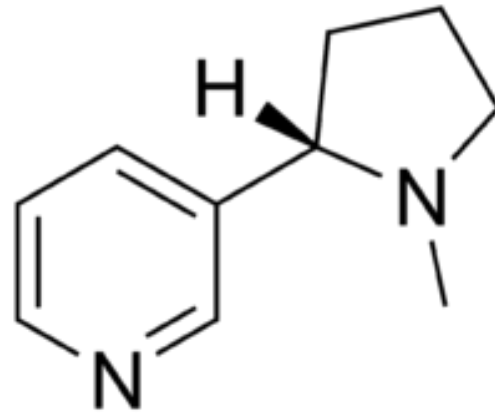
Nicotine



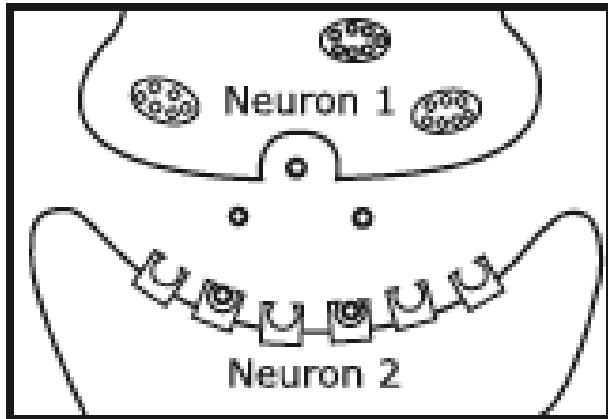
Acetylcholine



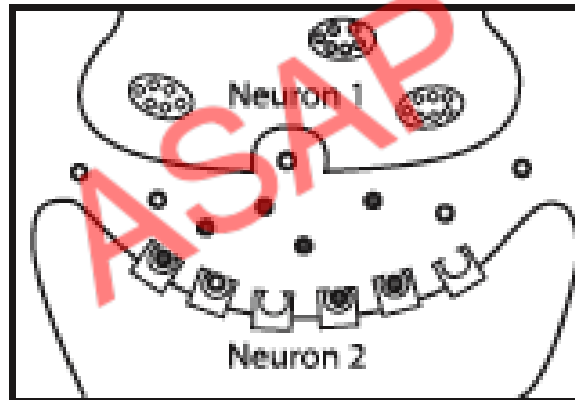
Nicotine



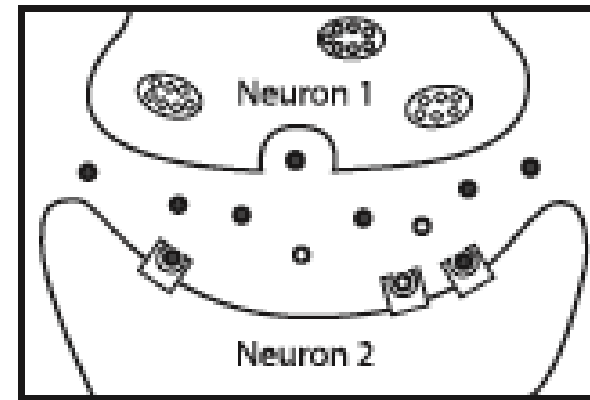
Nicotine Receptors in the CNS



Nonsmoker

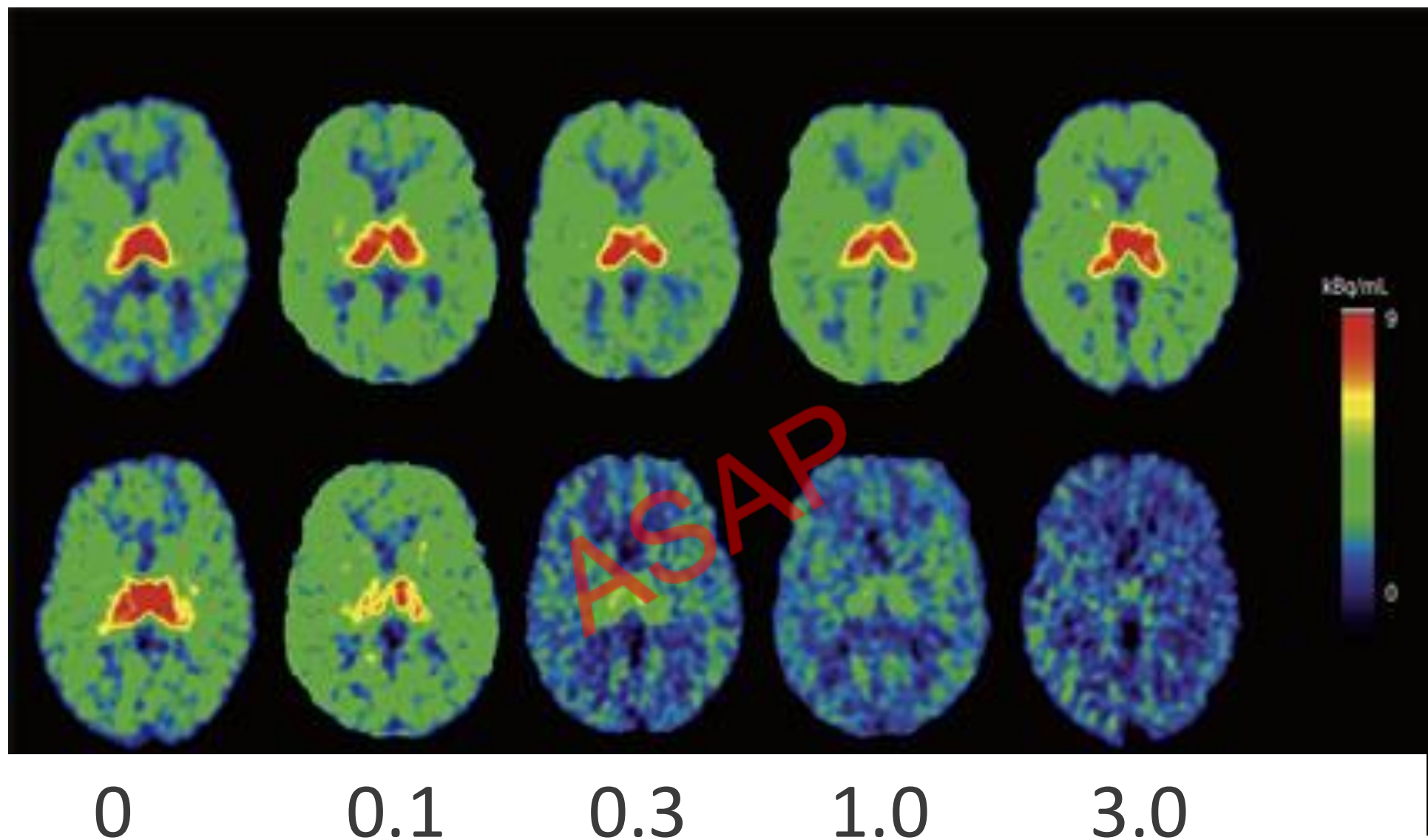


New Smoker



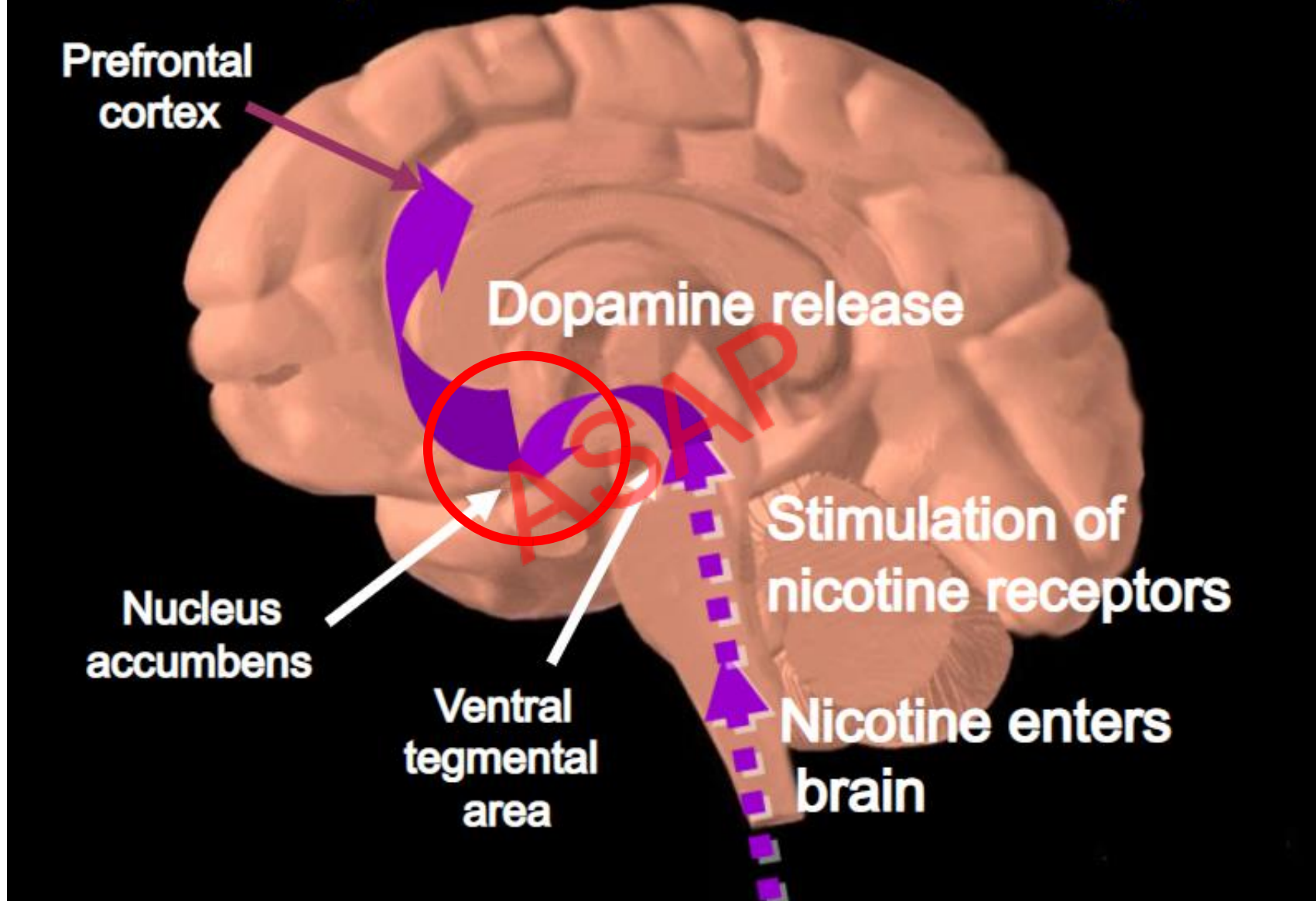
Addicted Smoker

Source: <https://www.drugabuse.gov/publications/brain-power/grades-6-9/legal-doesn't-mean-harmless-module-2/background>



Brody AL, et al. Cigarette Smoking Saturates Brain $\alpha 4\beta 2$ Nicotinic Acetylcholine Receptors. *Arch Gen Psychiatry*. 2006;63(8):907–914. doi:10.1001/archpsyc.63.8.907

Dopamine Reward Pathway



Dopamine



Acetylcholine



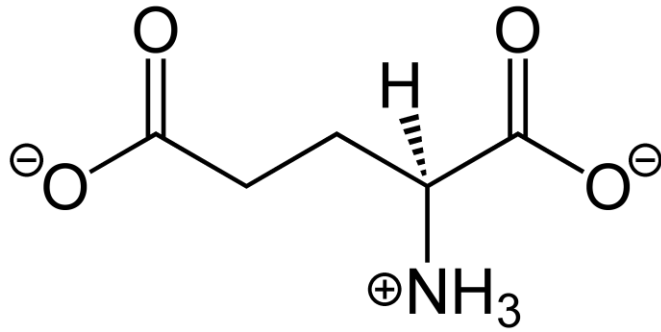
Nicotine



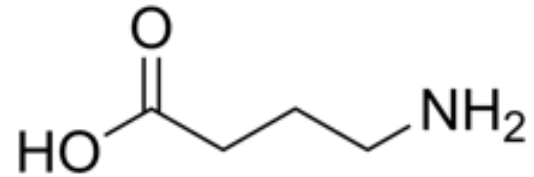
Serotonin



Glutamate and GABA



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Endorphins



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14 year old boy describing nicotine effects

It felt great.

14 year old boy describing nicotine effects

“I don't feel those things anymore.”

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14 year old boy describing nicotine effects

Nicotine Addiction

- **Nicotine addiction:** Nicotine is a highly addictive substance, possibly more so than cannabis, alcohol and cocaine
- **Nicotine dependence:** Increased tolerance and withdrawal symptoms
 - 1/5 of weekly teen smokers: symptoms of dependence
 - Cravings can emerge only 3-4 months after the first cigarette/e-cigarette, sometimes less
 - 18 months after the first cigarette, 25% of young smokers lose confidence in their ability to quit

Youth: **less severe withdrawal symptoms**, but can appear after only a few cigarettes
Obstacle for early cessation

Nutt, D et al. (2007) Development of a rational scale to assess the harm of drugs of potential misuse, Lancet 369(9566):1047-1053

86



Nicotine Toxicity



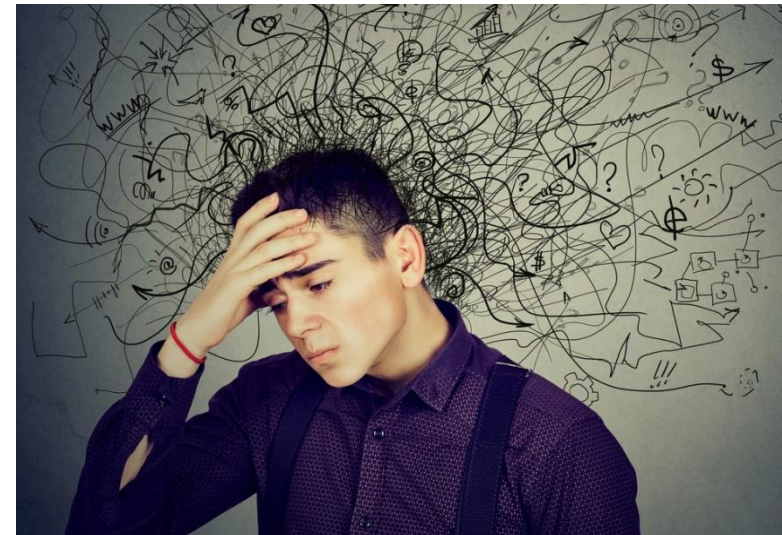
Stomach pain



Dizziness



Headaches



Decreased Concentration

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- **ADA** has adopted policies relating to products that contain nicotine, **including e-cigarettes**.
- Our policies call for **dentists to be fully aware** of the health risks that come with tobacco use, including:
 - higher rates of **tooth decay, gum disease, bone damage, tooth loss** and more.
- Dentists are encouraged to **screen patients** for nicotine use — including tobacco and non-tobacco products — and **provide counseling** to help people quit.
- In light of recent reports of vaping-related injuries and deaths, the **ADA** wishes to express its **opposition** to any use of oral tobacco, including **vaping** nicotine from e-cigarettes, and urges people using any type of tobacco product to quit.

Effects of Vaping on Teeth



[https://jada.ada.org/article/S0002-8177\(21\)00245-2/fulltext](https://jada.ada.org/article/S0002-8177(21)00245-2/fulltext)

<https://www.ada.org/en/about/press-releases/2019-archives/american-dental-association-statement-on-vaping>

How Do I Know I Have a Problem?

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Diagnosis of Tobacco Use disorder

Biological Response

Withdrawal
Tolerance
Cravings

Loss of control

Using more or for longer periods of time
Lot of time spent obtaining, using, recovering from substances
Repeated failed attempts to decrease use

Social Impairment

Failure to fulfill school, home, work obligations
Recurrent interpersonal problems
Give up important activities

Risky Use

Use in physically dangerous situations
Continue use despite knowledge of physical/psychological problem

What If I Have a Problem?

ASAP

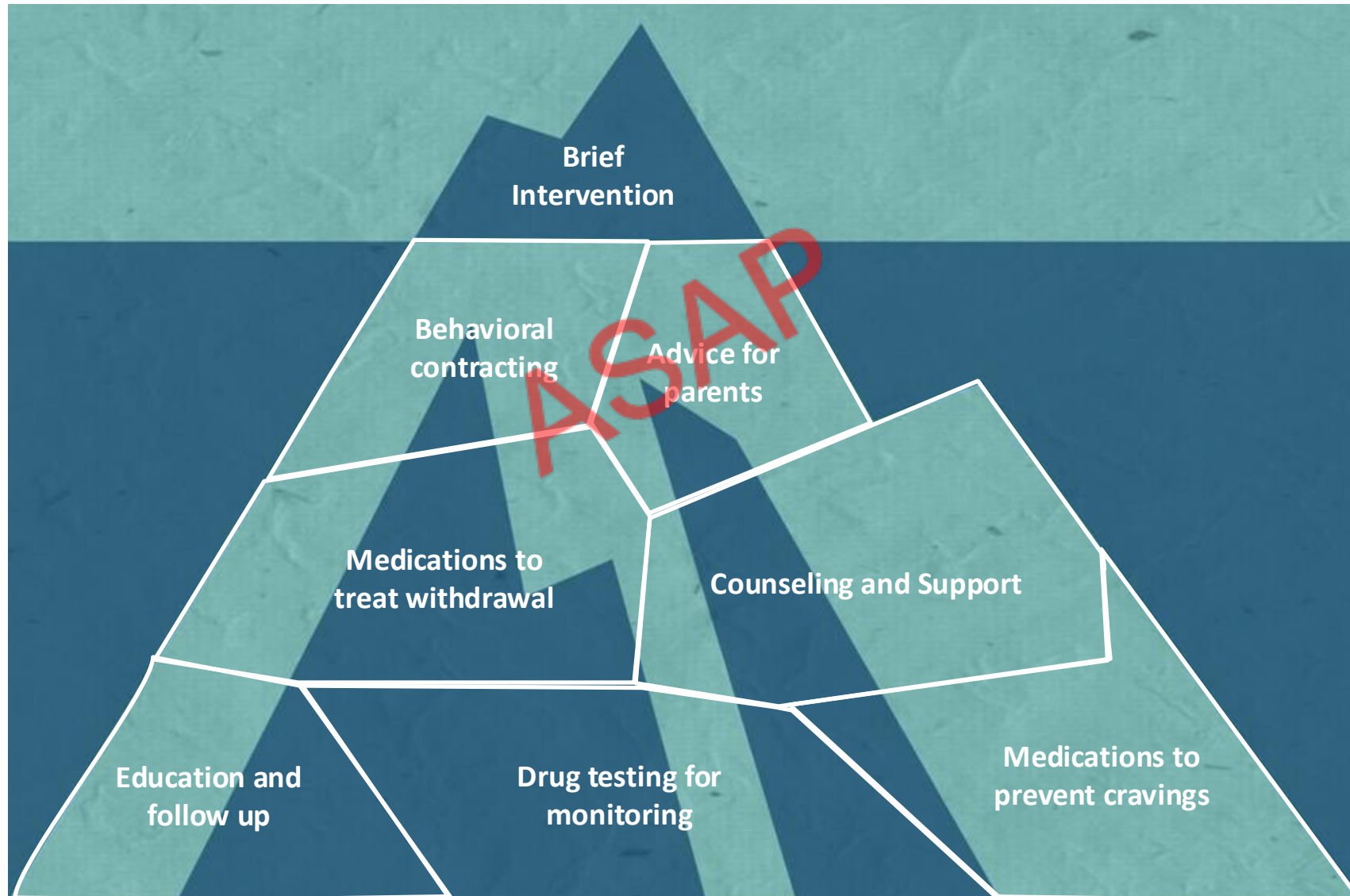


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Treating Adolescent Substance Use



Substance Use Treatment

Medications

Marijuana use: n-acetylcysteine (off-label)

Nicotine use: nicotine replacement, varenicline (17+), bupropion

Behavioral Interventions

Cognitive Behavioral Therapy

Motivational Enhancement Therapy

Dialectical Behavioral Therapy

Contingency Management

Vaping Resources

Cigarettes & Vaping treatment tips

Advice & Support

1

- Advise that "non-use" is best.
- Ask about cravings and symptoms of nicotine withdrawal (increased appetite, fatigue, headache, irritability, anxiety, depression). If patient is experiencing either, offer NRT.
- Assess for shortness of breath, decreased exercise tolerance or other respiratory symptoms. If present, refer to Pulmonary for evaluation.
- If possible, connect to counseling for support.
- Offer support lines: 1-800-QUIT-NOW and TEEN.SMOKEFREE.GOV.
- Ask patients to make a brief quit trial while trying NRT, or set a quit date.

Prescribe NRT

Nicotine Replacement Therapy

2

Cigarettes/Day 1 pod equals 20 cigarettes	Patch Dose
< 10	7-14 mgs
10-20	14-21 mgs
21-40	21-42 mgs
> 40	42 mgs

ASAM Essentials, 3rd Edition, 2020.

Patch & Lozenges

3

Add 2mg Lozenges for cravings, may use one every 2 hours.

If using multiple lozenges and still craving nicotine then increase dose of patch at next visit.

When lozenge use decreases consider weaning dose of patch while continuing prn lozenges.

Goal is to taper and stop the patch and then continue lozenges until they cravings stop or they can manage them without lozenges.

- Use NRT liberally. Increase dose as needed to suppress withdrawal and cravings.
- Follow up every 2-4 weeks while on NRT.

NRT not enough

4

Add Contingency Management: rewards provided for abstinence or decreased smoking.


Consider Adding Bupropion SR 150mgs once a day x 7 days then increase to 150mgs bid.

Or Adding Varenicline (Chantix) 0.5mgs once a day x 3 days then 0.5mgs bid x 4 days then 1mg bid for 12 to 24 weeks.

Both bupropion and varenicline lower seizure threshold so do not prescribe together.

Do not recommend e-cigarettes, nicotine nasal spray or nicotine Inhaler to adolescents as smoking cessation tool.

For support, please call ASAP at 617-355-2727 or contact ASAP on-call.



Boston Children's Hospital
Adolescent Substance Use
and Addiction Program

Vaping Resources

<http://www.childrenshospital.org/conditions-and-treatments/conditions/v/vaping>

<https://www.drugabuse.gov/publications/drugfacts/marijuana>

<https://www.cdc.gov/marijuana/health-effects.htm>

<https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/substance-use/Pages/marijuana.aspx>

<https://www.colorado.gov/pacific/cdphe/marijuana-clinical-guidelines>

<https://teens.drugabuse.gov/drug-facts/marijuana>

<https://www.healthychildren.org/English/ages-stages/teen/substance-abuse/Pages/Marijuana-Cannabis.aspx>

Toolkit for Pediatric PCPs

1.	Screening & Brief Intervention: Updates and Guidance
2.	Brief Brief Interventions: Common Answers and Suggested Responses
3.	Nicotine: Managing Nicotine Use Disorders in Pediatrics
4.	Cannabis: Helping Kids Quit THC/Cannabis
5.	Cannabis: Managing Cannabis Hyperemesis Syndrome
6.	CBD: Frequently Asked Questions about CBD Products
7.	Alcohol: Managing Alcohol Use in Pediatric Primary Care
8.	Naltrexone for Opioid Use Disorder
9.	Buprenorphine: Induction and Triage Protocols
10.	Drug Testing: Drug Testing in Pediatric Primary Care
11.	Coping with Cravings
12.	Tips to Prepare for a Quit Date
13.	Behavioral Contracts
14.	Parent/Caregiver Guidance
15.	Co-occurring Mental Health Disorders
16.	Co-occurring Medical Disorders
17.	Referrals: Referrals to Higher Levels of Care
18.	Communication: Guidelines and Tips for Caregivers

Tobacco Use Treatment

Family Support

Advice & support for parents

Working with family to establish goals & expectations

Family-based therapies:

- Community Reinforcement & Family Training
- Multidimensional Family Therapy
- Functional Family Therapy
- Brief Strategic Family Therapy
- Multisystemic Therapy

Community Support

Groups: NA, AA, SMART Recovery, Young People in Recovery

Peer mentors

Addiction medicine specialists

Pragmatic and Specific Ways to Monitor Youth



RULES



How Can We Prevent Substance Use & Related Problems?

ASAP

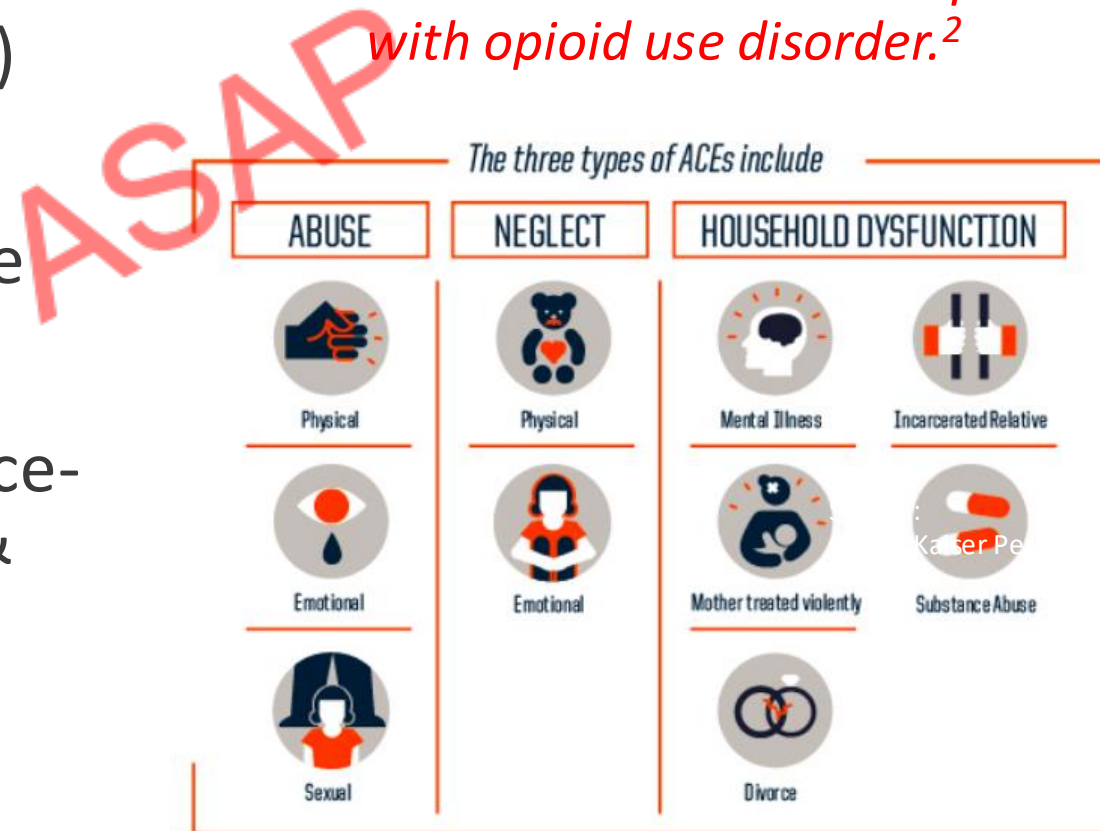


Recognize risk factors

1. Parent substance use
2. Adverse childhood experiences (ACEs)
3. Trauma
4. Peer substance use
5. Mood disorders
6. Favorable substance-related attitudes & expectancies

9% of kids in the US live with someone with problematic substance use.¹

1.4M kids in the US live with a parent with opioid use disorder.²



1. Sacks & Murphey, Child Trends, 2018.

2. United Hospital Fund, "The Ripple Effect", 2018.

Whitesell M et al., *J Addict* 2013. Stone AL et al., *Addictive Behaviors* 2012.

Promote protective factors

1. Engagement in school, hobbies, extracurriculars
2. Academic achievement
3. Family bonding
4. Parental monitoring



<https://youth.gov/youth-topics/substance-abuse>

Address Substance Use Early



What if I'm Worried About A Friend?

1. TRUST YOUR INSTINCTS.



If you think your friend has a problem, you're probably right, says Jamison Monroe, founder of California's Newport Academy teen treatment centers.

2. DON'T IGNORE THE SIGNS.

Changes in behavior and mood could signal that someone has a problem. A pal may start acting distant, secretive, or angry. You may also notice health and hygiene issues, including a messy appearance, extreme tiredness, frequent illness, weight loss or gain, and nosebleeds.

3. ENCOURAGE THEM TO GET HELP.

They can visit the Partnership for Drug-Free Kids at www.drugfree.org/heroin for a guide to resources and treatment centers in your state.

4. TALK TO A TRUSTED ADULT.

Whether you go to a parent, counselor, or a coach, a grown-up may be able to better intervene. "Yes, your friend is going to be angry with you in the short term, but ultimately they're going to thank you," says Monroe.

5. KNOW WHEN TO WALK AWAY.

You're not responsible for anyone else's recovery. If a friend's drug use negatively affects your life, it may be time to end the relationship.

Resources

- [ADA.org/tobacco](https://ada.org/tobacco).
- NIDA for Teens: <https://teens.drugabuse.gov/>
- Partnership to End Addiction: drugfree.org
- Frontiers for Young Minds: “What is Vaping?”
- <http://www.staytruetoyou.org/>
- <https://truthinitiative.org/>
- <https://teen.smokefree.gov/>
- Young People in Recovery: youngpeopleinrecovery.org
- SMART Recovery Young Adults: <https://www.smartrecovery.org/young-adults/>



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Thank You

