

BI 121 Lecture 17

I. Announcements Exam II next Friday, Dec 13th @ 8:00 am!
10 am lab section go to 5 KLA; 11 am lab section go to 130 HUE.
Discussion-Review this Thursday. Q?

II. Respiratory Connections LS ch 12, DC Module 7, SI Fox +...

- A. How do we breathe? LS fig12-12, fig12-25 pp 349-56, 373-8
- B. Histology LS fig 12-4 pp 347-9, DC fig 7-4 p 54
- C. Gas exchange LS fig 12-19 pp 362-5
- D. Gas transport LS tab 12-3 pp 365-70

III. Physiology of Cigarette Smoking & Vaping

- A. ANS, autonomic nerves & nicotine? Route of chemicals,...
- B. Emphysema? 2nd-hand smoke?... LS pp 356, 365
- C. Physiology of Vaping? Harmless? AHA 2019 Conference +
- D. UO Smoke-Free since Fall 2012! Help is available!

Muscles of Ventilation

Accessory muscles of inspiration
(contract only during forceful inspiration)



Sternocleidomastoid

Scalenus

Internal intercostal muscles

NB: Diaphragm is the chief muscle of ventilation!

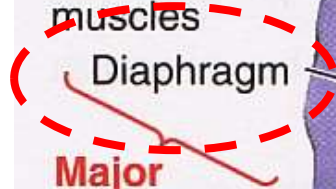
Sternum

Ribs

External intercostal muscles

Diaphragm

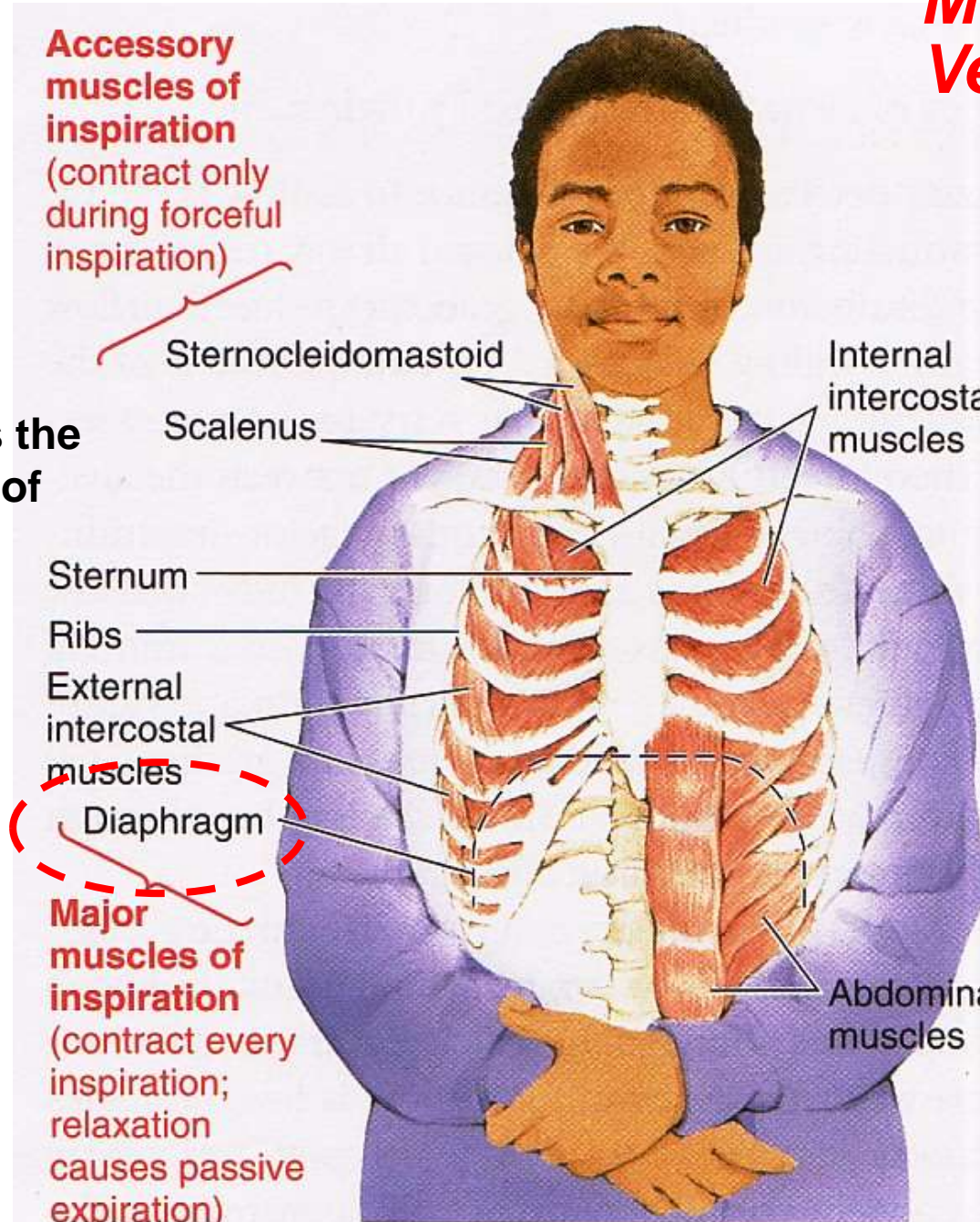
Major muscles of inspiration
(contract every inspiration; relaxation causes passive expiration)

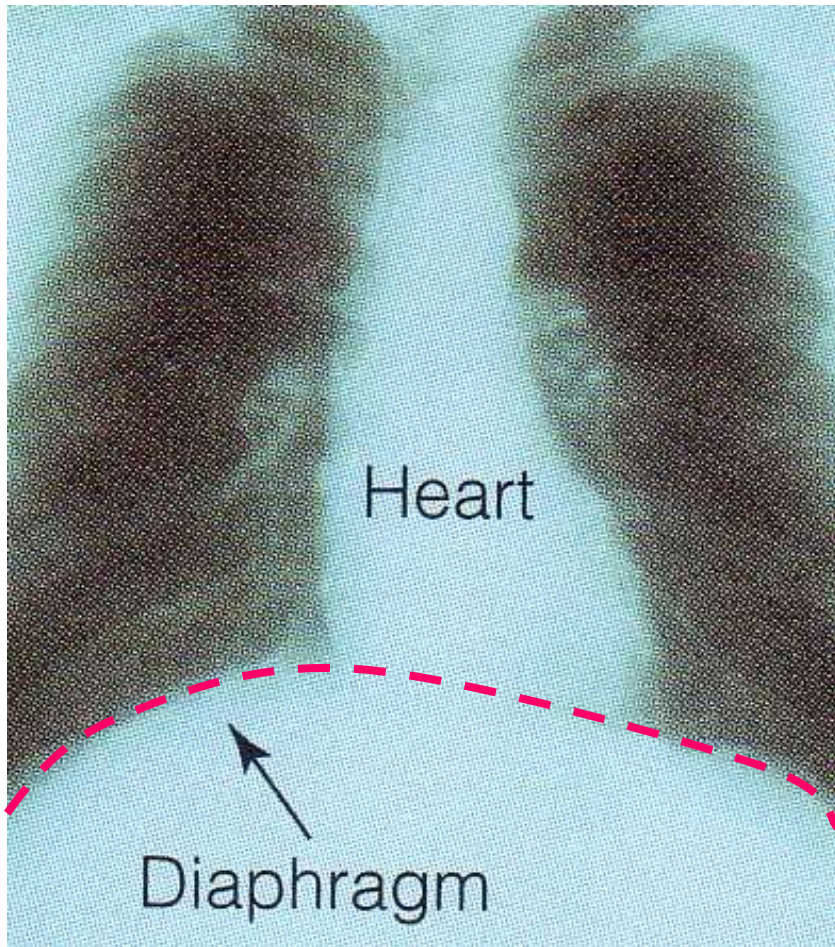


Muscles of active expiration
(contract only during active expiration)



Abdominal muscles



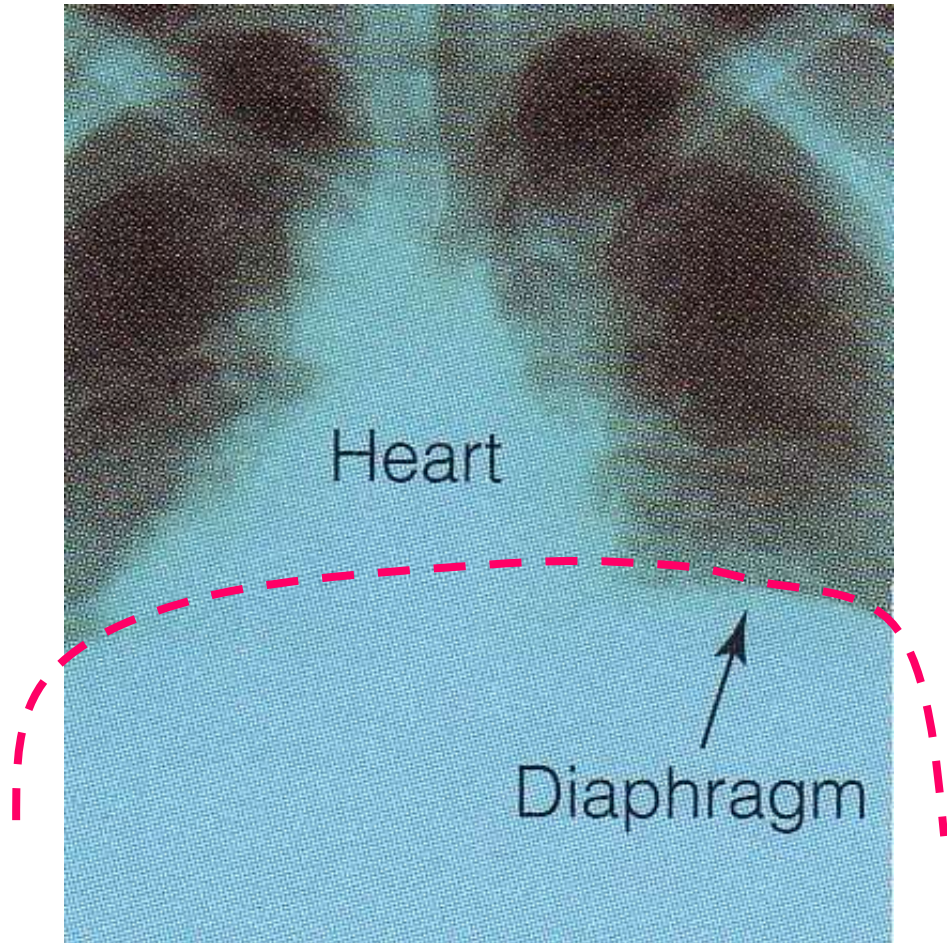


Heart

Diaphragm

Inhale (active)

Contract & flatten diaphragm



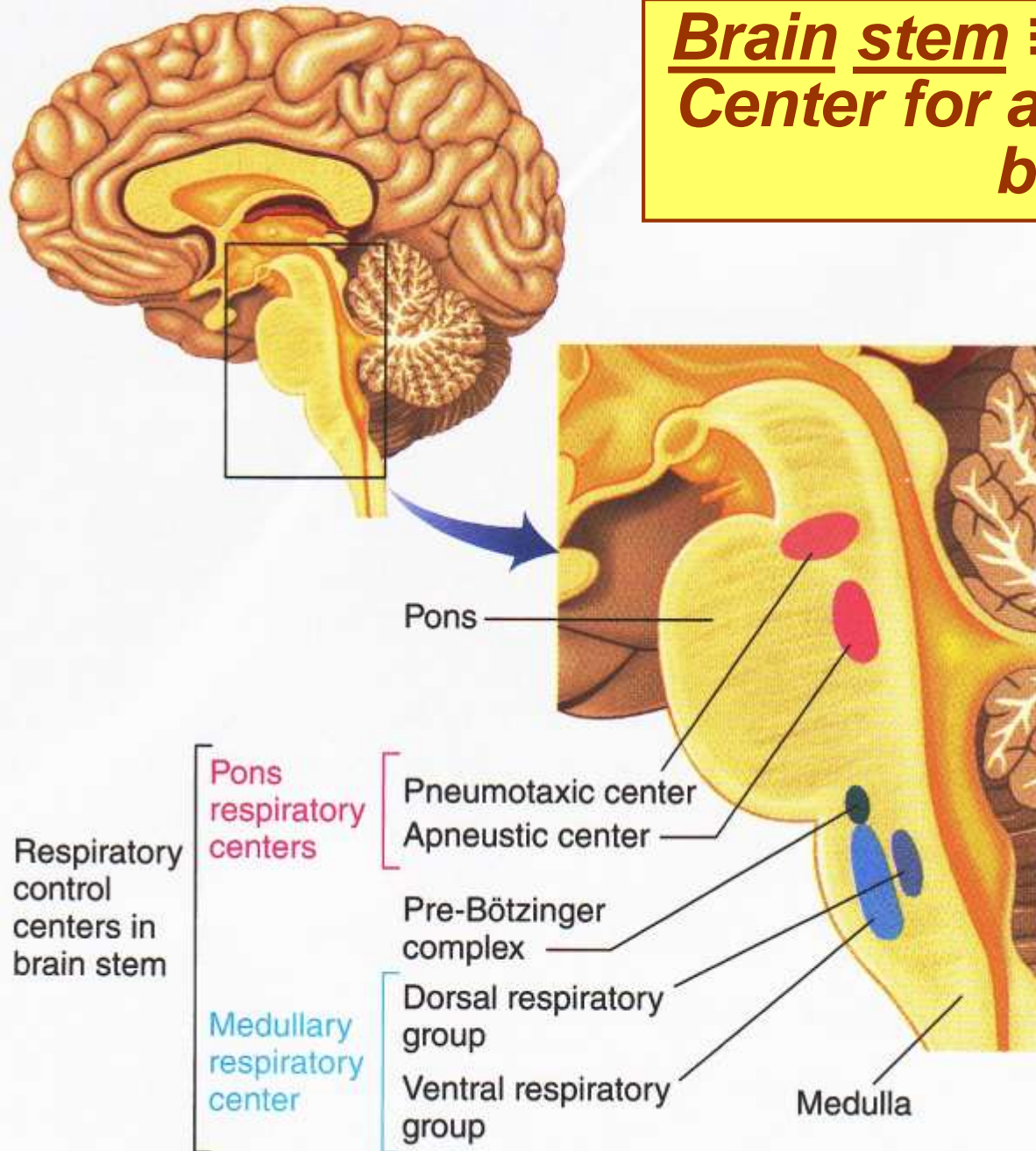
Heart

Diaphragm

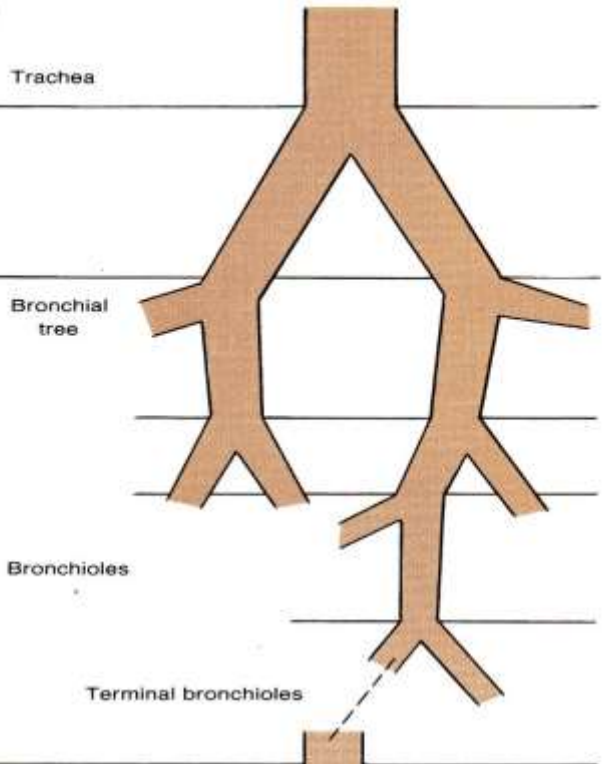
Exhale (passive @ rest)

Relax & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!

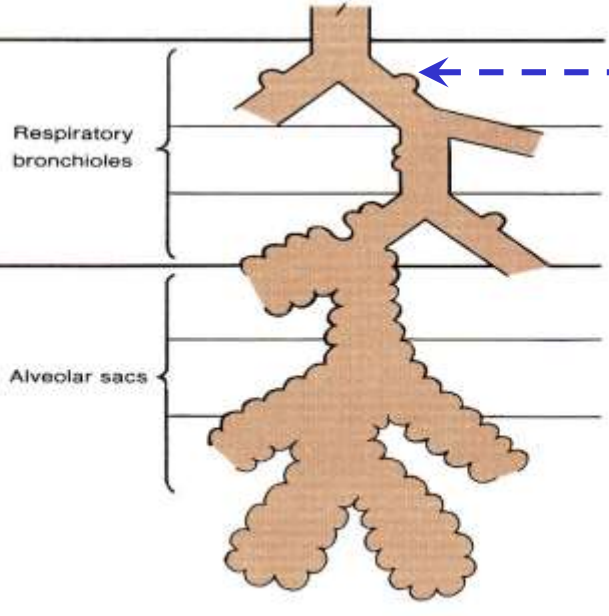


Conductive Zone



No Gas Exchange

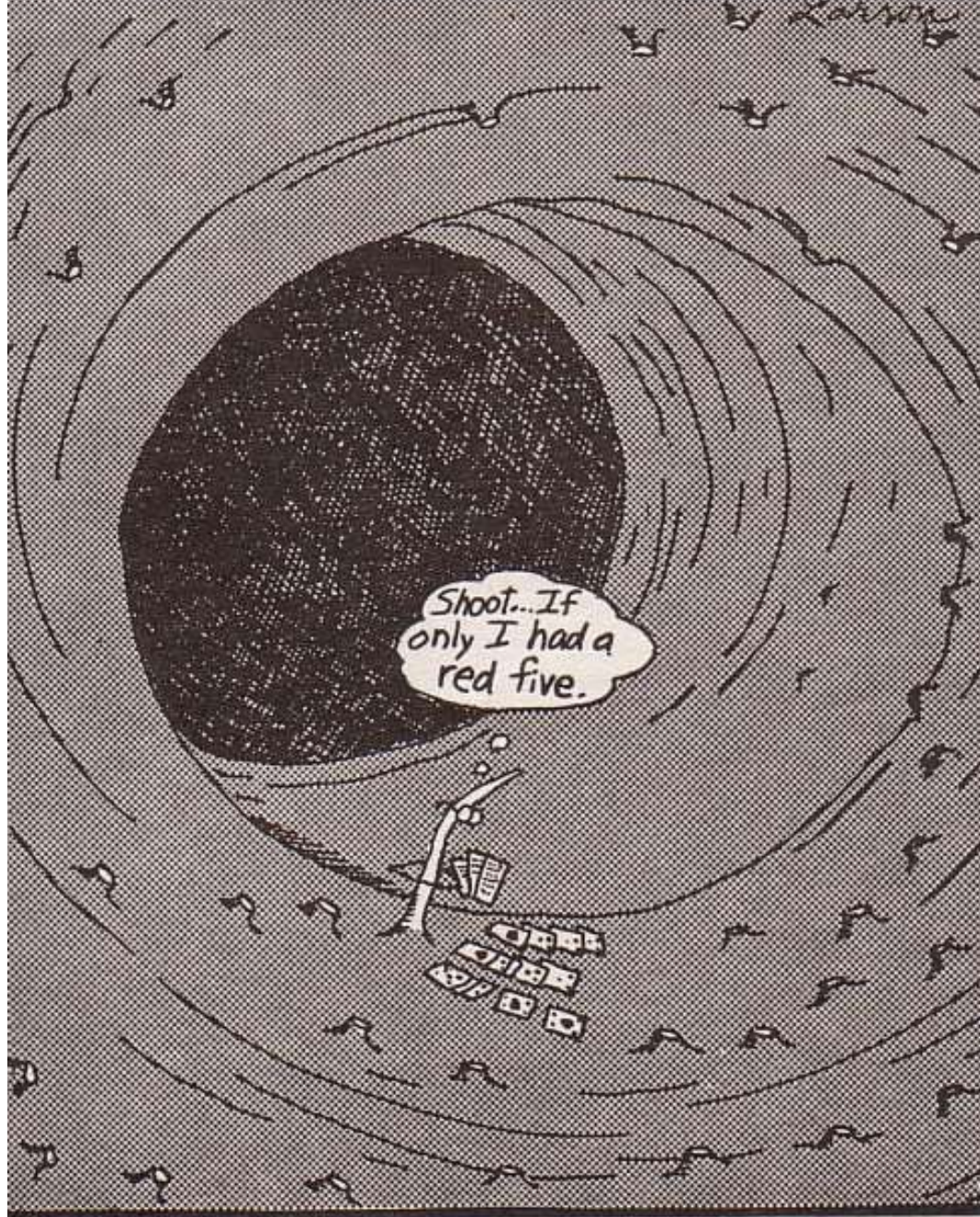
Respiratory Zone



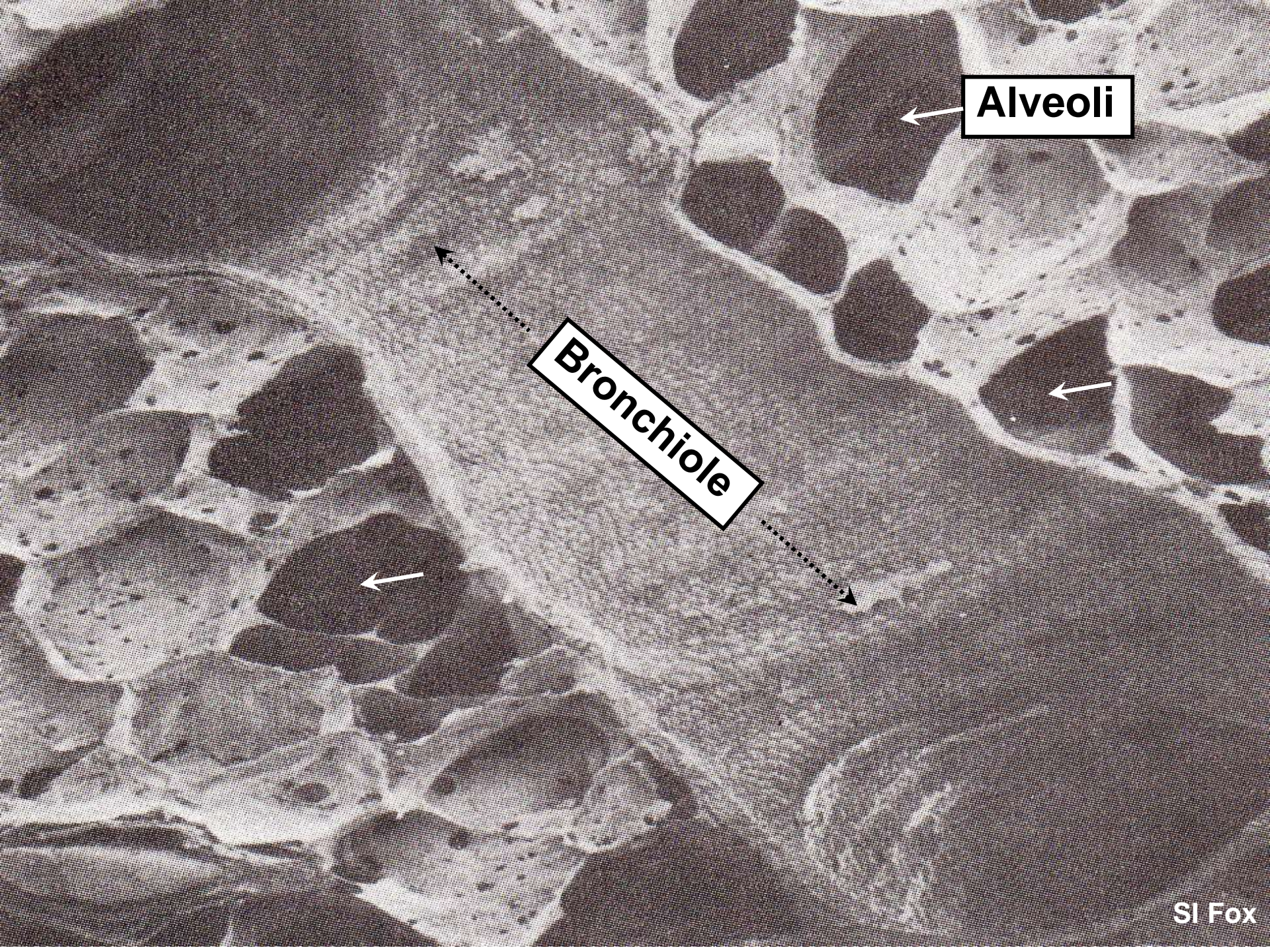
-1st alveolar outpouching!

Gas Exchange





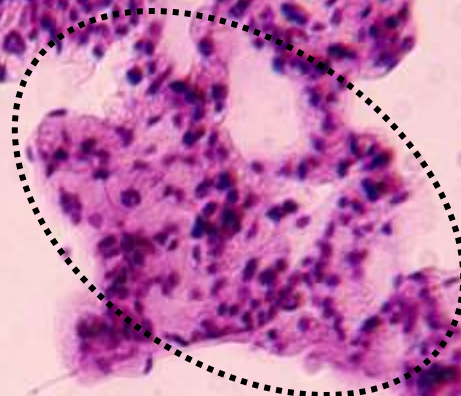
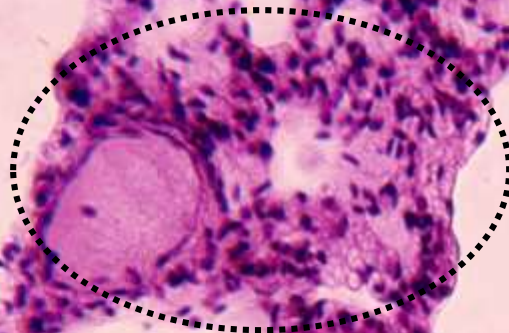
The last cilium on a smoker's lung



Alveoli

Bronchiole

Capillaries with rbcs!



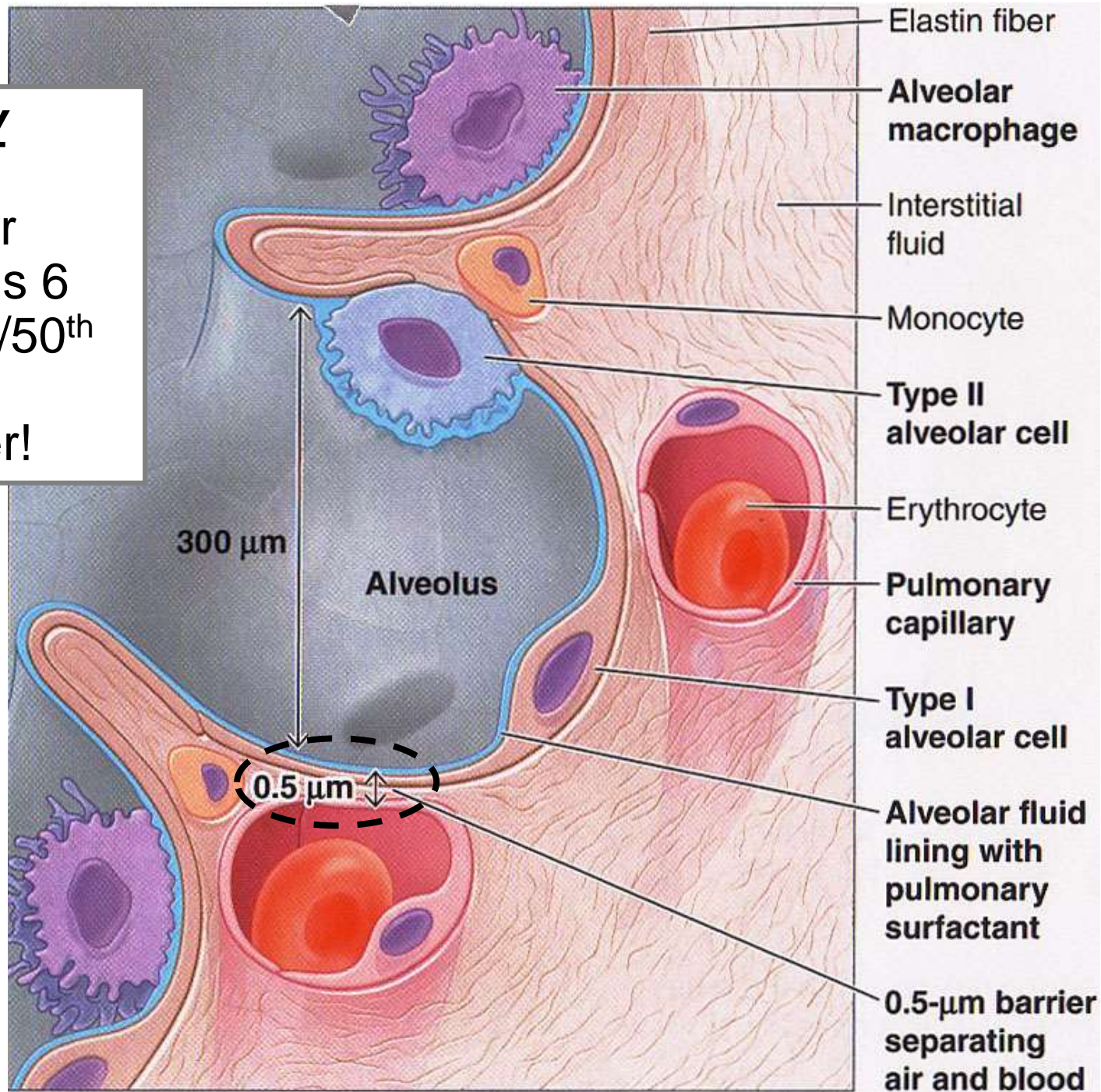
← Alveoli →



White Blood Cell

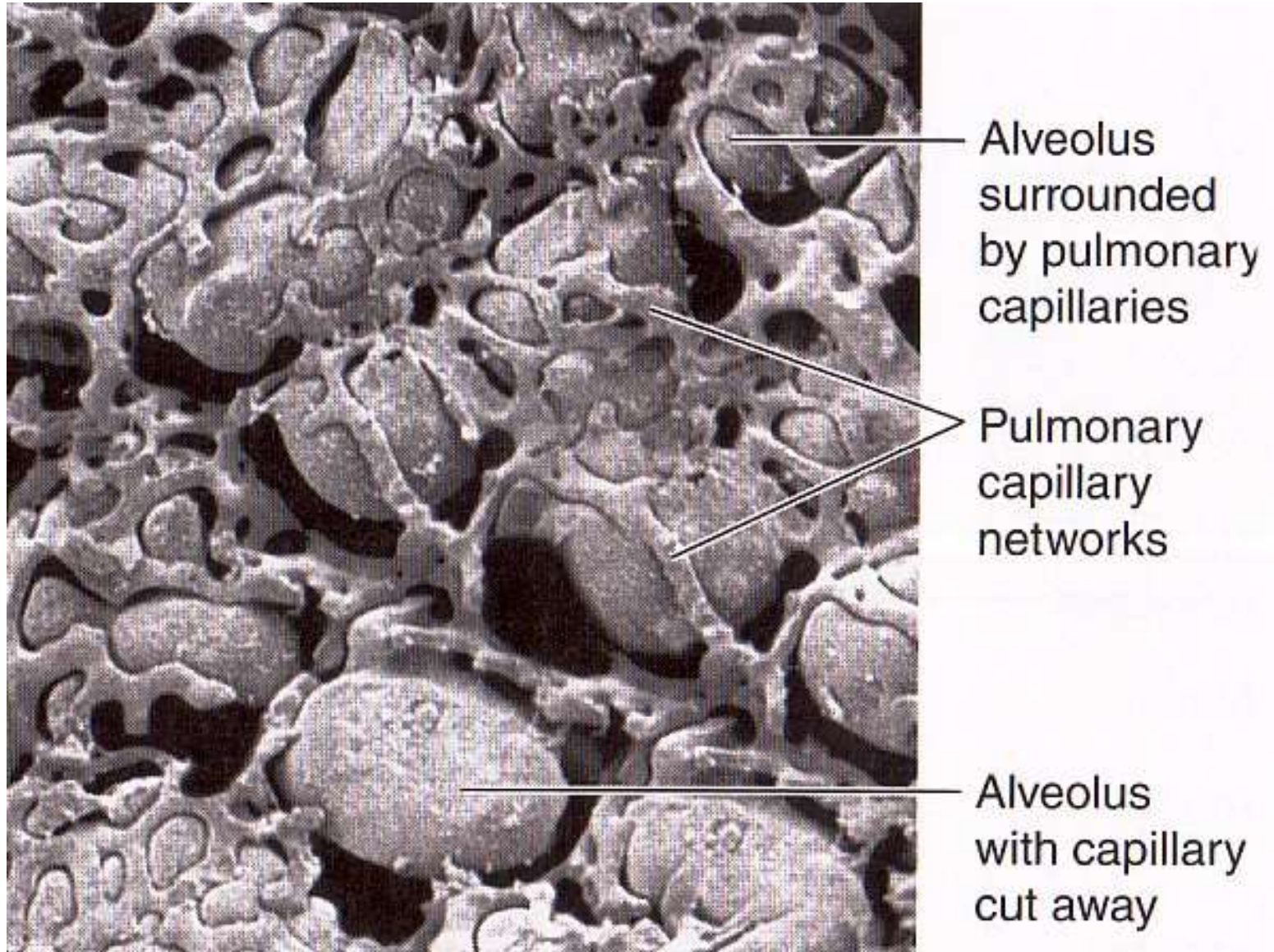
Respiratory membrane

separates air from blood, is 6 layers, yet 1/50th thickness of tracing paper!



LS 2012 fig 12-4a
cf: DC 2013 fig 7-4

Alveoli are surrounded by jackets of capillaries!



Gas Exchange

CO₂ LOW

O₂ HIGH

Across pulmonary capillaries:

O₂ partial pressure gradient from alveoli to blood = 60 mm Hg (100 → 40)

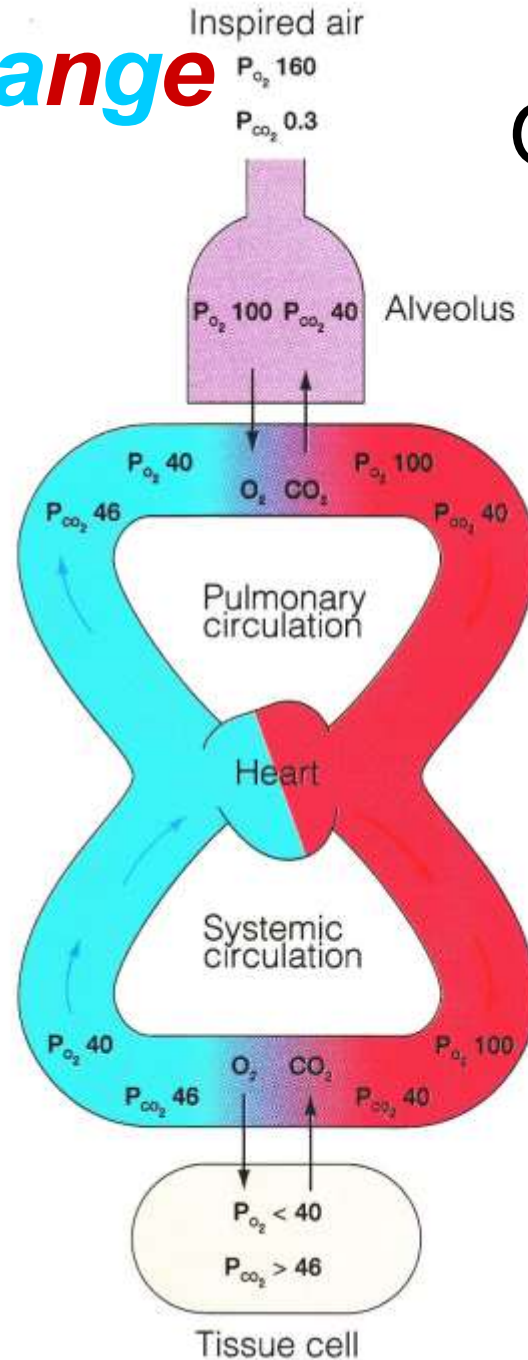
CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

Across systemic capillaries:

O₂ partial pressure gradient from blood to tissue cell = 60 mm Hg (100 → 40)

CO₂ partial pressure gradient from tissue cell to blood = 6 mm Hg (46 → 40)

Numbers are mm Hg pressure.



CO₂ HIGH

O₂ LOW

O_2 is carried mainly by red blood cell hemoglobin!

Polypeptide chain

Polypeptide chain

Each hemoglobin molecule carries 4 O_2 on 4 iron-containing disks!

Carbon monoxide, CO, binds $\geq 200x$ more powerfully to these same sites, thus poisoning the hemoglobin!



Polypeptide chain

Heme groups

Polypeptide chain

▲ TABLE 12-3

Methods of Gas Transport in the Blood

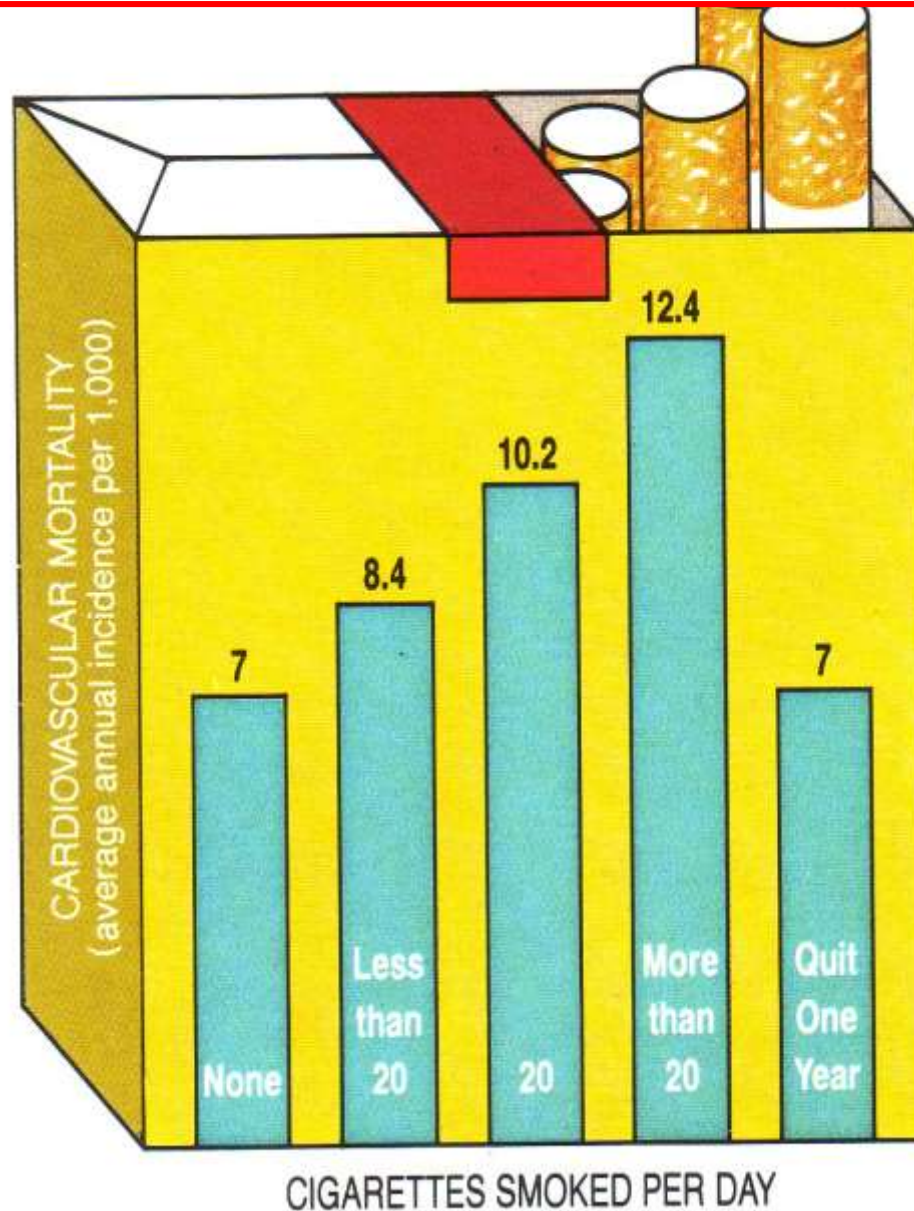
GAS	METHOD OF TRANSPORT IN BLOOD	PERCENTAGE CARRIED IN THIS FORM
O_2	Physically dissolved	1.5
	Bound to hemoglobin	98.5
CO_2	Physically dissolved	10
	Bound to hemoglobin	30
	As bicarbonate (HCO_3^-)	60

American Cancer Society Great American Smoke Out!

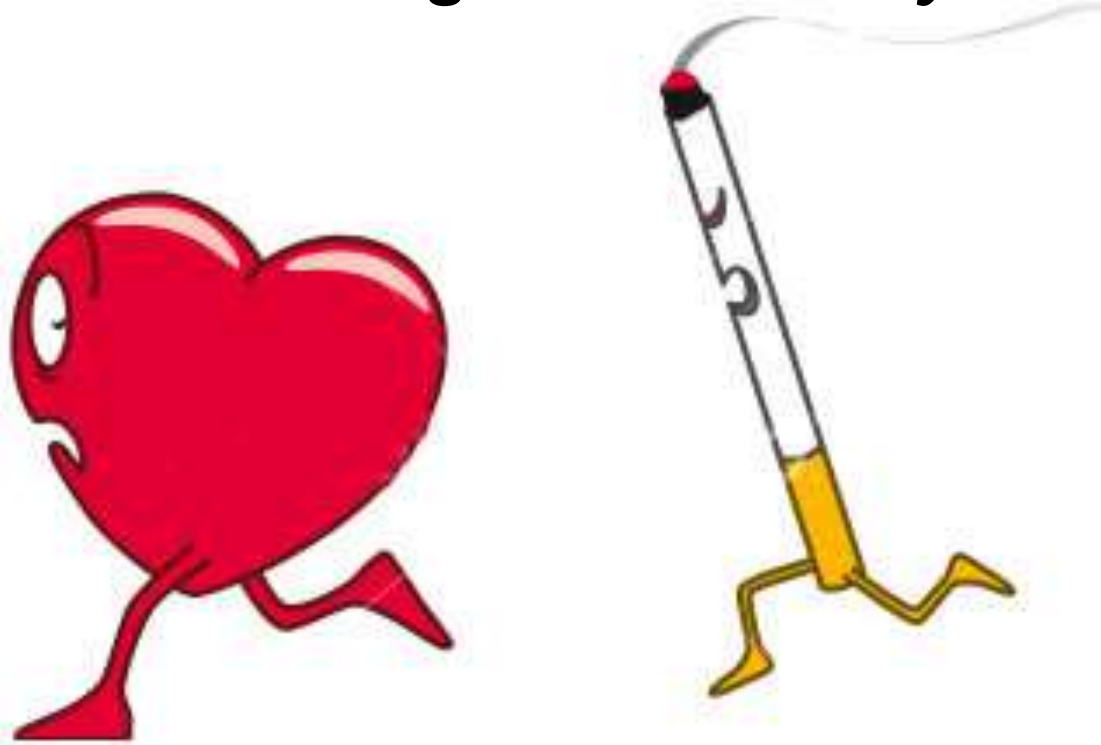


**[http://www.cancer.org/healthy/stayawayfromtobacco/
greatamericansmokeout/](http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/)**

Cigarette Smoking: #1 Preventable Cause of Premature Death in the US



Not only the Lungs, but the Heart, Brain & 100s of Other Tissues & Organs Adversely Affected!



Tobacco smoke = Deadly mix of > 7000 chemicals!

<https://www.lung.org/stop-smoking/smoking-facts/whats-in-a-cigarette.html>

https://www.cdc.gov/tobacco/data_statistics/fact_sheets/index.htm

<https://www.cancer.org/cancer/cancer-causes/tobacco-and-cancer/carcinogens-found-in-tobacco-products.html>

Cancer-causing Chemicals



Formaldehyde
Used to embalm dead bodies



Benzene
Found in gasoline



Polonium 210
Radioactive and very toxic



Vinyl chloride
Used to make pipes

Toxic Metals



Chromium
Used to make steel



Arsenic
Used in pesticides



Lead
Once used in paint



Cadmium
Used in making batteries

Poison Gases



Carbon monoxide
Found in car exhaust



Hydrogen cyanide
Used in chemical weapons



Ammonia
Used in household cleaners



Butane
Used in lighter fluid



Toluene
Found in paint thinners

Tobacco smoke contains a deadly mix of **more than 7,000 chemicals**. Hundreds are toxic. About 70 can cause cancer. Here are some of the chemicals.

**Cigarette + Smoke: > 7000 Chemicals; ~600 Tobacco Company Additives
Atherogenic, Carcinogenic (C), Tumor Initiating, Tumor Promoting (TP),
Toxic (T), Cornucoppia of Unknowns, Synergistic, Reactive...?**

4-aminobiphenyl	C	140 ng <u>per cigarette</u> ...
benz(a)anthracene	C	40-200 ng
benzene	C	400 µg
benz(o)pyrene	C	40-70 ng
carbon monoxide	T	26.8-61 mg
formaldehyde	C	1500 µg
hydrazine	C	90 ng
hydrogen cyanide	T	14-110 µg
2-naphthylamine	C	70 ng
nitrogen oxides	T	500-2000 µg
N-nitrosodimethylamine	C	200-1040 ng
N-nitrosodiethanolamine	C	43 ng
N-nitrospyrrolide	C	30-390 ng
phenol	TP	70-250 µg
polonium 210	C	0.5-1.6 pCi
quinoline	C	15-20 µg
O-toluidine	C	3 µg

SOURCES: US Surgeon General's Office, American Cancer Society, American Heart Association.

phoric Acid, Pimenta Leaf Oil, Pine Needle Oil, Pine Oil, Scotch, Pineapple
entrate, alpha-Pinene, beta-Pinene, D-Piperitone, Piperonal, Pipsissewa L
Potassium Sorbate, 1-Proline, Propenylguaethol, Propionic Acid, Propyl
Hydroxybenzoate, Propylene Glycol, 3-Propylideneephthalide, Prune Juice
ne, Pyroligneous Acid And Extract, Pyrrole, Pyruvic Acid, Raisin Juice Co
mol, Rose Absol
age Oleoresin, S
Snakeroot Oil,
nate, Sodium C
ct, Gum and Oil, Sucrose Octaacetate, Sugar Alcohols, Sugars, Tagetes
ic Acid, Tea Leaf and Absolute, alpha-Terpineol, Terpinolene, Terpinyl Ac
3-Tetrahydroquinoxaline, 1,5,5,9-Tetramethyl-13-Oxatricyclo(8.3.0.0(4,9))
5, and 3,4,5,6-Tetramethylethyl-Cyclohexanone, 2,3,5,6-Tetramethylpyraz
chloride, Thiazole, 1-Threonine, Thyme Oil, White and Red, Thymol, Tob
pherols (mixed). Tolu Balsam Gum and Extract Tolu aldehydes para-Tol

- Absorbs H₂O
- Preserves tobacco
- Antifreeze & de-icing
- Polyester compounds
- Artificial smoke in
- Theater & e-cigarettes

TOBACCO ADDITIVES

The tobacco industry has acknowledged that nearly 600 chemicals are added to cigarettes. It is not clear, however, how much of the various additives are used or which combinations appear together. Some of the chemicals among cigarette additives most questioned by tobacco opponents include:

■ **Megastigmatrienone:** A flavoring that tobacco companies contend is found naturally in grapefruit juice.

■ **Dehydromenthofuro lactone:** A flavoring that tobacco companies say is found in peppermint.

■ **Ethyl furoate:** Found naturally in coffee, kiwi and peanuts.

■ **Maltitol:** A sweetener used in chewing gum and diabetic candy.

■ **Sclareolide:** A synthetic form of a naturally occurring tobacco element.

■ **Ammonia:** A processing aid.

■ **Methoprene:** An insecticide that toxicologists say is biodegradable.

■ **Other additives:** Yeast, wine, caffeine, beeswax, beta carotene, chocolate, coconut oil.



freebase nicotine!!

Ammonia converts nicotine, the additive agent in tobacco, into a more volatile form, Pankow said. "Ammonia is the thing that helps tobacco companies hook the smoker by providing a means of delivering the nicotine."

Last October, a former tobacco industry employee revealed that secret industry documents indicated that ammonia was added to tobacco to double the impact of nicotine. Research now indicates that ammonia can boost nicotine availability up to 100x! The Oregon Graduate Institute (now a part of [OHSU](http://www.ohsu.edu)) was the 1st to research!

<http://pubs.acs.org/doi/abs/10.1021/es970402f>
<http://www.nasw.org/users/sperkins/nicotine.html>

Tobacco-free Campus

For better health,
smoking and use of
tobacco products are
prohibited everywhere
on our property.



UO's Josh Buehler

U.S. Surgeon General
Regina Benjamin

SMOKE AND TOBACCO-FREE UNIVERSITY



September 1, 2012

For a healthier community and cleaner
environment, the University of Oregon
will be smoke and tobacco free



Ready to Quit Tobacco?

Visit tobaccofree.uoregon.edu for free and low cost resources



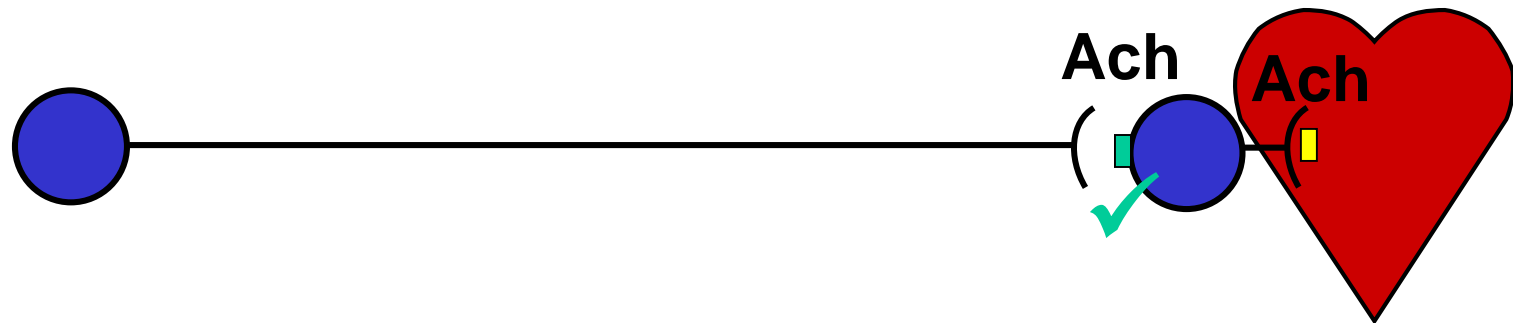
UNIVERSITY OF OREGON

tobaccofree.uoregon.edu



For a healthier community and cleaner
environment, the University of Oregon
is smoke and tobacco-free.

Parasympathetic

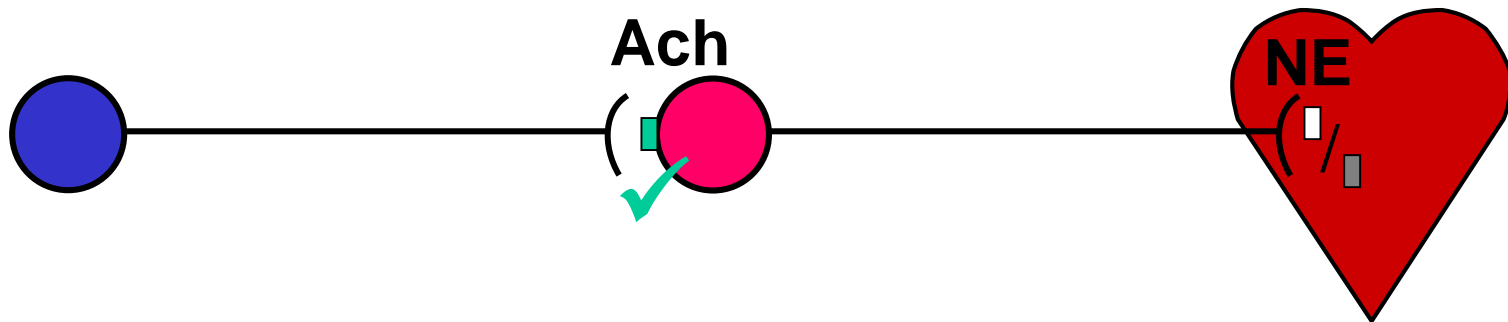


Ach = Acetylcholine

■ = Nicotinic Receptor

■ = Muscarinic Receptor

Sympathetic



NE = Norepinephrine

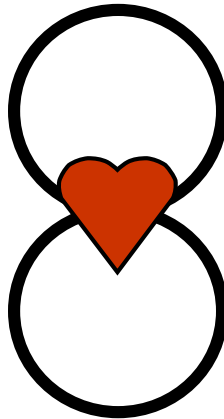
□ = α Receptor (α_1 , α_2)

■ = β Receptor (β_1 , β_2)

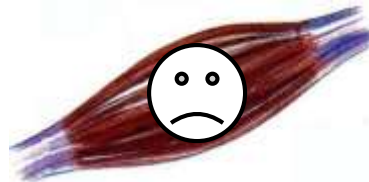
Cigarettes ≡ Patient-Assisted Drug-Delivery System Inhaling Bypasses the Systemic Circulation & Is Powerfully Reinforcing!



Pulmonary

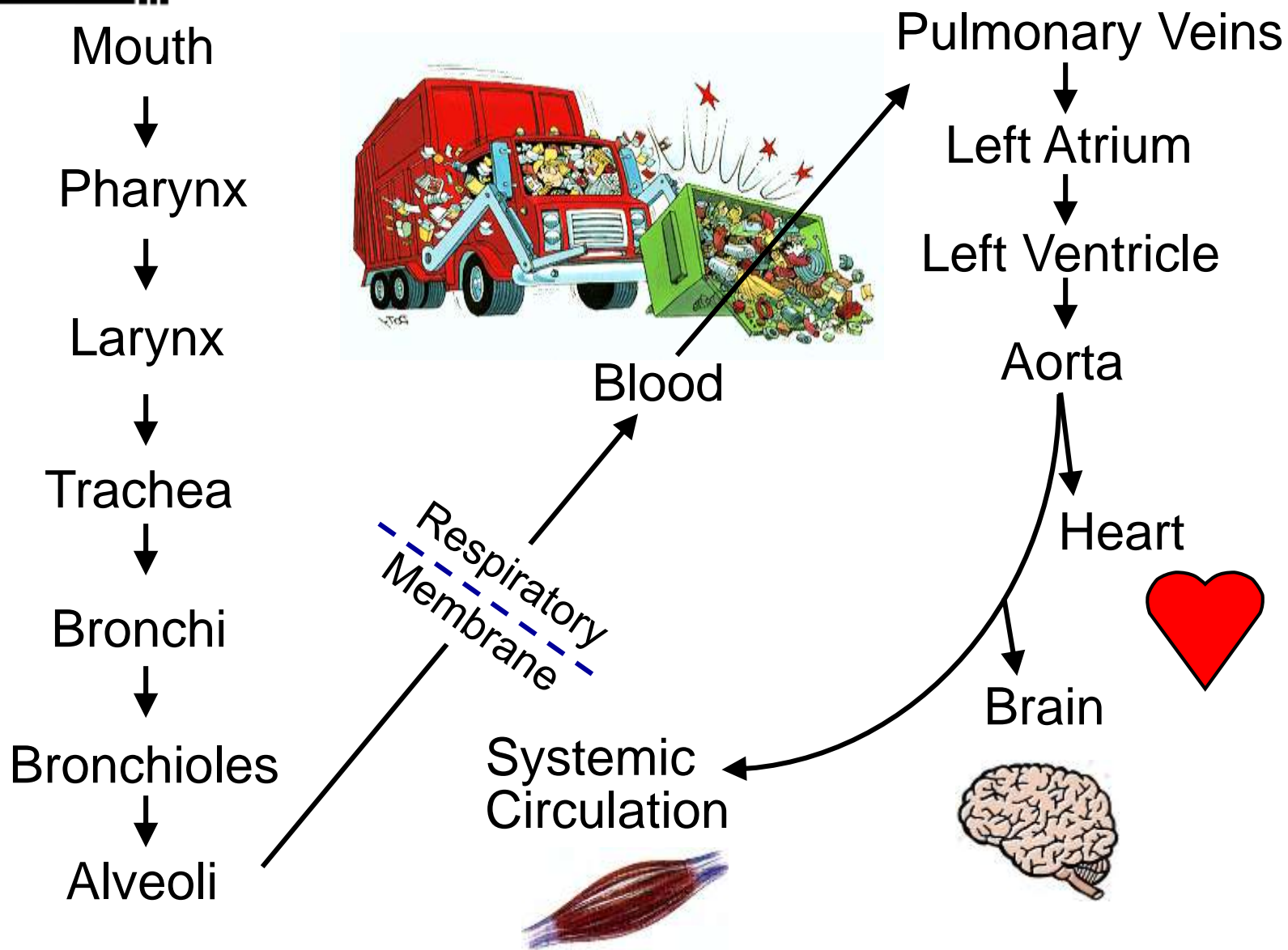


Systemic



Tracing the Route of Cigarette Smoke

Puff to Brain Time 5 to 8 seconds!!



Keep it Basic?

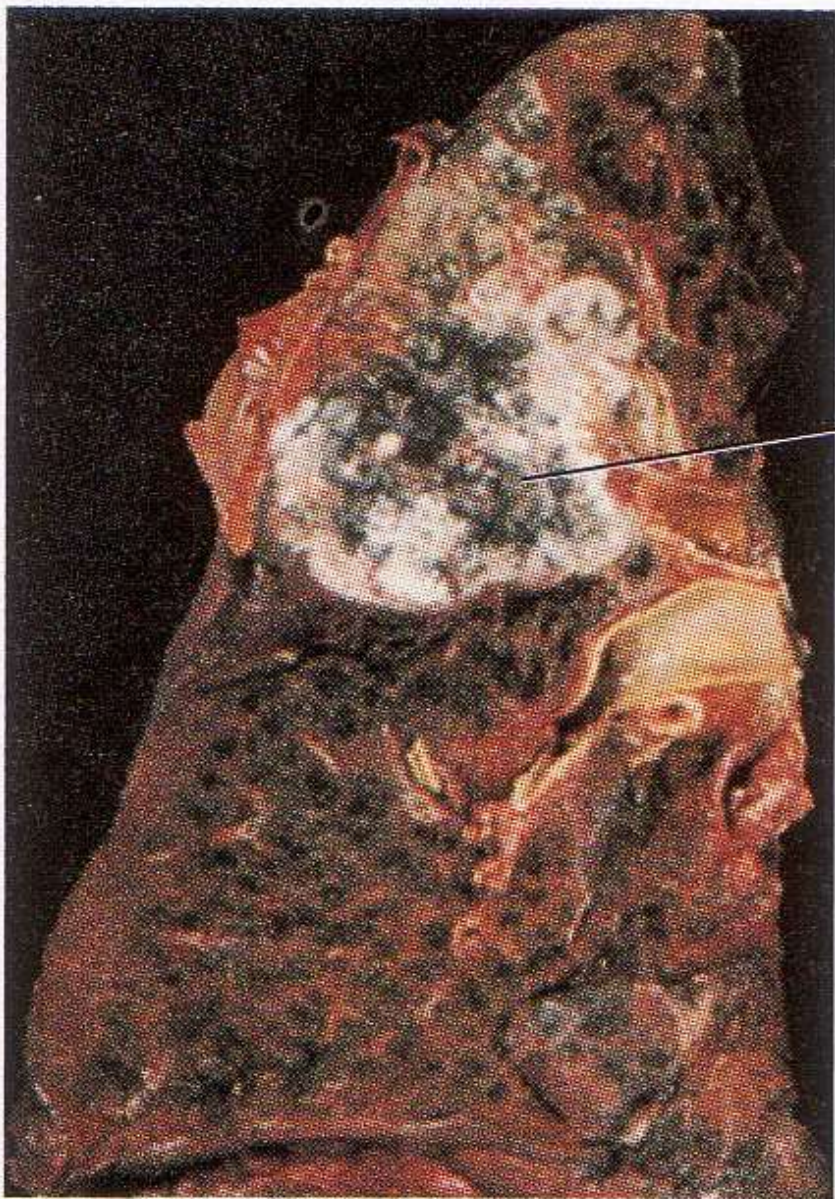
**Cigarette smoking is the
most important
preventable cause of
premature death in the
U.S. accounting for
480,000 annual deaths!**

[http://www.cdc.gov/tobacco/data_statistics/fact_sheets/
health_effects/tobacco_related_mortality/#cigs](http://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/tobacco_related_mortality/#cigs)

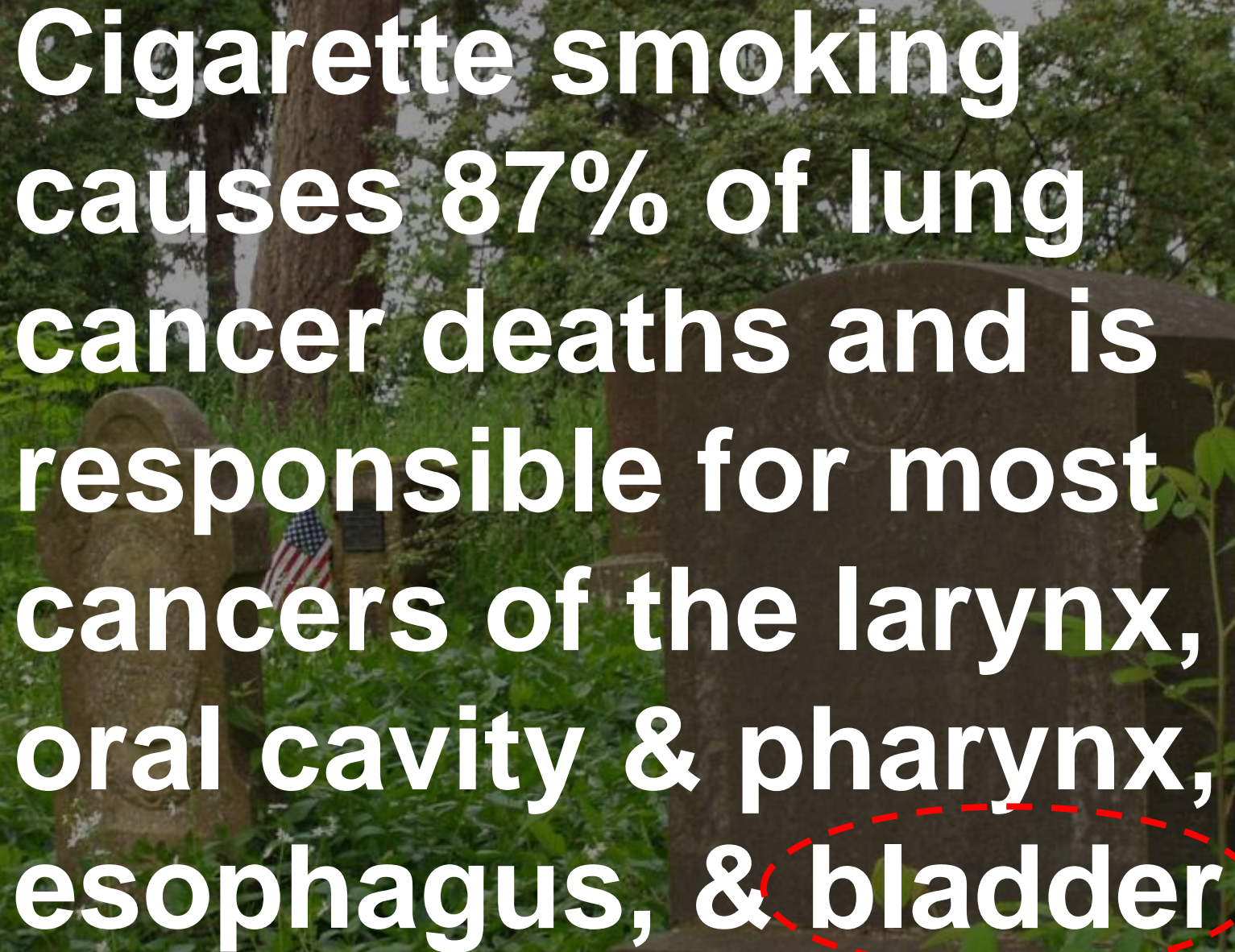
We know about lung cancer, but what about...?



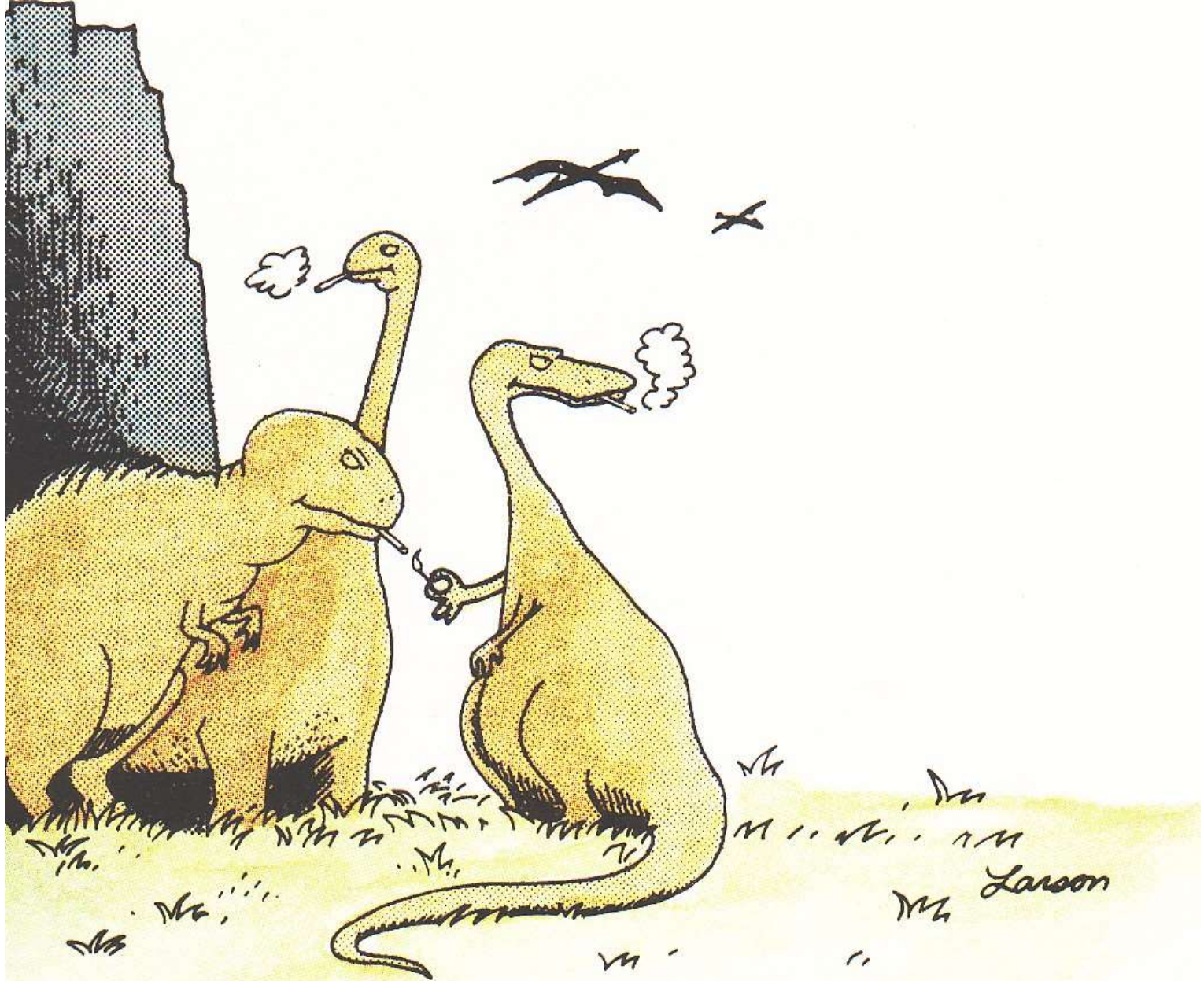
(a)



(b)



Cigarette smoking causes 87% of lung cancer deaths and is responsible for most cancers of the larynx, oral cavity & pharynx, esophagus, & bladder



The real reason dinosaurs became extinct

Macho Man?

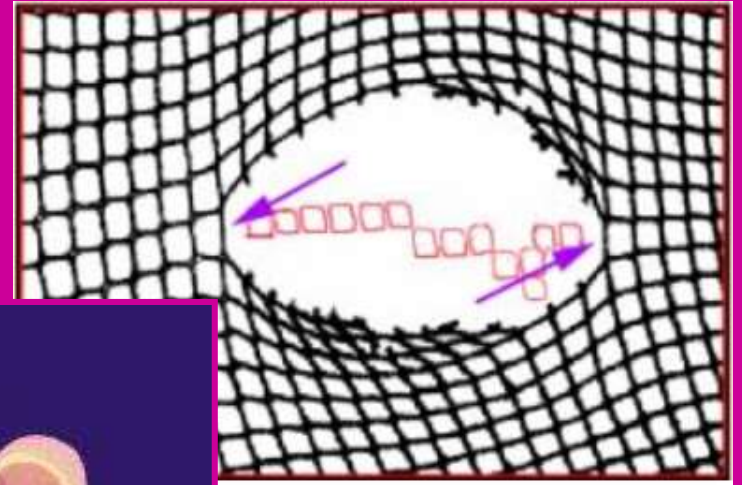
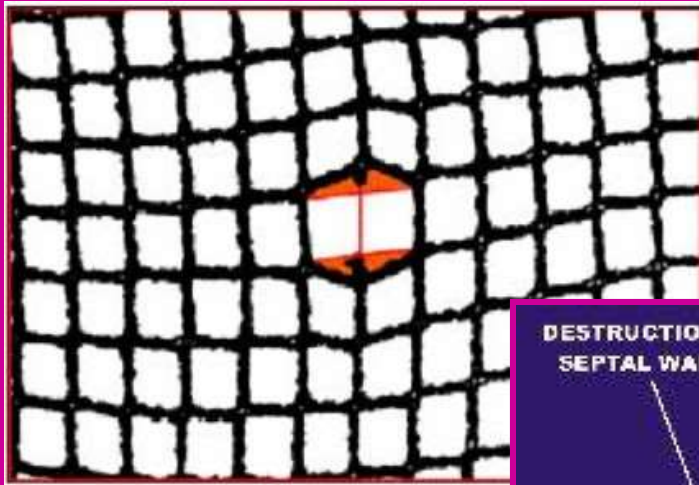


Bob, I've got Emphysema.

WARNING: Cigarette Advertising Makes
Smoking Look Cool And Cowboys Look Stupid

0A1405

Emphysema ≡ Corrosion of Alveolar Walls with ↓ SA & Labored Breathing

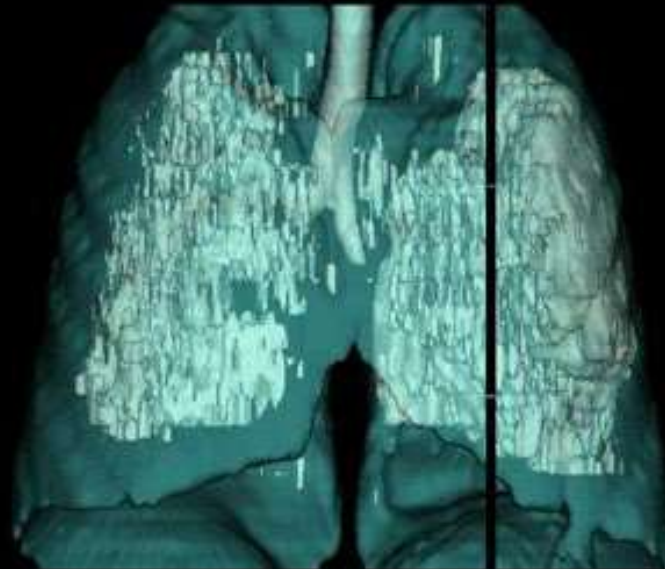
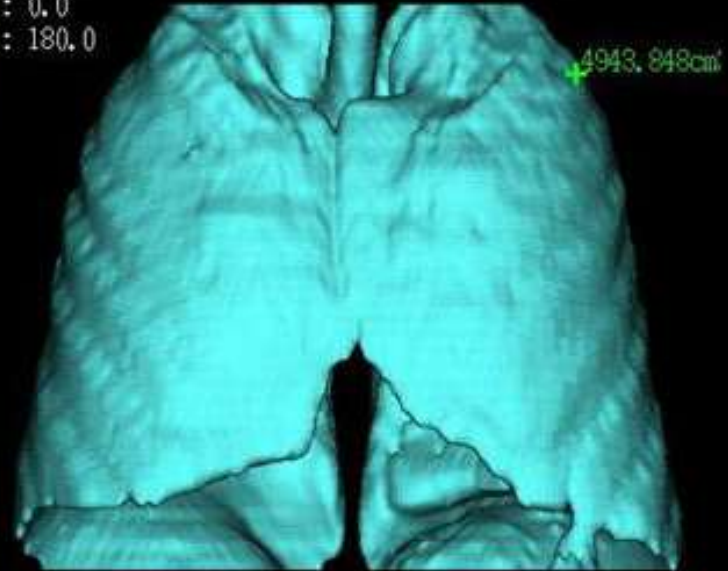


CT Densitovolumetry in Heavy Smoker with Emphysema Indicating ~ 22% Compromise of Lung Parenchyma

Y : 0.0
Z : 180.0



Y : 0.0
Z : 180.0



SOURCE: Corrêa da Silva, 2001, from *Emphysema Imaging* Ali Nawaz Khan

<https://www.tru.nc.gov/>



Terrie Hall, who has appeared in television commercials for Tobacco.Reality.Unfiltered., started smoking when she was 18. She smoked two packs a day for twenty-two years before she was diagnosed with throat cancer. She had a permanent tracheotomy and has fought cancer seven times. The photo to the right is of Terrie as a teenager. Photos: Tobacco.Reality.Unfiltered.



Why you have to tell your gynecologist you smoke. Even if it's only at parties.



You figure an occasional cigarette can't hurt, and you really don't want to listen to the "stop smoking" lecture from your doctor. But if you want any type of hormonal birth control, smoking is a vitally important issue.

Hormonal birth control is a prescription drug, and while the risks are rare, they can be serious, and smoking, even a little, increases the risks, especially if you're over 35.

Risks include blood clots, stroke, and heart attack. If you have a history of these conditions or certain cancers, you shouldn't use hormonal birth control.

Of course, you should tell your healthcare professional if you could be pregnant, and because hormonal birth control doesn't protect against HIV or sexually transmitted diseases, learn how to stay safe and healthy.

Hormonal birth control has been used safely by millions of women for 45 years, and is 99% effective when used correctly.

It could be a good choice for you. To find out, talk to your healthcare professional. And to help you get started, there's a list of questions to ask at: www.orthowomenshealth.com



Be smart about your body.
Be smart about your birth control.

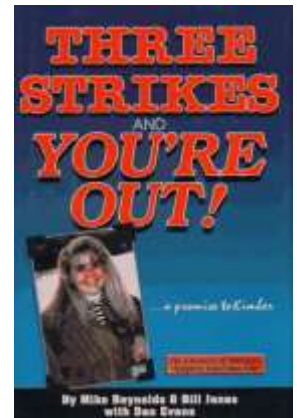
On the Pill & Smoke?

Increased Risk of:

1. Blood Clots

2. Heart Attack

3. Strokes!



**Breathing 2nd-hand
smoke for as little as
1/2 hr activates
platelets almost as
much as if you were a
pack-a-day smoker**

2nd-hand smoke is the 3rd leading preventable cause of death in the US!

A photograph of a man in a tuxedo smoking a cigarette, looking at a woman. The man is on the left, smiling slightly, with a lit cigarette in his mouth. The woman is on the right, looking towards the man. The background is a plain, light color.

"Mind if I smoke?"

"Care if I die?"

Each year ~45,000 Americans die due to 2nd-hand smoke exposure!

News: Health, Toxicology, Pollution

Health risks of e-cigarettes emerge

Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

By JANET RALOFF 4:31PM, JUNE 3, 2014



<https://www.sciencenewsforstudents.org/collections/vaping>
<https://www.intechopen.com/books/frontiers-in-i-staphylococcus-aureus-i-effects-of-electronic-e-cigarette-vapor-on-staphylococcal-virulence-are-e-cigarettes-safer-than-conv>

**As of 10/29/19, 1299 Illnesses, 29 Deaths in
49 States, Washington DC & US Virgin Islands
Vaping Causes Acute Lung Inflammation &
Decreased Gas Exchange**

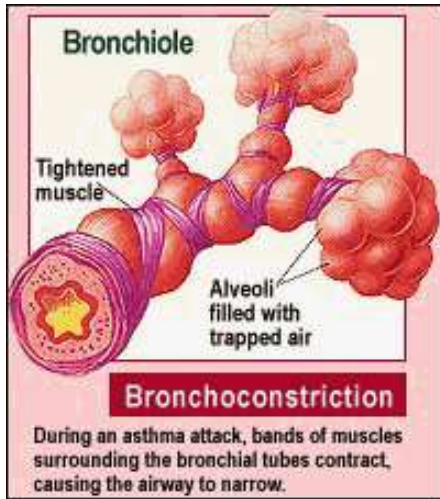


<https://www.sciencenews.org/article/vaping-tied-nearly-1300-lung-injuries-29-deaths-united-states>

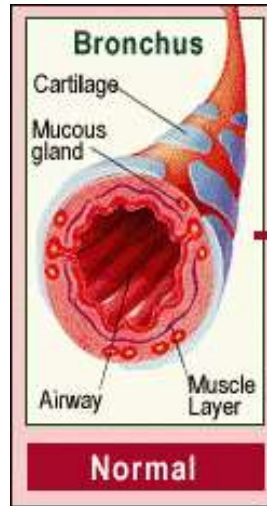
<https://www.physiology.org/doi/full/10.1152/ajplung.00492.2018>

<https://www.npr.org/sections/health-shots/2019/10/10/768588170/how-vaping-nicotine-can-affect-a-teenage-brain>

SMOKING ≡ ASTHMA?



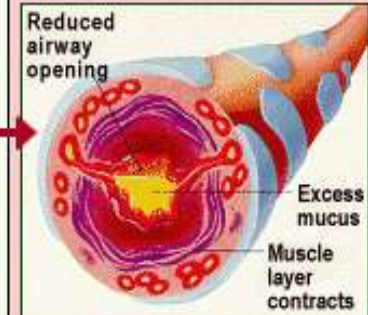
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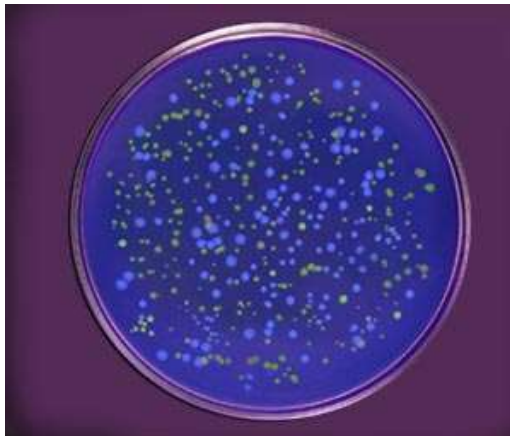
Asthma Triggers

- Allergens
- Drugs
- Exercise
- Occupational stimuli
- Infections
- Environmental changes
- Air pollutants
- Chemical irritants
- Emotions
- Weather/Temp.
- Food additives

Inflammation

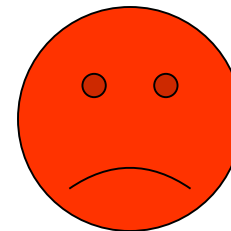


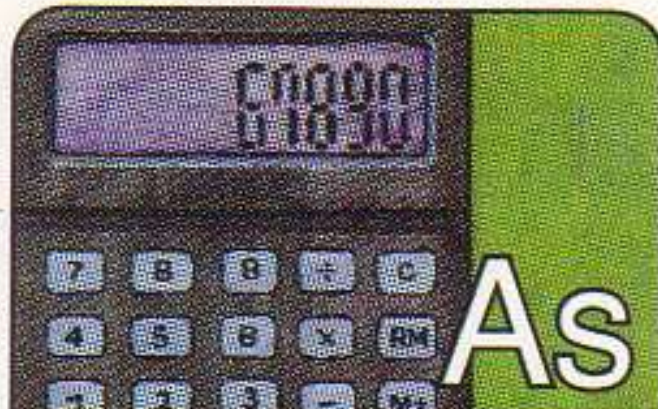
=



Petri-dish Effect

Ugh!!
Cough!
Cough!!






As

Arsenic 33

- o Shotgun pellets
- + Metal for mirrors
- v Glass, lasers
- v **Light emitting diodes=LED**
- x 74.9216



Po

Polonium 84

- o **Nuclear batteries**
- o Neutron source
- o Antistatic agents
- o Film cleaner
- x (209)



Sunflowers are planted along with our organic tobacco to attract beneficial insects to protect our organic crops...



To be buried with
sunflowers?
Compost?

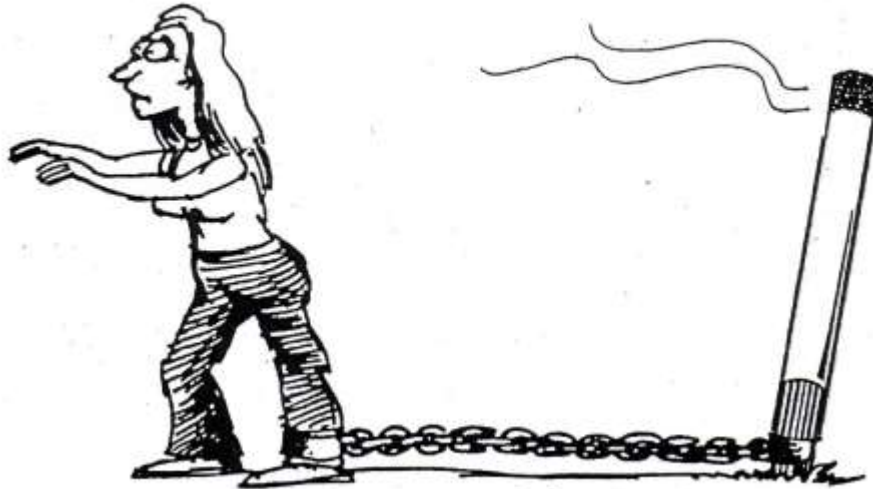


Cigarettes & 2nd-hand smoke!!

...and to **avoid** the use of chemical pesticides.



Cigarettes got you on a tight leash?



Free Yourself

Smoking Cessation

Workshop

Wednesdays, 3:30-4:30 p.m.
January 22 to March 5, 1997

Student Health Center, Medical Library
Free to UO students

Call 346-4456 to register

**Thanks for
helping us
for > 20 yr!!**



Stop Smoking Through Acupuncture

If you're serious about quitting the smoking habit, now's your chance.
In honor of the great American Smoke Out



Tom Williams, a licensed acupuncturist in Eugene, provides stop-smoking treatments to relieve cravings and irritability at the four-session stop smoking workshop that begins at the Health Center November 18th in conjunction with the Great American Smokeout on November 19th. Call 346-4456 to sign up.

Educational Session*

Wednesday, November 18, 4-5 pm

*You must attend this session in order to receive acupuncture treatment.

Acupuncture Sessions

Thursday, November 19, 4-6 pm

Friday, November 20, 4:30-6 pm

Monday, November 23, from 4:30-6 pm

All sessions meet in the medical library in the basement of the University Health Center.

**Space is limited, so sign up now
by calling the Health Education
office at 346-4456.**

\$30 fee that will be donated to the American Lung Association is requested.

U N I V E R S I T Y

HEALTH CENTER

We're a matter of degrees ◆

Open daily 8 a.m. to 6 p.m., except Tuesdays (9 a.m.) and Sundays (10 a.m.).
Appointments and after hours: 346-2770 • Web: darkwing.uoregon.edu/~uoshc

Nicotine Addiction & Help Quitting Smoking

[http://www.cancer.org/healthy/stayawayfromtobacco/guide toquittingsmoking/guide-to- quitting-smoking-help-phys-nrt](http://www.cancer.org/healthy/stayawayfromtobacco/guide-toquittingsmoking/guide-to- quitting-smoking-help-phys-nrt)

2nd-Hand Smoke or ETS & 3rd-Hand Smoke?

[http://www.cancer.org/cancer/cancercauses/tobaccocancer/ secondhand-smoke](http://www.cancer.org/cancer/cancercauses/tobaccocancer/secondhand-smoke)

2nd-Hand Smoke Addictive?

[http://www.ncbi.nlm.nih.gov/pubmed?term=2nd%20hand %20smoke%20addictive](http://www.ncbi.nlm.nih.gov/pubmed?term=2nd%20hand%20smoke%20addictive)

<http://www.ncbi.nlm.nih.gov/pubmed/20211642>

<http://www.ncbi.nlm.nih.gov/pubmed/19936715>

<http://www.ncbi.nlm.nih.gov/pubmed/21840504>

Vaping & Lung Injury?

<https://www.ncbi.nlm.nih.gov/pubmed/?term=vaping+lung+injury>

