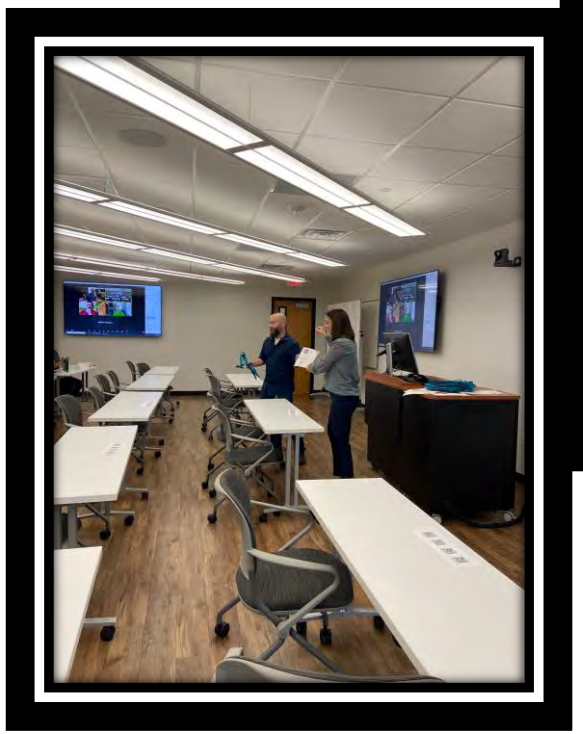
ECDC -- Summer 2021 Quarterly Meeting – Up Goer 5 Challenge



Hi, I am me, and I study noses.

We know that people around the world have noses that look different, and we are pretty sure this is because their noses help to get air ready to go into the two big air-bags [CLICK] inside their chest. This is important, because the air going into the air-bags has to be as hot and wet as the inside of the body. That's 37 things of hot (or 98 things of the other kind of hot) and all the way filled with water-smoke [CLICK] (that's the kind of water that is not water-ice or water-water). If the air we breathe is not made to be 37 things of hot and completely filled with water-smoke, then our air-bags will get very dry. And having dry air-bags is bad.

First, having dry air-bags keeps us from being able to get all the good stuff [CLICK] from the air we need to live. And also keeps us from breathing out all the bad stuff [CLICK] that is slowly trying to kill us.

Drying also lets very small and very bad not-animals grow in our nose, throat, and air-bags. This used to kill a lot of people before we learned how to make the [CLICK] not-animal death shot,

and still kills a lot of people today who can not easily get a not-animal death shot.

But usually, the nose is really good at adding enough hot and water-smoke to the air we breathe. That is because the nose is packed full of hot blood pipes [CLICK] and can make a lot of its own water-water.

So when we breathe in, [CLICK] air is able to pick up almost all the hot and water-smoke needed for it to enter the air-bags just by passing through the nose.

Now, because air in some places of the world is colder and/or drier than in other places, some people have to add more hot and water-smoke to the air they breathe.

The nose is where most of this added hot and water-smoke comes from, but how a person's nose is put together makes it more or less able to add hot and water-smoke to air.

We have known for a long time that people from hot-wet places found along the [CLICK] great make-believe line that goes around the middle of our world usually have short and wide noses [CLICK], while people living at the top of the world where it is very cold and dry [CLICK] usually have very tall and not-wide noses.

People who think a lot about noses (like me), think this is because short and wide noses make it very easy to breathe [CLICK], which is good because the hot-wet air found near the make-believe middle-of-the-world line does not need very much hot or water-smoke added to it.

Also, having a short-wide nose may actually help these people lose hot from their body when they breathe out, helping to keep their body from getting too hot (which can also kill them).

While tall and not-wide noses make breathing a little harder [CLICK], we think it helps to add more hot and water-smoke to air when breathing in. This is important in cold-dry places where people need to add lots of hot and water-smoke to air so that their air-bags do not dry out and make them dead.

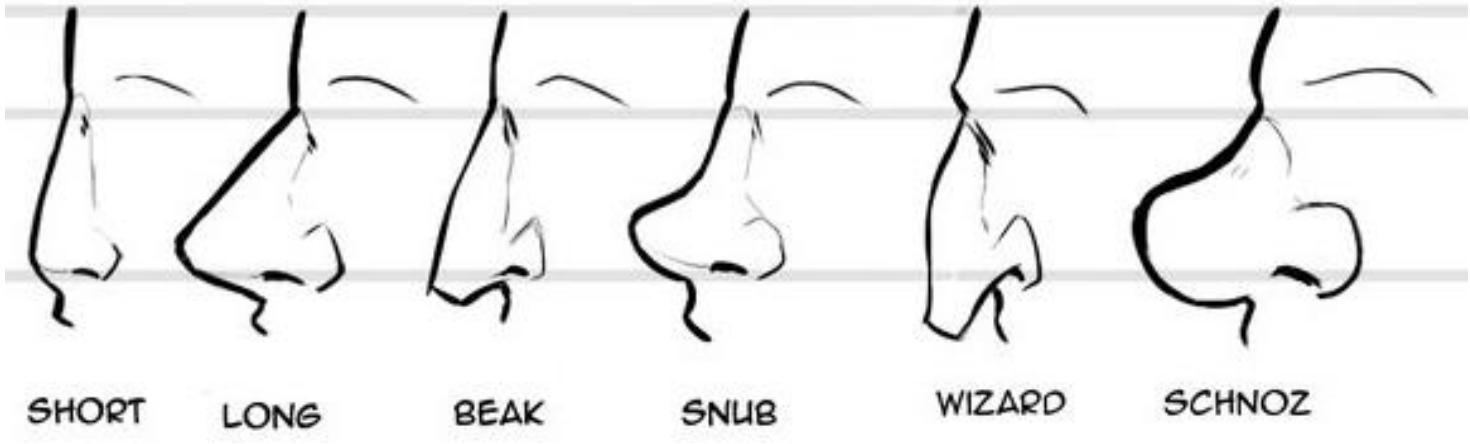
However, because it is hard to actually see how much hot and water-smoke is inside a persons nose [CLICK], we really don't know if these ideas are actually why people from around the world have noses that are put together different.

This is why the people in my school room are working with people at another school who study how air moves around flying things (like up-goers and air-cars) to see if we can use really strong and fast computers to figure out what really happens when air moves through the nose.

We hope this will eventually let us help people who have problems with their nose or air-bags so we can keep them from getting sick or dead. And we actually just got help from the people with the big money bags for this one.

Climate and the Human Nose

Linking evolutionary anatomy and physiology



Scott D. Maddux, PhD

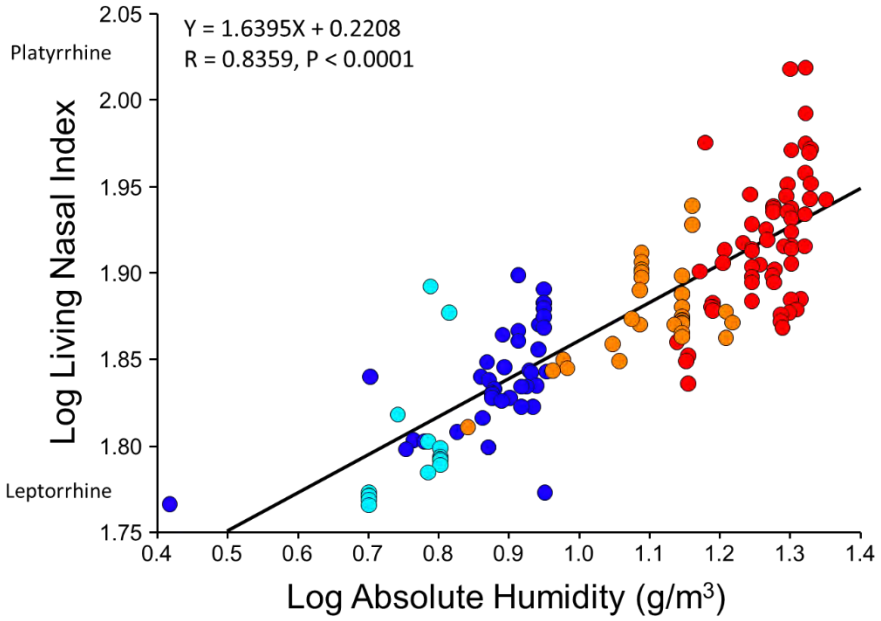
Assistant Professor

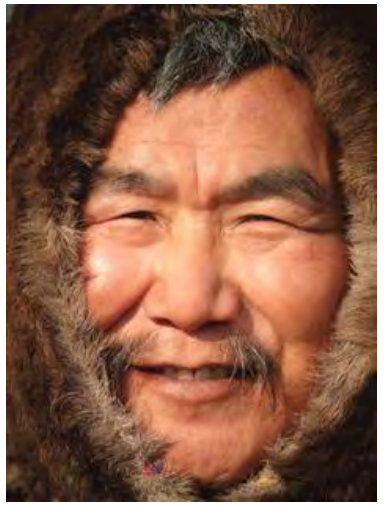
Center for Anatomical Sciences, GSBS

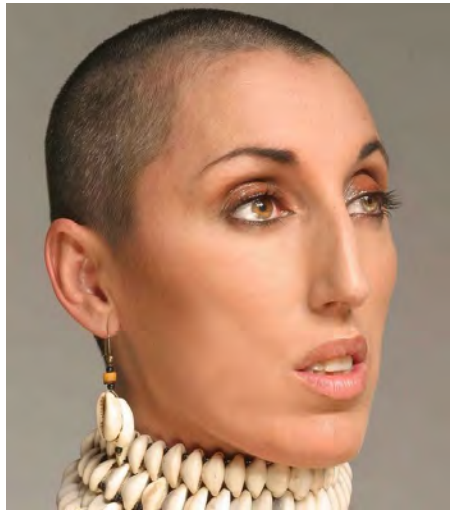
THE UNIVERSITY of NORTH TEXAS
HEALTH SCIENCE CENTER at FORT WORTH

Ecogeographic Variation in Nasal Morphology

Ancestral variation in nasal morphology is statistically associated with geographically-patterned climatic variables







Pulmonary Requirements

Air entering lungs must be at core body temperature (37°C) and 100% saturated with water vapor

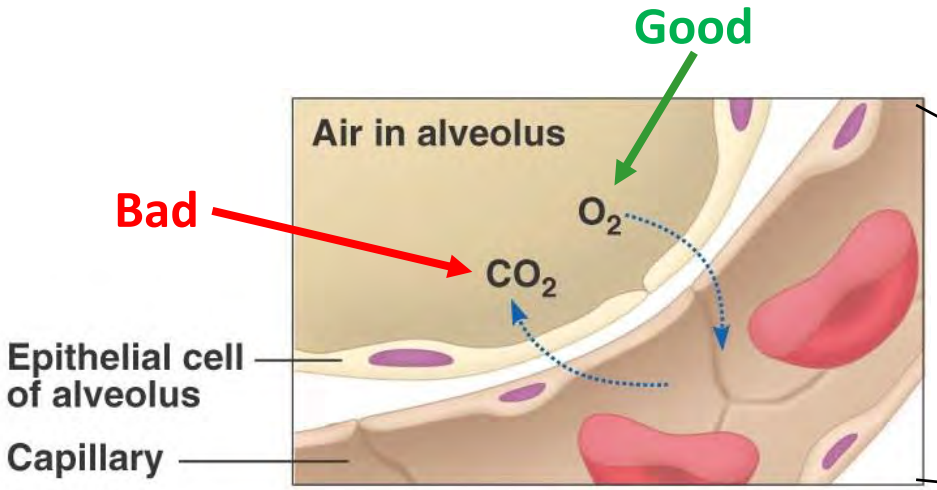
Ice Water Vapor

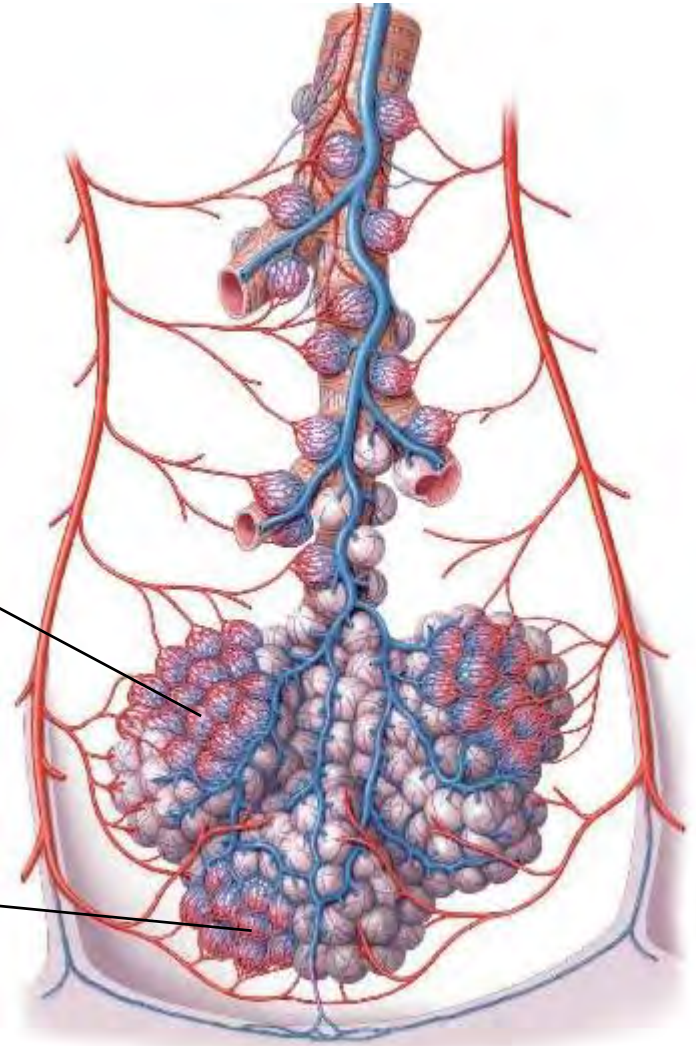
Lungs

Pulmonary Requirements

Air entering lungs must be at core body temperature (37°C) and 100% saturated with water vapor

Facilitates pulmonary gas exchange (O_2/CO_2)





Pulmonary Requirements

Air entering lungs must be at core body temperature (37°C) and 100% saturated with water vapor

- Facilitates pulmonary gas exchange (O_2/CO_2)
- Prevents desiccation of lung tissues

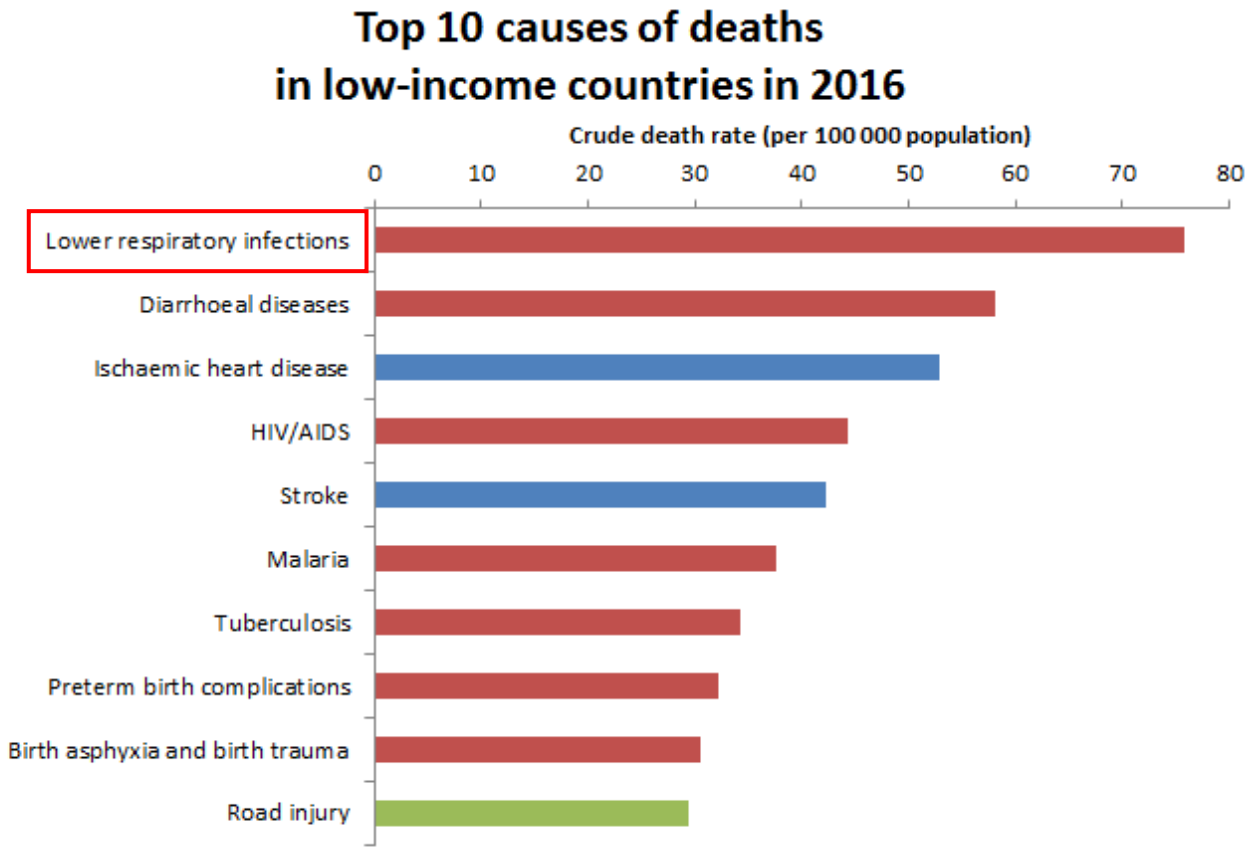
Pathogens

Pulmonary Requirements

Air entering lungs must be at core body temperature (37°C) and 100% saturated with water vapor

Facilitates pulmonary gas exchange (O_2/CO_2)

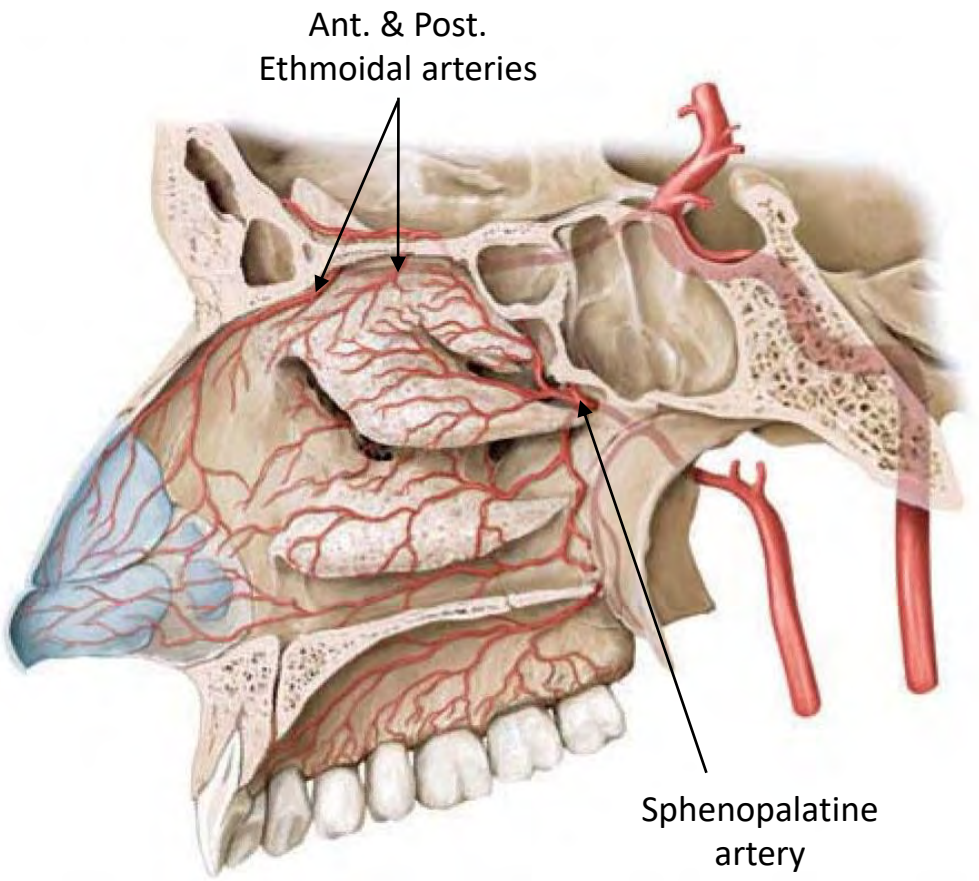
Prevents desiccation of lung tissues



WHO 2018

Nasal Air-Conditioning

Nose accounts for 90-95% of inspiratory heat and moisture exchange



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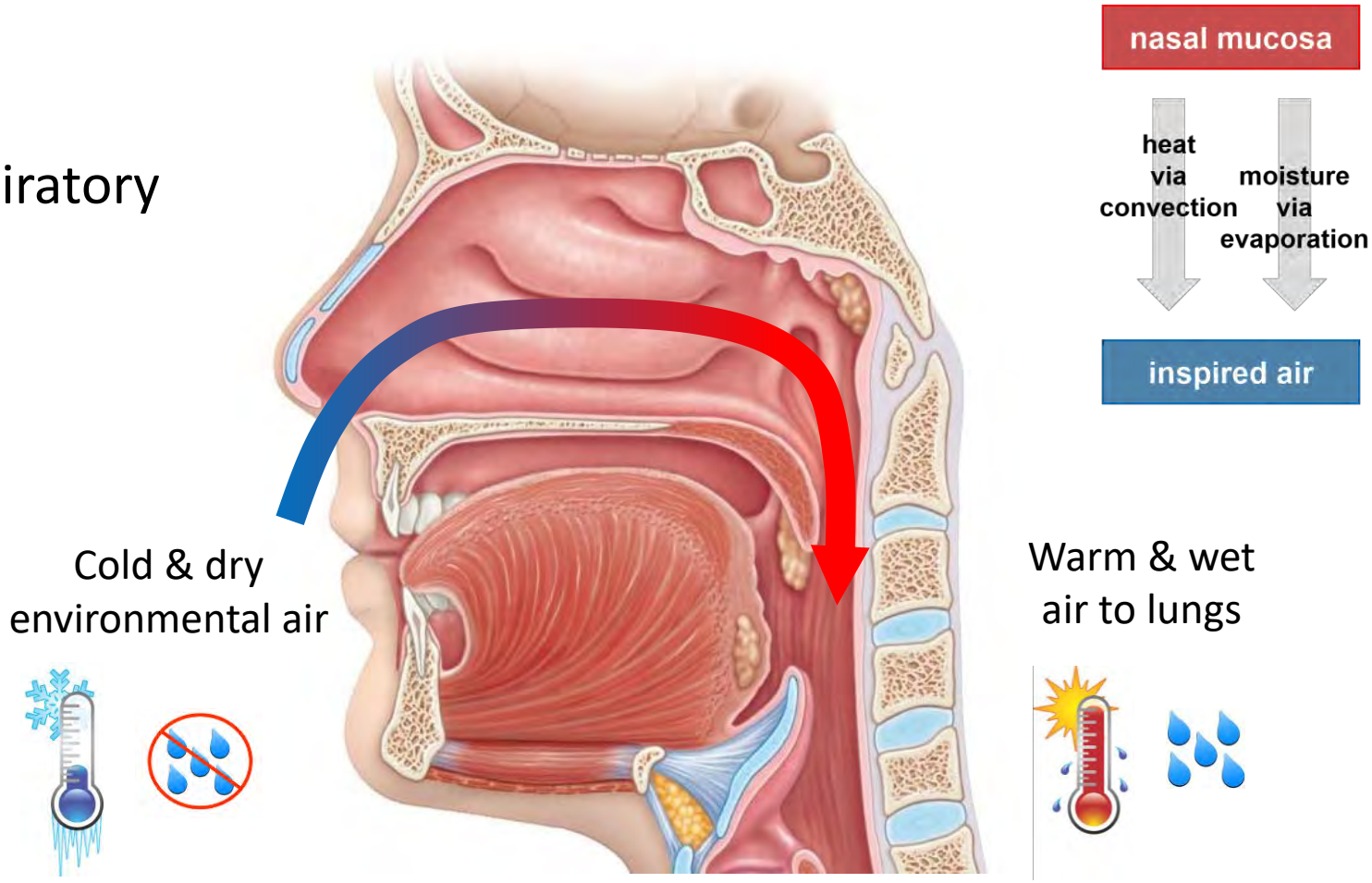


Climatic Pressures

Depending on geographic locale and season, humans need to transfer more/ less heat and moisture to inspired air

Hot-dry air

Hot-wet air

Cold-dry air

Nasal Morphology and Climate

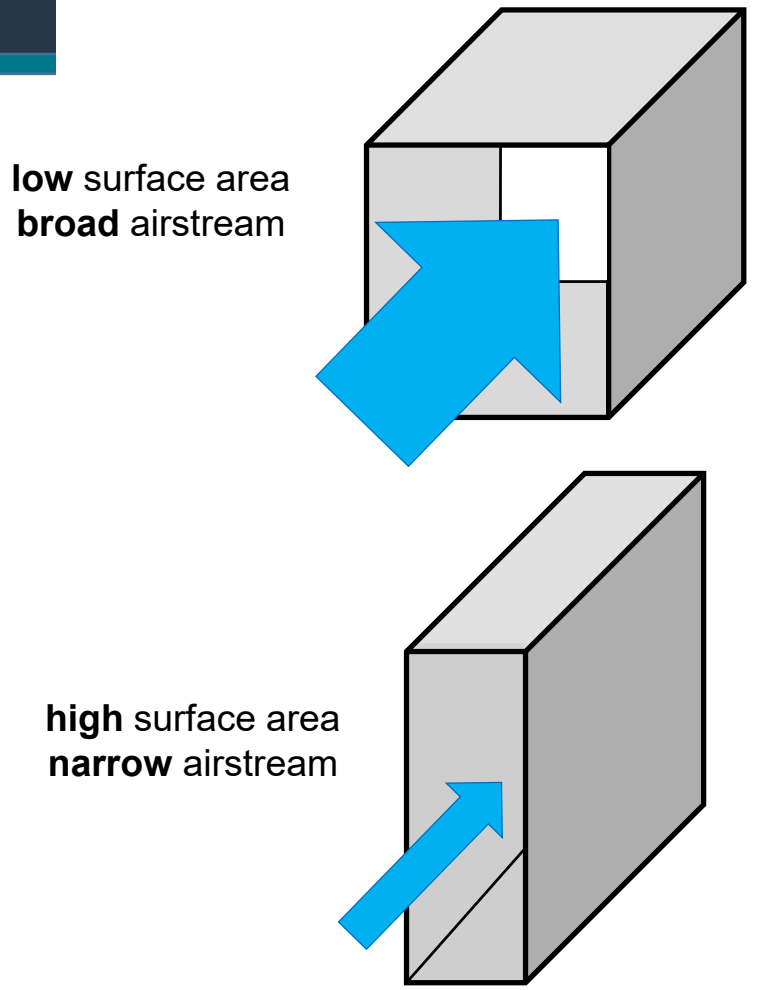
Schmidt-Nielsen et al. (1970)

Intranasal heat & moisture exchange depends on three parameters:

1) **total surface area available**
2) **distance from the center of the airstream to the surface**

Anatomical

3) velocity of air flow



Simple geometric models of nasal passages

Nasal Morphology and Climate

“Thomson’s Rule”

Thomson and Buxton (1923):

Data from 15,000 individuals from 147 global populations

Humans from **equatorial** (hotter/wetter) environments exhibit **shorter/wider noses**

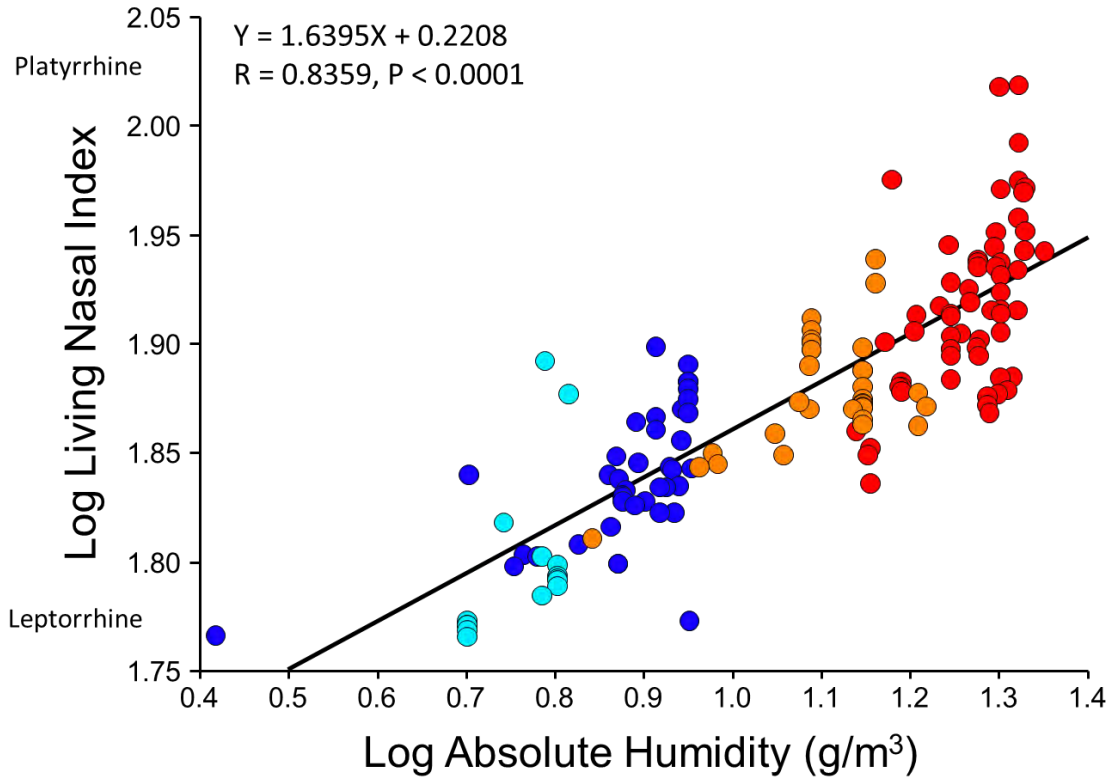


Figure from Maddux et al. (2016)

Nasal Morphology and Climate

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Thomson and Buxton (1923):

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Humans from **equatorial** (hotter/wetter) environments exhibit **shorter/wider noses**

Humans from **higher latitude** (colder/drier) environments exhibit **taller/narrower noses**

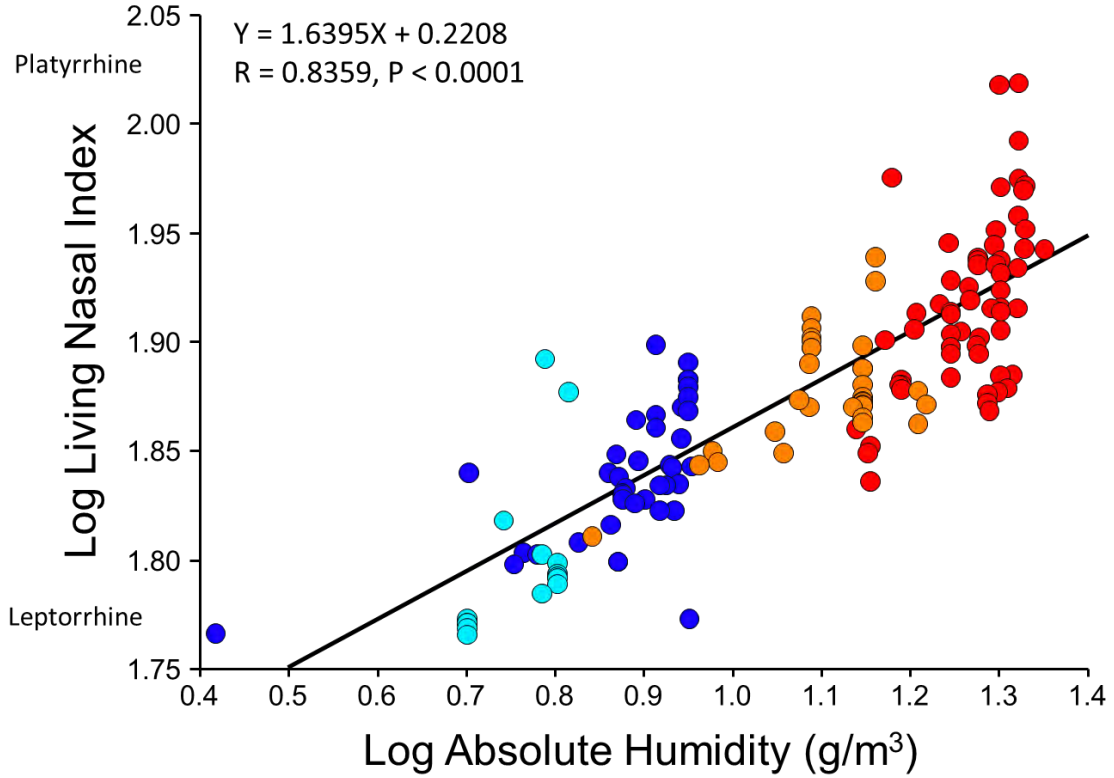


Figure from Maddux et al. (2016)

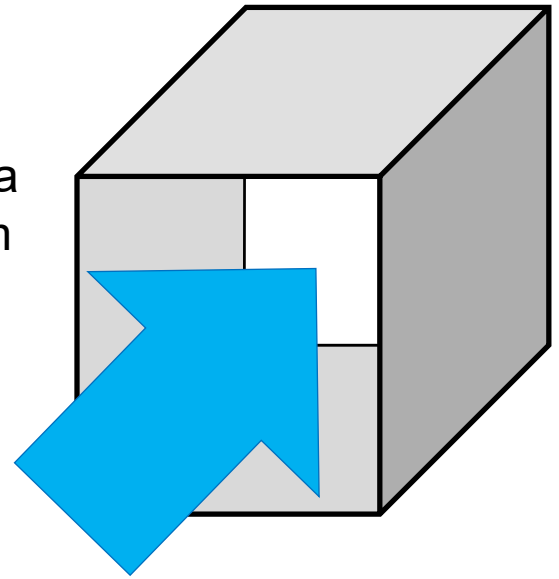
Nasal Morphology and Climate

“Thomson’s Rule”

Thomson and Buxton (1923):

Humans from equatorial (hotter/wetter) environments exhibit shorter/wider noses

Hot-Wet



low surface area
broad airstream

Less resistance
Minimal heat and moisture exchange

Nasal Morphology and Climate

"Thomson's Rule"

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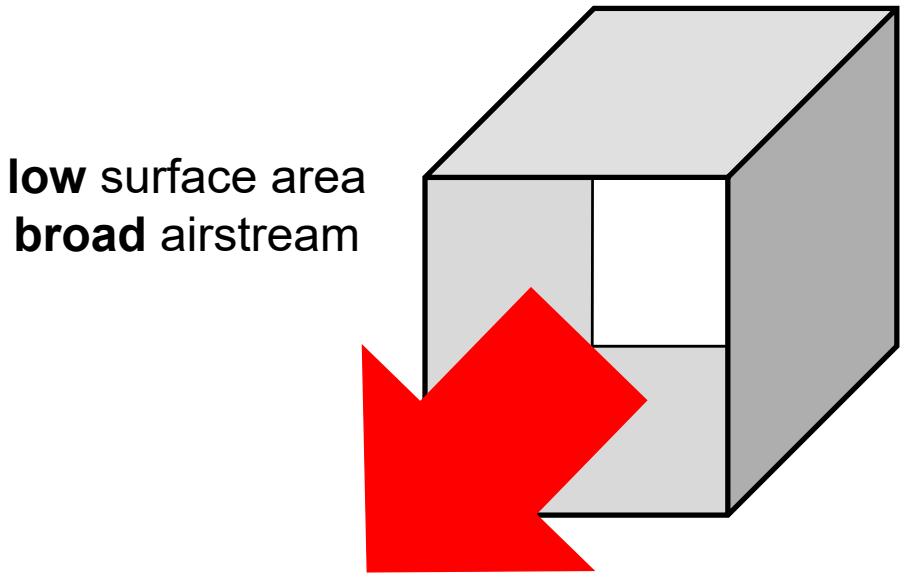
Hot-Wet



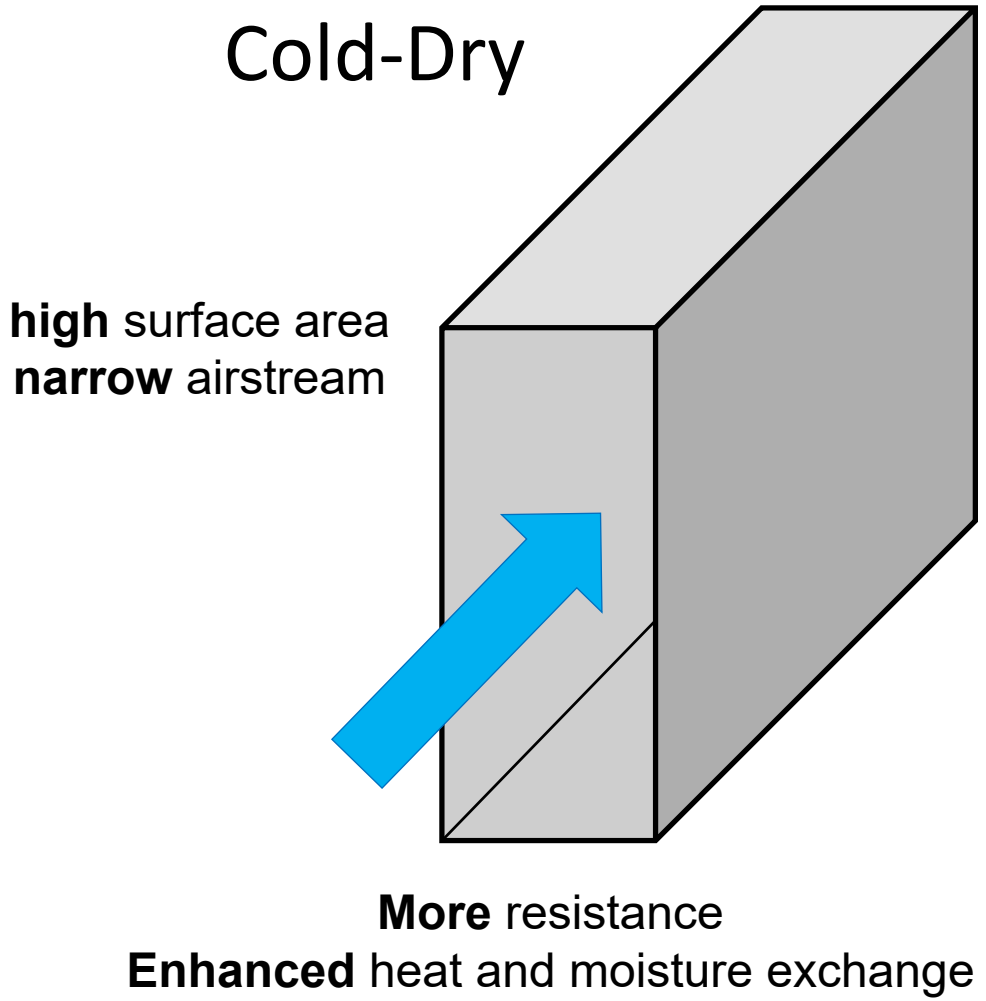
Increased **heat loss** during **expiration**

Nasal Morphology and Climate

“Thomson’s Rule”

Thomson and Buxton (1923):

Humans from high-latitude (colder/drier) environments exhibit taller/narrower noses

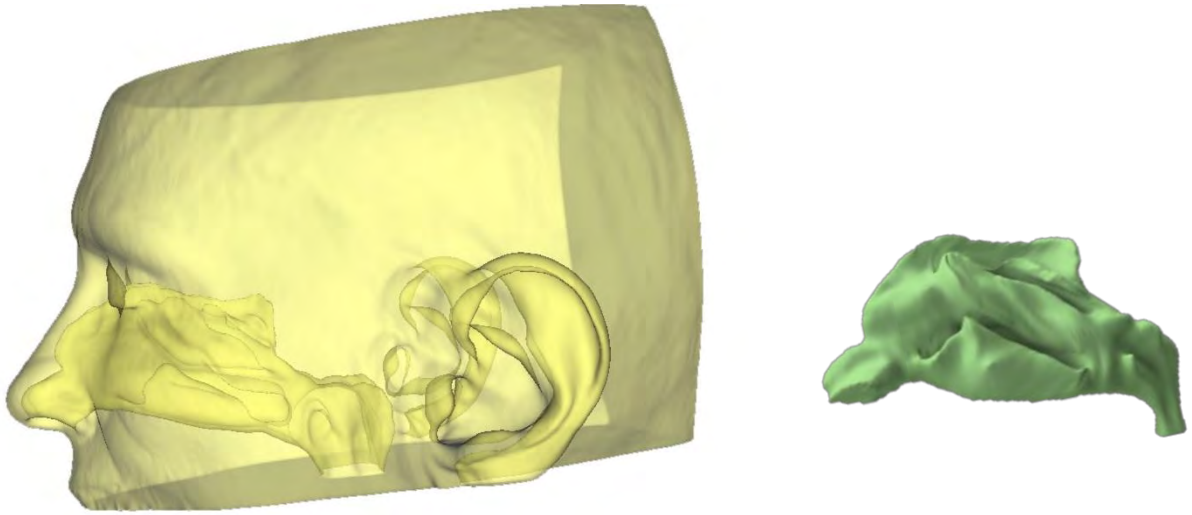


Ongoing Research

Testing hypothesized relationships between nasal anatomy and air-conditioning physiology is “challenging”…

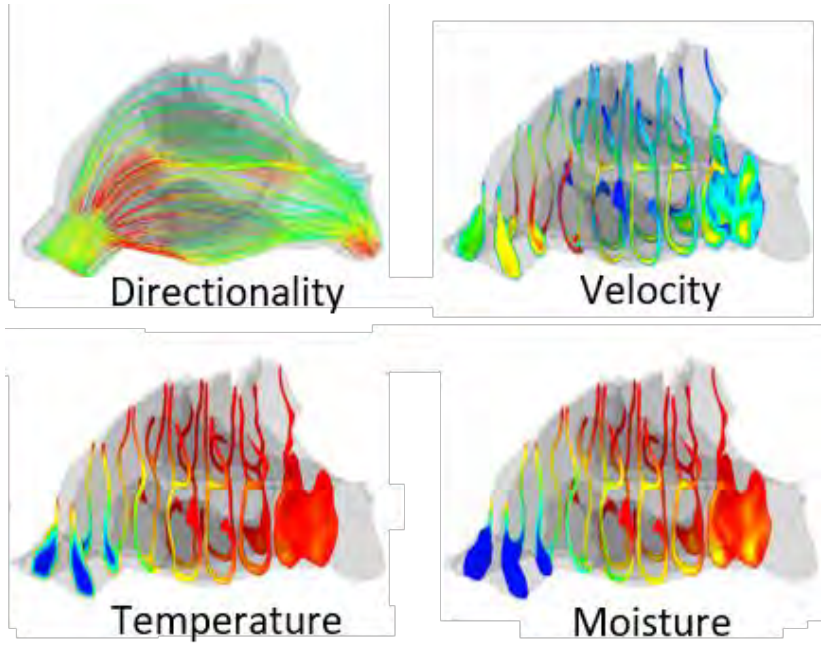
(we’re doing it anyway)

Ongoing Research



3D modeling of nasal passage anatomy

Maddux Lab
Center for Anatomical Sciences, UNTHSC

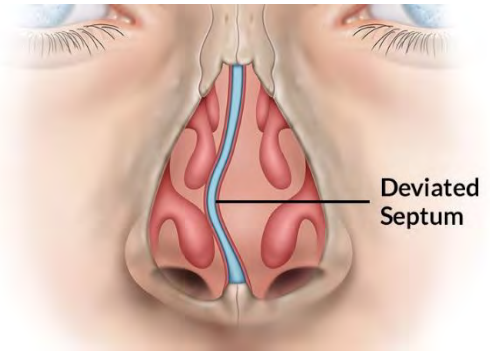


Computational Fluid Dynamics Analysis of nasal airflow

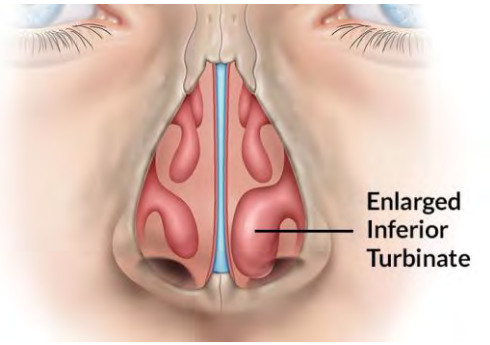
Dennis Lab
Dept. of Mechanical & Aerospace Engineering
UT-Arlington

Future Research

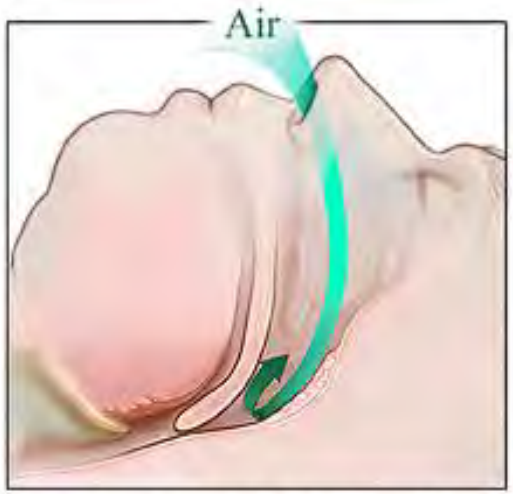
Septal deviation



Turbinate hypertrophy

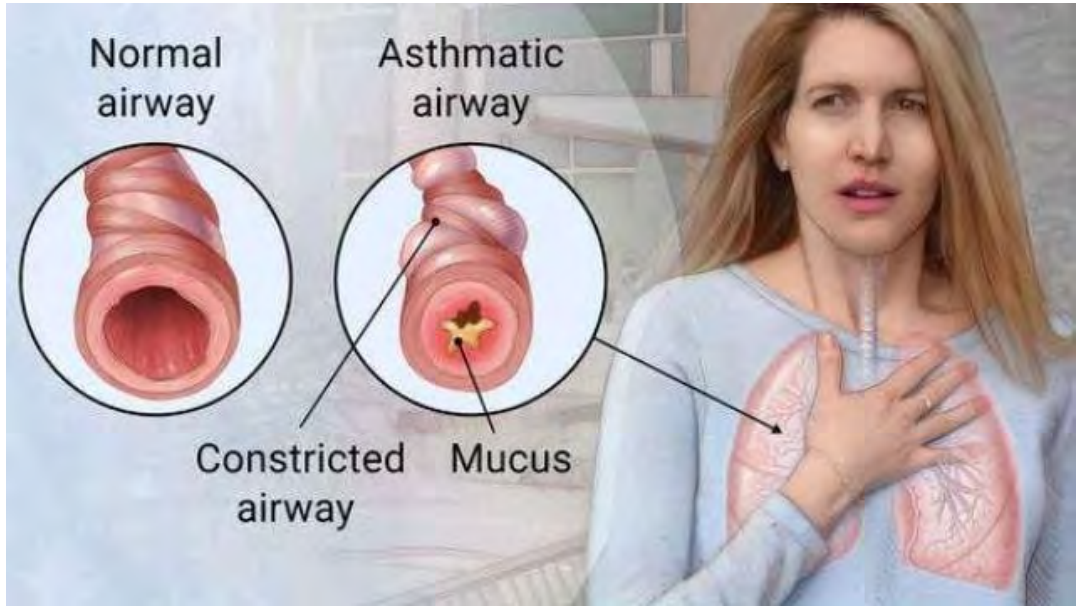


Sleep Apnea



Airway is blocked and
air does not move through

Cold/Exercise-induced Bronchoconstriction (Asthma)



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Texas Center for Health Disparities

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Maddux Lab

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- Graduate School of Biomedical Sciences
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AMERICAN ASSOCIATION FOR ANATOMY

NSF National Science Foundation WHERE DISCOVERIES BEGIN

Texas Center for Health Disparities