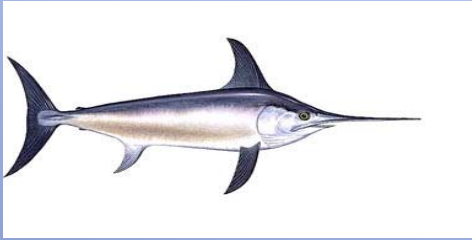


There are many Challenges in Modern Medicine

- Our ability to treat disease well beyond our ability to pay for it
- Expectation is extremely high
- The compensation structure for physicians, hospitals and medical institutions is far from optimal
- The subspecialty structure of physicians may add some limitations to solve problems

Highlight how we might go beyond our subspecialty structure and use nature to help approach problems

- Examine an old issue- how engineers used nature to help with supersonic aircraft
- Examine a ongoing issue- artificial blood
- Review a current and future issue- hospital acquired infection-can nature help?



Why does a swordfish
have a sword?

Is it used to Shish Kabob dinner?



There are two types of fish

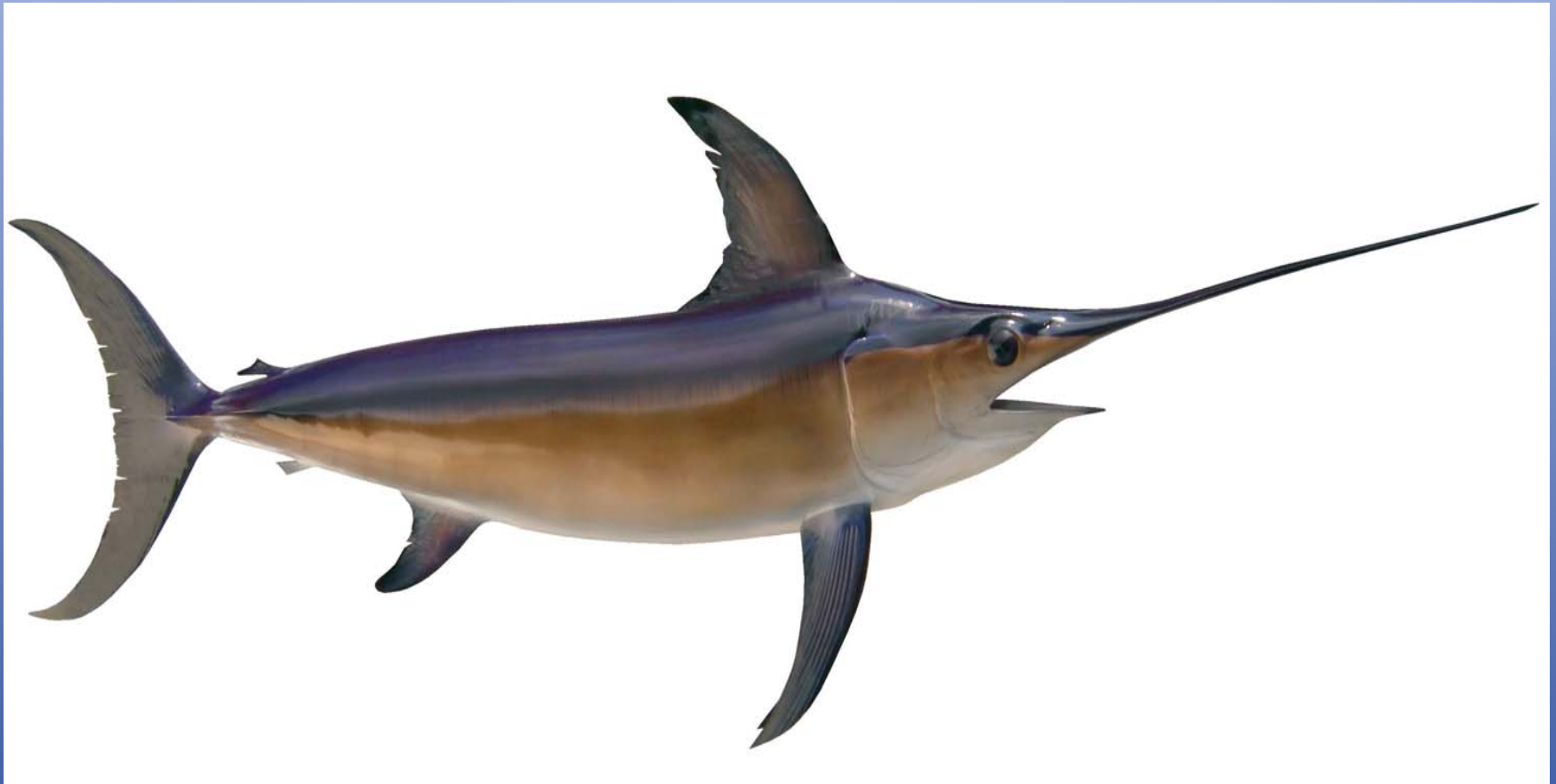


- Some fish wait for dinner to land in front of their face. These include Bass, Carp, Goldfish, puffer fish, and others
- Some fish must chase dinner. Sharks, Barracuda and Swordfish
- Many fish that chase dinner don't waste energy pumping gills





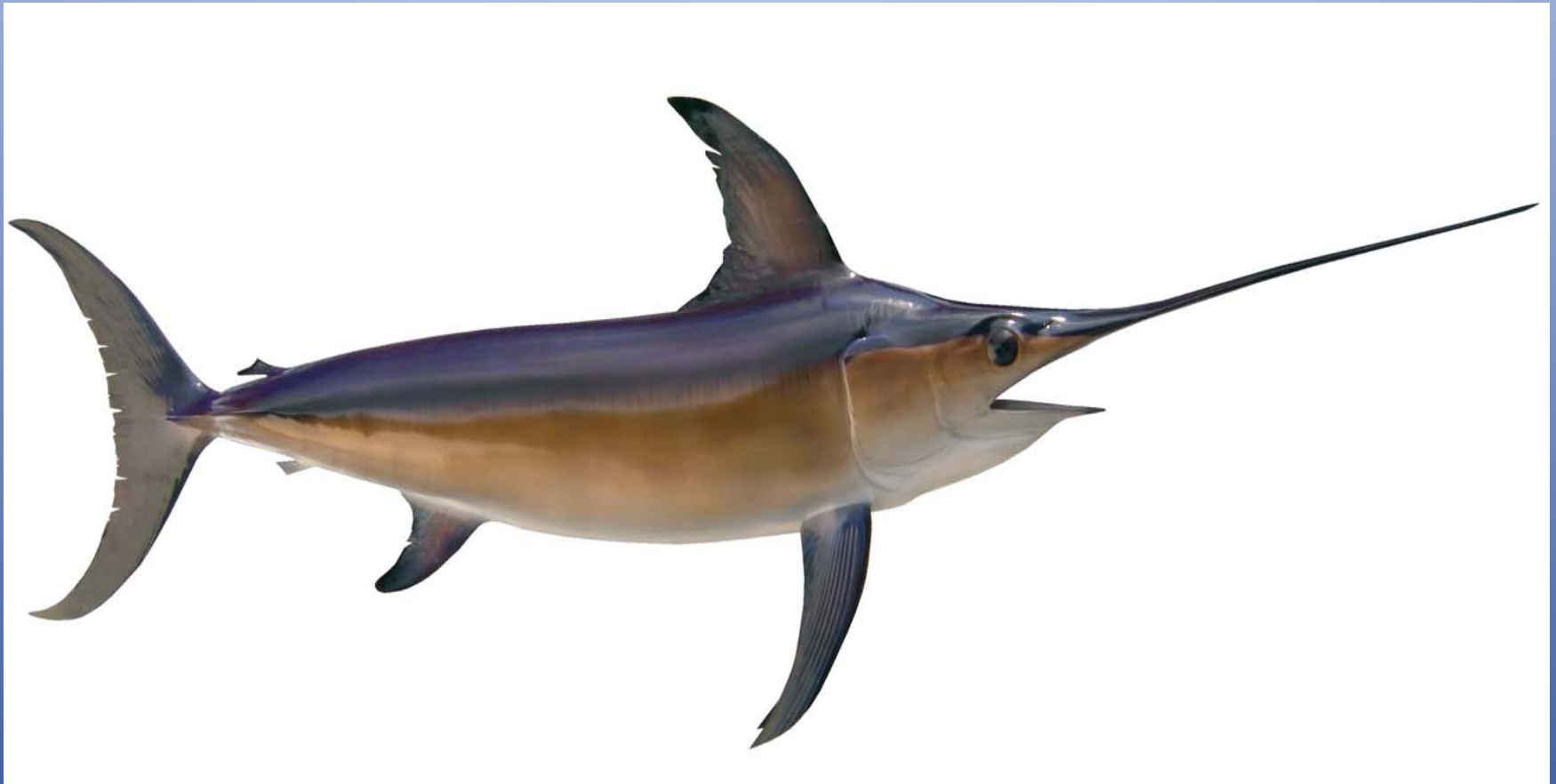
PUFFER FISH
PUMPS GILLS



swordfish doesn't pump their gills
they have a "ram" water system

Aircraft engineers had a challenge in the early 1950's

- How does one design a supersonic aircraft that will be supersonic at high altitude (little oxygen) without computer aided design
- At supersonic speeds air becomes incompressible like water.
- Supersonic wind tunnels don't yet exist
- Answer, look to nature –use swordfish as a model



The sword helps direct water into mouth



F-16



A-5 Vigilante



SUPERSONIC CONCORDE

Research on Artificial blood

Over a dozen manufactures

Millions of dollars over 30 years

[Home](#) » [Science & Technology](#) » **Artificial Blood**

SCIENCE / TECHNOLOGY

FEBRUARY 23, 2009 | VOLUME 87, NUMBER 08 | PP. 52-55

Artificial Blood

Poor clinical trial results and controversy stymie attempts to create alternatives to donated blood

[Sarah Everts](#)

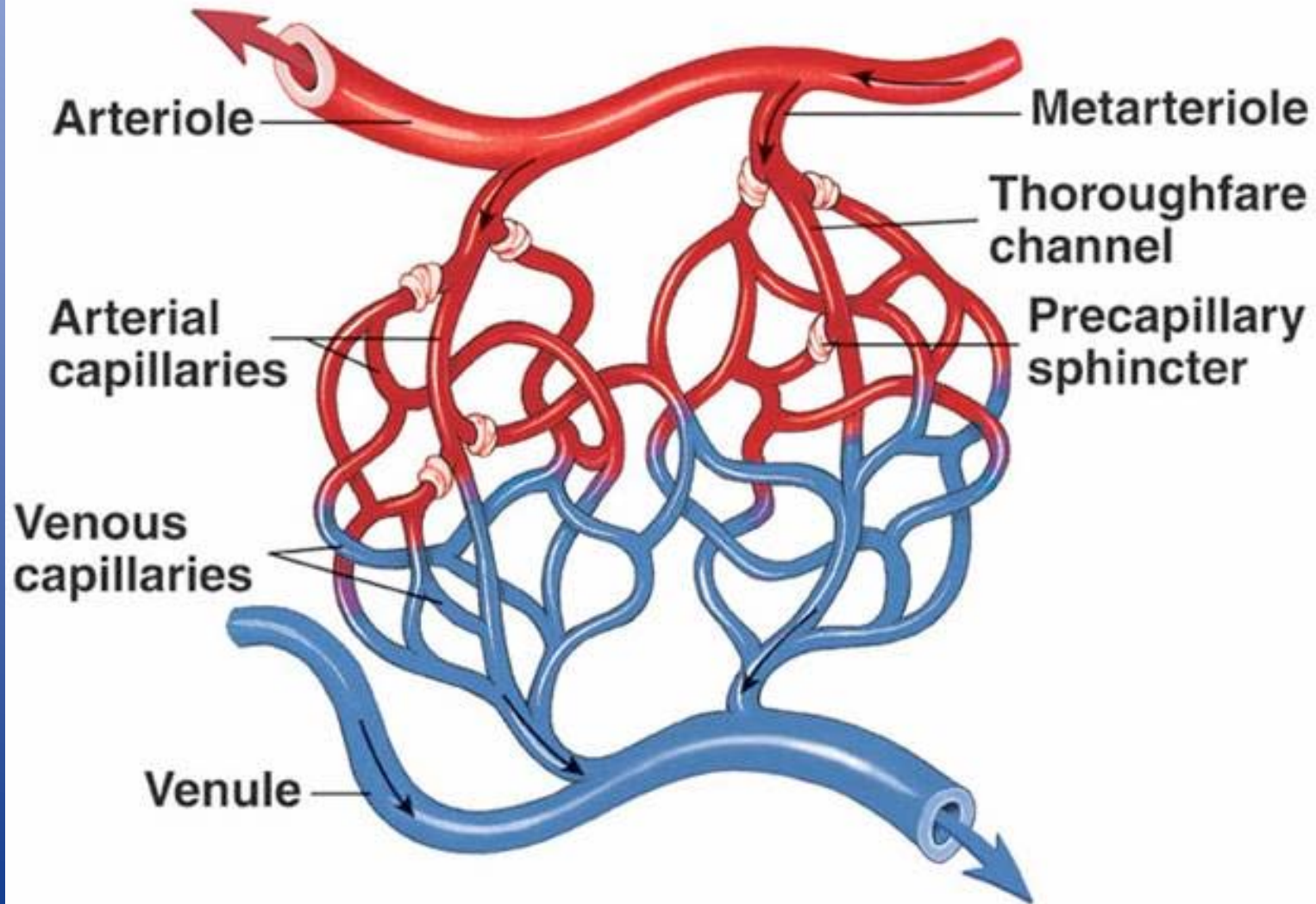
IT'S BEEN TWO DECADES since academic and industrial research of blood substitutes took off, yet the field has never been as turbulent as it is now. A diverse cast of characters play leading roles in this tumultuous field, including doctors, military scientists, [Food & Drug Administration](#) regulators, academics, and a handful of companies trying to develop products that can deliver oxygen within the body. Some argue that blood substitutes are necessary and safe. Others say blood substitutes are dangerous and clinical trials should be abandoned.

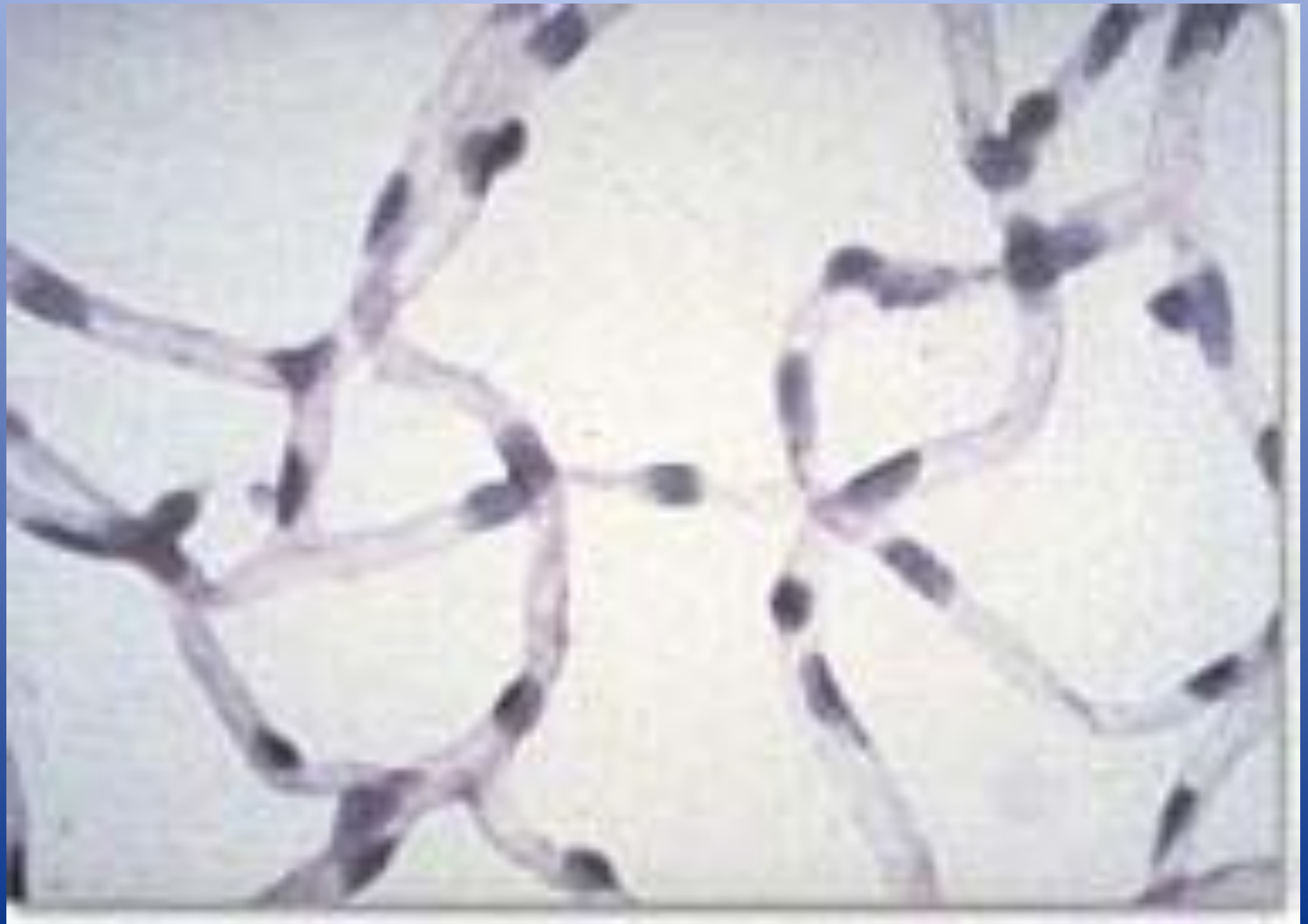
How is it possible that all trials are so disappointing with so much money and popular interest?

- Blood with a hemoglobin of 10 mg/dL can have 70 times more oxygen than water
- Fluids are available that can come close to these levels of oxygen content (perfluorocarbons)
- perhaps we (these current companies) should look to nature

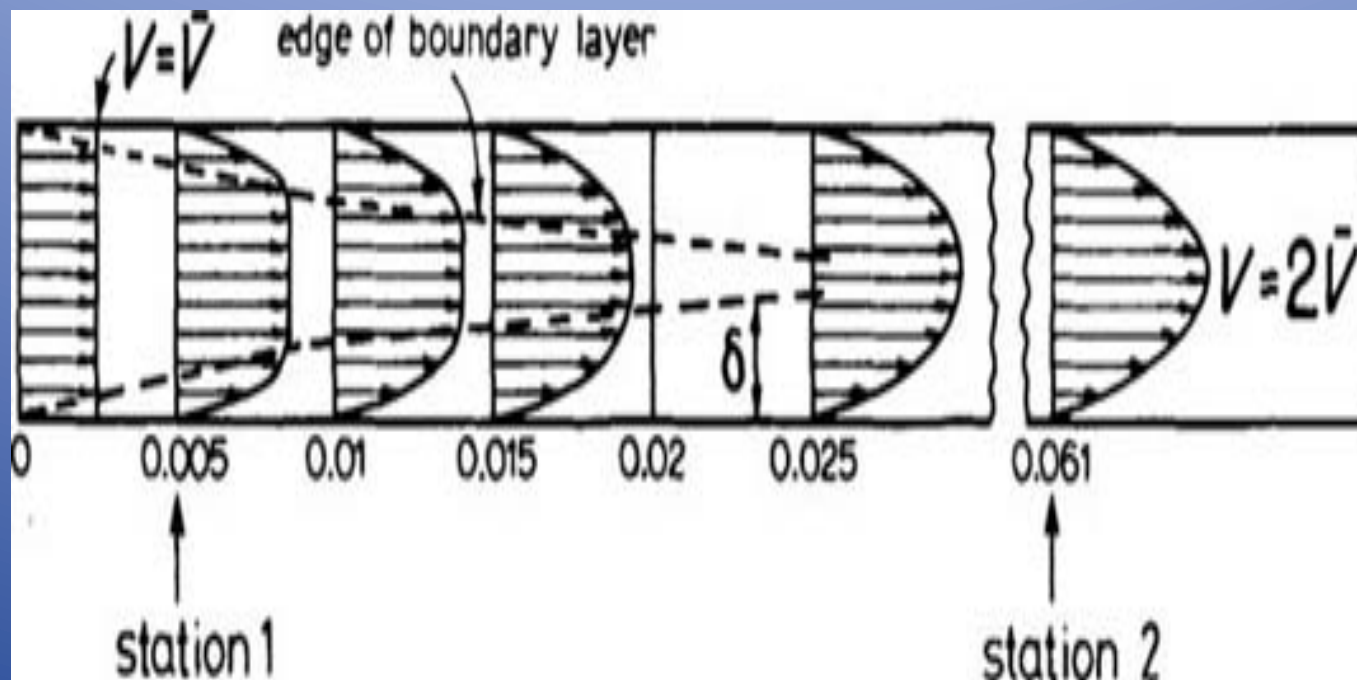
Capillary bed

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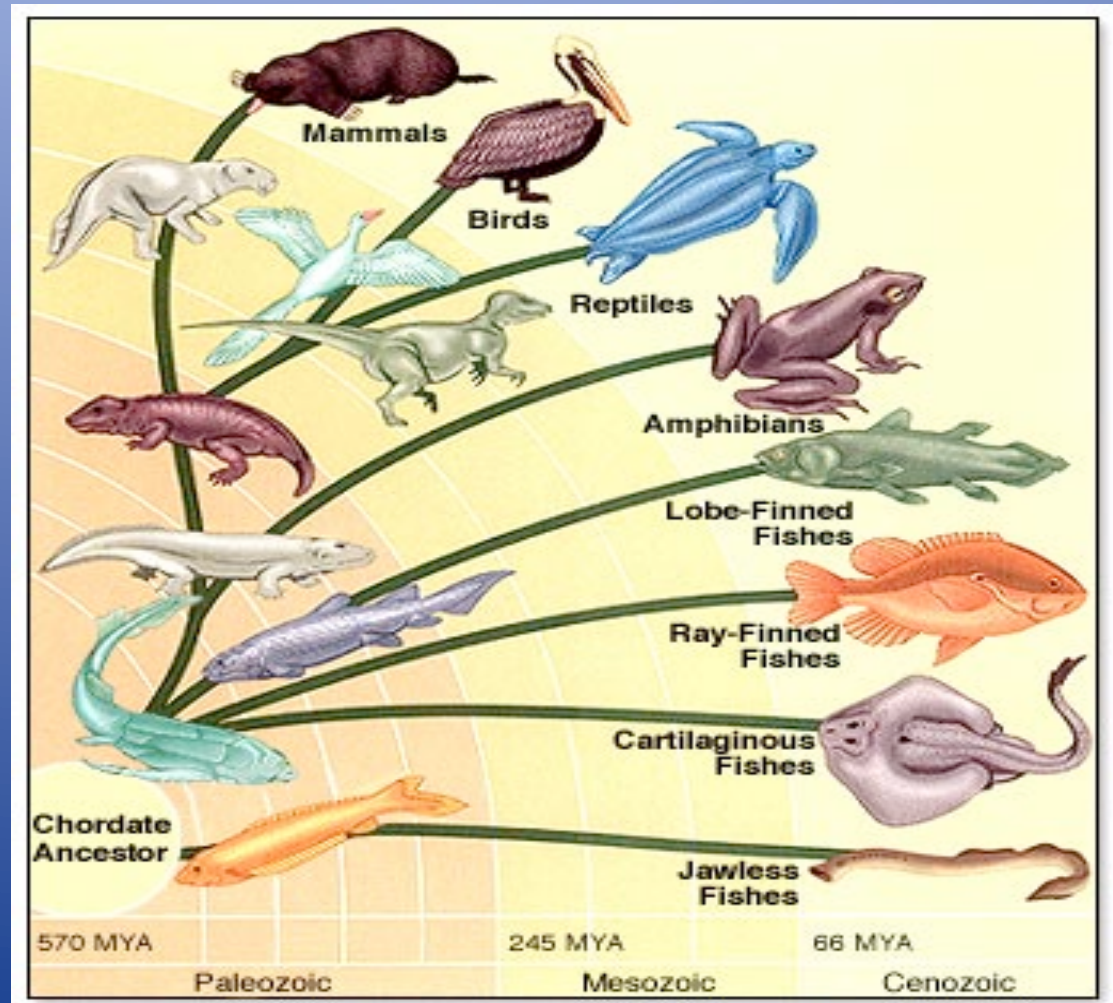
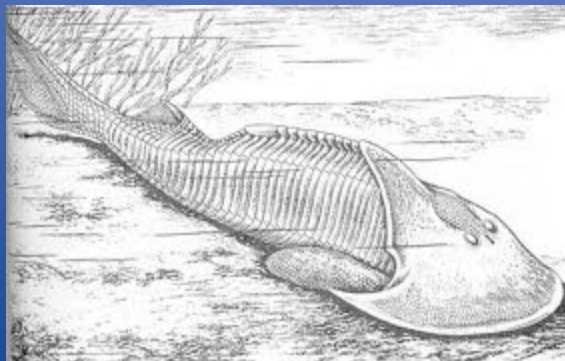
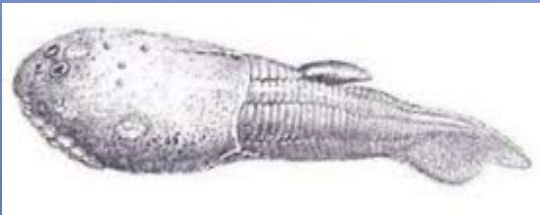
Velocity profile of fluid in a tube



Oxygen exchange at the capillary

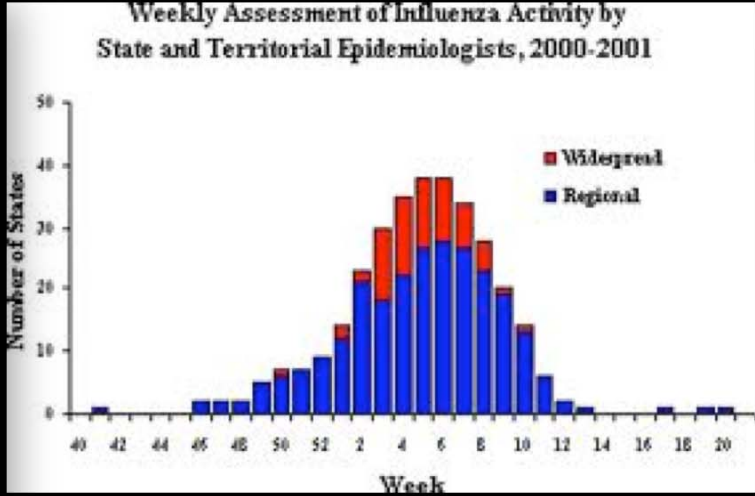
- Oxygen delivery at the capillary level complex but occurs quickly
- Compression and “rolling” of RBC’s in the capillary well defined in the 1960’s and 1970’s
- The physics of fluid flow would limit rapid exchange of oxygen with a simple fluid because of a boundary layer
- Red blood cells remove the boundary layer

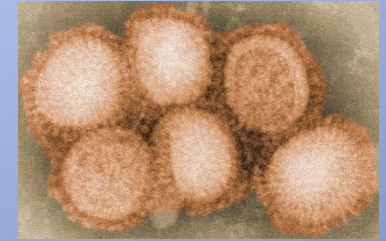
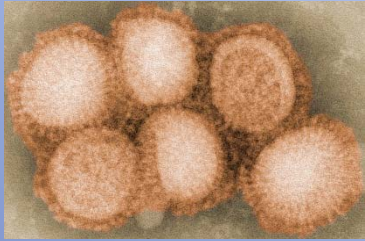
This may be why RBC's have been around for 500 Million years



Current problem:
Hospital acquired infection
Resistant organisms
Clostridium difficile

- How important is it to clean rooms between patients?
- Costs are immense, both time and equipment
- Is the media involved with this?





Why is flu seasonal?

- People are indoors more often during the winter, they are in close contact more often.
- Cold temperatures lead to drier air, which may dehydrate mucus, preventing the body from effectively expelling virus particles.
- The virus may linger longer on exposed surfaces (doorknobs, countertops, etc.) in colder temperatures.

Could the flu season be more related to the host than the environment?

- Allergy season is the summer in spite of allergens being around all year
- Exposure to cold may shift your immune system from th2 (humoral) to th1 (cellular)
- The immune system consumes a tremendous amount of energy-maybe it can't "fight two types of war at the same time"
- The majority of deaths in the 1918 flu epidemic were from bacterial pneumonia

Could flu infection be largely related to the host rather than exposure?

- Could cold exposure alter your immune function away from viral defense
- Could it be true that doing outside with wet hair or bare feet on a cold day can cause you to catch a cold



Back to our problem

Hospital acquired infection

How important is it to terminally clean the room between patients? (beyond the emotional issues)

Does the host overshadow how much you clean the room between patients?

- Hospital workers who get pneumonia get community pathogens not hospital pathogens
- Do all those “soccer moms” with minivans filled with wipes limit transmission of illness?
- Hospital workers generally don’t get infected
- In the large recent study documenting transmission of c.diff between patients-the majority of patients exposed didn’t get infected.

How should we approach the problem of hospital acquired infection?

- Multidisciplinary approach: Involve multiple medical subspecialists as well as support staff
- Hopefully limit ineffective use of resources
- Highlight and minimize unintended consequences

Summary

- There are many challenges on the horizon
- Multidisciplinary approach may improve our ability to make solve issues efficiently (looking to nature may help)
- Going beyond our traditional medical subspecialty system may help-we are already on our way , research boundaries are already broken.
- Significant changes in approach may be needed (Hopkins has reorganized the entire curriculum)