

20.219

Day 2 Script: ELIZABETH'S (VERY) ROUGH DRAFT

This was the very, very beginning of my brainstorming for an episode about snot - do keep in mind that there are lots of opportunities for improvement with it (and it did end up changing a lot by the end). Hopefully you guys will be able to have a little more material to work with tomorrow than this ([Paul's post](#) is a good example of the kind of thing that'll be most useful to have tomorrow), but here is just an example to get you started:

(B-roll of amazing human feats: bodybuilder, cellular division)

Ahh, the human body. One of the most complex, high-tech technologies on the planet today. After perfecting our machinery through years of evolution, we have gained our spot at the top of the food chain. Yes - we are humans, bow down to our physiological majesty, we are humans, hear us –

(Sneeze)

(Close up of snot coming out of nose)

__ million years of evolution and this is all we have to show for it? Well, actually, this stuff is about as high tech as it gets. Snot may seem gross, but the crap that oozes out of and within you is what's protecting your body at all times.

(Emerge from under covers)

In fact, the goop that you associate with days spent under the covers groaning in misery is a complex concoction of proteins, sugars, and immune system components that provides mechanical protection to your esophagus (?), helps you absorb nutrients from food, protects your digestive system, and defends against infection and unwanted intruders (wording?).

Shareable facts

- We usually associate mucus with snot, but it covers our whole body - eyes, nose, lung, mouth, digestive tract, reproductive tract, individual cells
- Also hard because mucus self-heals! It allows passage of macromolecules without disintegrating. When you induce stress on it, it recovers its stiffness.

Possible points/themes:

- Something we think of as gross and associated with being sick etc. is actually capable and does an incredible amount to protect our bodies and can be manipulated to help us.
- Mucus is not inert. It actually differentiates between objects. It's a dynamic material. (e.g. it self heals, it interacts with other things, it changes depending on the environment.) IT'S ALLLLLLIIIIIVVEEEEEEE. Mucus is a marker. Preterm labor. Color of snot tell you if sick.

- Mimics real life - We have an alien life form inside of us. It's a gatekeeper, self-heals, responds to its environment (changes structure based on pH)
- By understanding how mucus works and manipulating it, you can solve a lot of drug delivery problems. Mucus is a huge barrier to drug development, because it protects you against the drugs that are supposed to help you. If you can manipulate it to do what you want it to do, then you can solve a lot of medical problems.

This is where I just started brainstorming facts because I got stuck

What is mucus:

- Made of meshwork of MUCINS (snot brushes): protein backbone with stringy sugars called glycan branching off
- Sugars (glycan) give mucins high capacity to bind to water, which keeps cells moist and is important for protection against infection and mechanical stress (like during swallowing - really hard to swallow food with a dry throat)

How does mucus work:

- Suspends unwanted bacteria/viruses/particles and then cilia hairs sweep out of body, or antibodies also floating in mucus target and immune system attacks
- Mucus layer coats our digestive tract so our stomach acid doesn't dissolve our bodies, just the food we need to digest
- Prevents biofilm formation: Biofilms are when a ton of bacteria stick together and form a mega Transformer bacteria together that antibiotics can't treat. Mucins poke the bacteria to swim, so they don't aggregate (specifically, the glycans interact with the bacteria).
- Mucus itself is an indicator:
 - Snot is like a mood ring - color tells you the extent of an infection (<http://www.sciencealert.com/features/20140108-25962-2.html>)
 - pH affects size of the meshwork - increasing pH allows bigger things to go through (during ovulatory phase, to let sperm through) and makes mucus thin, low pH makes thick, solid-like gel with tight mesh. Ribbeck's research looks into cervical mucus as a marker for pre-term birth risks (<http://www.popsci.com/article/science/brilliant-ten-katharina-ribbeck-makes-antibiotic-alternatives-out-mucus>)

Mucus as a problem:

- Too much mucus:

- COPD: Pollutants stimulate immune response of making more mucus than cilia can remove, thick gobs breed pneumonia bacteria
(<http://www.popsci.com/bown/2009/innovator/pied-piper-mucus>)
- Cystic fibrosis: Abnormal transport of sodium and chloride over goblet cells cause them to secrete thick layers of mucus. Lots of lung infections.
- Main barrier to drug delivery! So good at keeping the bad stuff out, it also keeps out drugs we develop to treat cancer, for instance:
 - If you make your drug particles stick to the mucus too well, they'll just end up getting expelled with the rest of the crap your mucus traps!
 - If drugs don't touch mucus at all, it can't penetrate into the areas of the body it needs to go to!
 - Experiment: Add PEG (polyethylene glycol) to outside - able to penetrate, but is inert to the mucus (won't interact too much). Researchers tagged the PEG with fluorescence and tracked it in mucus and found that they were much more mobile in mucus.

Research

- If mucus is so great, why don't we make fake mucus in the lab and use it to cure diseases where there's not enough mucus, or replace faulty mucus with better stuff?
 - Culturing mucus in vitro is hard because it relies on environmental feedback. In the body, goblet cells take signals from the surrounding environment which affects how they make the mucus.
 - Also hard because mucus self-heals! It allows passage of macromolecules without disintegrating. When you induce stress on it, it recovers its stiffness.

Random facts:

- Your body produces about a gallon of mucus a day (<http://newsoffice.mit.edu/2013/faculty-highlight-katharina-ribbeck>)
- Mucus surface area in body: 2000 sq. ft (20.363 Fall 2012 notes)
- We usually associate mucus with snot, but it covers our whole body - eyes, nose, lung, mouth, digestive tract, reproductive tract, individual cells
(<https://www.youtube.com/watch?v=uYuPranLS1k>)
- Hagfish produce mucus slime when touched to defend themselves
(<https://www.youtube.com/watch?v=pmaal7HfOWA&feature=related>)

- “Phlegm” refers to mucus of the respiratory tract (http://en.wikipedia.org/wiki/Mucus#cite_note-1)
- “Sputum” is the mucus you cough up from the lower airways (<http://en.wikipedia.org/wiki/Sputum>)
- Mucus is “smart” - knows what bacteria are allowed to stay, and which bacteria/viruses to reject. It’s selective
- Way mucus looks can maybe predict pre-term labor far in advance

[Link to the original post on Tumblr](#)

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