Transcript

Episode 126

Ten Things We Forget to Tell Students About Cells | A Forest in My Office

The A&P Professor Podcast

This transcript is supported by the
American Association for Anatomy anatomy.org

Contents

The A&P Professor podcast (TAPP radio) episodes are made for listening, not reading. This transcript is provided for your convenience, but hey, it's just not possible to capture the emphasis and dramatic delivery of the audio version. Or the cool theme music. Or laughs and snorts. And because it's generated by a combo of machine and human transcription, it may not be exactly right. If possible, listen to the audio file available at theAPprofessor.org or wherever you listen to audio.

A **captioned audiogram** version of any episode is available at theAPprofessor.org/youtube

Introduction

Kevin Patton (00:00):

Nobel Laureate Albert Claude, discoverer of the endoplasmic reticulum and other organelles, once said, "It is the cells which create and maintain in us, during the span of our lives, our will to live and survive, to search and experiment, and to struggle."

Aileen Park (00:24):

Welcome to The A&P Professor, a few minutes to focus on teaching human anatomy and physiology with a veteran educator and teaching mentor, your host, Kevin Patton.

Kevin Patton (00:37):

This episode gives 10 things we forget to tell our students about cells, how to forest bathe in our office, getting my winter shorts ready, and when to teach the urinary system.

Pee Again

(00:56):

Back in episode 125, which I called The Pee Episode, I proposed that urinary system structure and function is particularly difficult to understand, to learn, and therefore to teach compared to many of the other concepts in A&P. Well, our friend Margaret Reece, who you've heard from a number of times on this podcast, sent in a comment at the episode page for The Pee Episode, and that can be found at theAPprofessor.org/125.

(01:31):

And in her comment, she says this, "It is hard for A&P students to switch from large systems like bones and muscles to the renal system, which is explained almost exclusively in molecular terms. Many courses do review the relevant biochemistry at the beginning of A&P. The students are bored. They do not see the need for it. I think it would be better to begin A&P with tissues, move to the relevant chemistry, follow with renal physiology, then move to larger anatomical systems like bone, muscle, et cetera. However, I have not yet found an administrator or faculty group to give my suggestion to try."

(02:27):

Well, thank you Margaret for that comment. And you know what? I never considered doing things in that order. But now that I read your comment, I can see how that could work really well for student understanding. Besides the particular application to how we might better teach urinary structure and function, I think this is a great example of the kind of thinking that helps us think of our course as a kind of storytelling. We have options in the order in which we present concepts. Well, sometimes we do.

(03:02):

Yeah, there could be departmental or course practicalities, especially when working with other faculty teaching the course at the same time, and these might limit our flexibility when telling our story in a different order than we see in the textbook or in the official course description. But I think even in the tightest of boxes we find ourselves in, there's still some wiggle room. We have to be like an escape artist who's shackled and locked in a trunk, but still manages to pick the locks and find their way out of that trunk. And since there's nobody here right now to stop me, I'm going to admit something that may shock you.

(03:50):

I don't think there's any fundamental cognitive need to make sure that all sections of a course are lockstep in sync with one another. Who cares if one instructor gives five tests and another gives seven tests in the same course? What if this instructor requires a research paper and another instructor offers a choice of projects, and the third instructor doesn't have any kind of requirement like that? Yeah, I know, some students will offer that as an excuse for why they are not succeeding in A&P. They'll say their grade would be higher if they didn't have to do a research paper. Another student will say doing a research paper would mitigate their poor test scores, so I want a research paper and I can't have one.

(04:50):

You know what? The grass is always greener, isn't it? I know. If we get student complaints like this, we might be able to make them go away if we make sure that every instructor is doing exactly the same thing. There won't be one section or instructor perceived as being easier than the others. But is that annoyance with having to counsel students who are trying to find reasons for their failures outside of themselves really the noblest goal that we can have for ourselves? I don't think so. I don't think that's really that important.

(05:29):

Let's just go ahead and help those individual students and show them that it isn't about how their course is structured, it's about what they're doing in their course, that it doesn't matter which of the sections they were in. Unless it does matter, and then we can attack that situation and either fix a course that's broken or help students choose better which instructor or section to enroll in. I think the diversity of different course designs and styles and vibes adds to the richness of a department's offerings. It allows for experimenting with new or rediscovered teaching and learning techniques.

(06:18):

I don't think it helps anybody if I'm barred from trying to flip my course or replace an exam with a project or adding more opportunities for retrieval practice to my course. We can all learn from each other's experiments with those things. Doesn't such diversity support diversity, equity, and inclusion for students? If they have some choice about differently designed course sections, might they not be able to find one that fits their learning needs better than another?

(06:58):

If Dr. Reece wants to put the urinary system early in her A&P course and I'm teaching another section in the same semester and I don't want to experiment with that, it should not only be okay, it should be welcomed, it should be supported, and it should be encouraged. Think about it. By the way, you too can make comments on the episode page like Margaret Reece did. You can leave ratings and reviews on that episode page too. And you know what? Wherever you're listening right now, there are probably opportunities to leave comments, leave a rating, or to review this or any episode.

A Forest in My Office

(07:47):

Here's a pee story that did not make it into The Pee Episode, episode 125.

(07:53):

You've probably had this experience. You're dining at The Olive Garden. You've taken their suggestion to get a bottle of wine. Now you have to pee. You walk into the restroom and immediately you're bathed in the voice of Dean Martin singing his signature song. That's Amore. The Italian American vibe is reinforced in a not too subtle way. The Dean Martin connection may even plant a subliminal hint to go back to your

table and order another bottle of wine. It turns out there's a way we can twist this around for our own good, our own piece of mind and refreshment and stress relief.

(08:47):

I realized this back in 2004 when I was invited to give a paper on my wacky online testing scheme at the World Congress of Associations of Anatomists in Kyoto, Japan. It was a huge event held in a huge convention center in a crowded, but amazingly beautiful city, Kyoto. I've mentioned before, I'm an introvert. I do just fine in crowds and often enjoy the experience, but it is energy draining for me. Sometimes it kind of puts me on edge a little bit. So here I am in a huge crowd of many thousands gathering for the opening ceremony in a new place with only a few friends in attendance and who I had not run into yet.

(09:43):

I hadn't seen them up until that point. I had just had a slightly harrowing experience getting registered and politely lectured on the importance of displaying my ID tag at all times. There were bottles of cold green tea everywhere. And you guessed it, I had to pee. I wasn't remembering how to ask for directions to the restroom in Japanese. I had practiced all those essential phrases in Japanese and I couldn't remember that one. The more I tried to think of it, the more intense was my urge to pee. I finally did figure out where to go, and I walked briskly into the men's room. I had a very different kind of experience from Dean Martin's That's Amore.

(10:36):

I had to go through a narrow hallway where the crowd of men entering the restroom was forced into a slowed down single file, and the lighting became increasingly dim and indirect. Not dark, just not the brightness and the whiteness of the main convention hall. The walls were green and there were photo murals of forests and other nature scenes. There were even a few plants here and there. And as the noise of the crowded hall receded, I was in a much quieter space with soft nature sounds being played in the background, birds tweeting, but not too much, brooks battling, but not too much, leaves rusting, but not too much, that and also probably the great sense of relief in finally being able to avoid my bladder to the sound of distant waterfalls.

(11:44):

That all made a big impression on me. Unlike the festive Olive Garden restroom experience, this nature experience was clearly designed to be a way to relax and refresh after stepping for a moment outside the huddle and bustle of that big crowd in the big hall right outside the restroom door. Remember Kevin's law of professional

development? It states that if you learn just one useful thing in a professional development experience, it's worth it. This conference hadn't officially started yet and I had already learned my first useful thing. And you know what? I still use it after all these years.

(12:33):

I started turning off the overhead fluorescent lights in my office and turning on only a small lamp when leaving my office for class or a meeting or lunch or whatever, and also turning on some nature sounds on a CD. So that when I came back from class both exhilarated and exhausted, I'd have that kind of refreshing forest bathing kind of experience I'd had at the Kyoto Convention Center. Now that I work mainly in my home office and now that technology has advanced quite a bit, I set my smart speaker to play nature sounds and to adjust the lighting using smart plugs to achieve the same somewhat dim atmosphere. If I could change my orange walls to green by doing that, oh man, I'd do that too.

(13:33):

I wonder if there is a way to do that. I'm going to look into that. If you know, let me know how to do that. Anyway, I just wanted to share an easy way to inject just a bit of nature's piece into our hectic day of teaching and Zooming and all those other things we do.

Sponsored by AAA

(13:54):

A searchable transcript and a caption audiogram of this episode are funded by AAA, the American Association for Anatomy. You're probably already a member, and you already know that HAPS members get a hefty discount on AAA membership. Even paying full price, AAA membership is worth more than that to anyone serious about teaching the A&P course. Check it all out at anatomy.org.

Getting Out My Winter Shorts

(14:27):

It's that time of year. Yes, it's time for me to get my winter shorts out of moth balls so that I can properly benefit from the coming holiday break. If you've been with us long enough, you may recall that I took a brief hiatus from this podcast last winter for a bit of

self-care, and it really helped a lot. I'm going to do that again starting after this episode. But unlike last year, I'll be dropping episodes regularly. However, instead of the winter break episodes being the longish collection of super fresh content like this episode, the winter shorts are going to be remixes of just one or two classic segments taken from episodes over the last five years. The short length is why I'm calling these remixed episodes my winter shorts.

(15:25):

I'm already having a great time revisiting some intriguing topics as eyebrows for segments to bring out again and put into these winter shorts. It's kind of like rewatching some favorite holiday movies and getting something a bit different out of them this time, or maybe just enjoying the very same aspects that I did the first time around. I plan to be back with fresh episodes in late January when I'll again have my annual debriefing episode. That's the episode where we review some of the highlights and new features and so on from the past year. And yes, we'll revisit the predictions I made last year and see how close or how far away from the mark that I hit each one.

(16:18):

And yes, I'll once again make some predictions for how A&P teaching may go for us in 2023. If you have some predictions or want to mention some things from the past year that made an impression on you, be sure to get them to me soon. In the meantime, please try to find some opportunities to refresh yourself during this upcoming season of renewal. Maybe host some podcast listening parties, that'd be fun, or make yourself some hot chocolate and curl up with your pet by the fire and binge listen to five years worth of The A&P Professor episodes. Okay, if you don't get chances to do those things and find some other ways to relax and refresh, at least you'll have some winter shorts coming up.

(17:15):

I'll send you some smaller bite size tastes of those binge watching experiences. Peace and blessings to you for this winter, my friend.

Sponsored by HAPI

(17:31):

The free distribution of this podcast is sponsored by the Master of Science in Human Anatomy & Physiology Instruction, the HAPI degree. I'm on the faculty of this online graduate program at Northeast College of Health Sciences, and I'd love to have you as a

student in my courses. Check it out at northeastcollege.edu/hapi, that's H-A-P-I, or click the link in the show notes or episode page.

Things We Forget to Tell Students About Cells

(18:02):

I'm now going to review with you 10 things that I think that we forget to emphasize about cells.

(18:09):

At least they're things that I have to intentionally remember to emphasize about cells when I'm teaching A&P. Let's start with number one. That's always a good place to start. The first one is that cell illustrations are cartoons. Not only should we not forget, but we need to make that clear to our students. Sometimes we forget to emphasize that. And what I mean by the idea that cell illustrations are cartoons is that no matter how detailed a cell illustration is, maybe one of those really detailed ones from your textbook or from a reference book or some other resource that you have, even those very detailed ones are simplified to a huge extent, just like cartoons.

(18:59):

Think of a cartoon version of a person like Fred Flinstone or Barney Rubble or something like that. Those cartoons are simplified versions of people. They just have the main outlines and very little of the detail in there. And that's okay and that's actually very good for what its purpose is. And that's true of these cell illustrations too. If we have an accurate representation of a cell, it will be so intense and so detailed. If we don't already know a lot about cells, it's going to be virtually useless to us, useless to us is teachers and useless to students as they try to figure out what a cell is and what it does and what the main characteristics are.

(19:46):

We want to emphasize just the main characteristics. We want to emphasize the outline of the cell. We want to emphasize just a handful of the many kinds and numbers of organelles there are inside the cell. That's what those cell illustrations do. And you know what? Even the micrographs that are in our textbooks or other resources or looks that we see of cells under microscope if we can even visualize individual cells, sometimes you can, sometimes you can't, depending on the tissue and the way it's stained and so on, but even micrographs and tissue specimens are cartoonish in the sense that certain things are emphasized and other things are missing.

(20:30):

When we stain a specimen, we are looking at cells that are mostly transparent and only certain things absorb that stain, only certain things bind to that stain. We might see an outline of the cell. It may or may not be the actual membrane, but an outline of the cell. We may see the nucleus. Those often pick up the common stains that are used in micrographs that we would see or even specimens that we would use in our lab. And certain other organelles or things outside the cell will pick up a stain, but everything else is invisible because it's transparent. It hasn't picked up a stain. Even those are cartoonish.

(21:13):

I think point number one is we need to emphasize to our students that what we're going to be looking at is a simplified view, and that's okay because that's where we are right now in our learning. And that kind of leads us to number two on my list of 10, and that is cells are not multicolored. They seem like they might be, right? Because even in those micrographs, sometimes they'll be more than one stain used or the lighting effects will produce what appears to be multiple colors. We get the idea, oh, those are real cells there, and there's all these different colors I can see. Even if it's just white and pink and blue, there are different colors, but those are false colors.

(21:58):

Those are the colors of the stain. That can't be true. But then we say, okay, well, look at this illustration here. There are other things in the book, pictures of organs and parts of the body and so on that's seen that they're realistically colored. Even those are not really, but they're a little bit more realistic in their color many times than we would see in a cell illustration. Because you know what? Nuclei aren't really bluish purple like we see illustrate it very often. And maybe the mitochondria are pink and the ER is green or purple or something. We have all these different colors in there and students sometimes get the idea that we will see colors like that in cells and that they're all multicolored.

(22:48):

But as I just mentioned for item number one, cells are pretty much transparent in real life. I mean, in a natural environment. If we could see a cell, we wouldn't see the cell in most cases. We have to do something to enhance that unless we're going down to a very, very high magnification, then maybe we start to see some shadows and different things in those cells. But all those colors are false colors. The only time we would see a color might be one color if we're seeing hemoglobin in a cell, or myoglobin or neuroglobin we might see color, sure, just in that one kind of area in the cell, but we're

not going to see the multiple colors we're seeing in the cartoons that are in our textbook and resources.

(23:37):

Let's move on to number three. Number three on my list is the cytoskeleton. I think that most of us mention what the cytoskeleton is, talk about some of the major components of the cytoskeleton, that is these microscopic little fibers and fibrils, that is things like microtubules and microfilaments and intermediate filaments, and we say that here's what they are, here's how they're different from each other, and they all get together and form what's called a cytoskeleton and that's the skeleton of the cell. Okay, yeah, that's important, but I think we need to do at least two things that we all forget.

(24:22):

One is to really emphasize that that's hydroskeleton like the skeleton of our body made up of bones and including the ligaments. I would even include the muscles and tendons in my model of the cytoskeleton. That whole skeletal muscular system maybe is a better model for the cytoskeleton than just the bony skeleton alone. Even there we see that it's a dynamic moving thing. Yeah, okay, when we see it in the book, it's not dynamic and moving. When we see it in a specimen or model in the lab or even in a body donor lab, then yeah, it's not going to look so dynamic. It's not going to seem so dynamic.

(25:05):

But we know that in life it is. It's always moving around. Even when we seem still, things are happening in all parts. And that's what allows us to move, right? That allows us to move our body around. It allows us to make and use tools. There's all kinds of important things going on there that we don't necessarily appreciate if we look at a static picture. Now, we do appreciate that about the human skeletal muscular system because we have one and we're using it, so that's fairly easy. But cytoskeleton, students first encountering that, or even if it's their second or third time encountering that, they're not going to appreciate that aspect of it.

(25:48):

We need to get in there and show them that, you know what? It's the cytoskeleton that allows cells to move. When we look at muscles, it's the cytoskeleton that is doing the muscle contraction. And you say, "Well, wait a minute, it's the sarcomeres." Well, yeah, the sarcomeres are part of the cytoskeleton, right? They're made up of those microfilaments that we just talked about, and they're arranged in an unusual way compared to other kinds of cells. That's an important thing to emphasize when we get there. It's like, look what the cytoskeleton is doing here. But you know what?

(26:24):

Those actin-myosin and other kinds of reactions like that create movement and muscle fibers are also present in other kinds of cells. For example, you look at a red blood cell and there are actin-myosin reactions going on in red blood cell that allow red blood cells to deform their shape, for example, when they're trying to squeeze through a capillary. We look at nerve fibers. We see that in the axon, that there are microtubules that are present there that are allowing the rapid shuttling of little bubbles of neurotransmitter and other substances from one end of that axon up to the cell body and back.

(27:13):

There's that. We also see that cytoskeleton is being used like the strings of a marionette in some ways inside the cell. When we see animations or even photographed videos of things moving around in a cell, often, usually it's elements of the cytoskeleton that are causing that movement. When we go through the changes that occur during mitotic cell division, we see things moving all around. What is that? Those are elements of the cytoskeleton that are causing that movement. They're pulling things this way and pulling things that way like a marionette puppeteer is pulling on different parts of their puppet to make them move around in different ways.

(27:59):

That's an important aspect of the cytoskeleton. This leads me into an overarching idea that I want to get across with this whole list of 10, and that is that it's something that we ought to explain maybe a little bit more carry with these things in mind at the beginning when we're first introducing these things in our course. But I think it's important for us to keep bringing them back again, keep reminding students, when we get to our discussion of muscle fibers and how they do contraction, how they're built and organized into sarcomeres and these other levels of organization within the cytoskeleton of a muscle fiber, it's important that we come back and tell them, this is the cytoskeleton.

(28:46):

That's what we're looking at. Do we really do that? Do we ever mention the word cytoskeleton when we're talking about the muscle fibers structure and function? I don't think most of us often do. For a long time, I didn't, until I realized how helpful that is to students because it's connecting them to something they already have some idea about. It reinforces the concept of a cytoskeleton, so that they can not only be applying it to the muscle fiber, but when we get to the nerve fiber and I bring it up again and say, "Look, here's a different way to use your cytoskeleton to shuttle things up and down this very, very long fiber, this very long passage way where things need to move rapidly.

(29:27):

How can we solve that problem? How can the cells solve that problem? Well, here's a way, it's like a little transport system, a little high speed train that's shuttling things up and down that passage way." There are many, many other examples that we run into, even an introductory level A&P course where that cytoskeleton can come up again and again and again and again. Cytoskeleton was number three on our list. Number four on the list is very related to that, and that is molecular motors. I've already had some of my colleagues in A&P over the years tell me that molecular motors, I don't get into that in my course because that's too much detail for my students.

(30:11):

Well, I'll tell you what, I'm not about detail in my A&P course, so that was always kind of shocking when I heard that, because I was thinking, man, like many A&P instructors, I'm always a little worried that I'm not giving my students enough detail. And then I, of course, pull myself back from that and realize that it's not the level of detail that is important, what's important is that they're walking out with basic principles that they can use and apply later. They're never going to remember the minutia of the details anyway. That's really pretty much a waste of time and just potentially add confusion rather than clarity.

(30:52):

I don't want to get off into that topic, but coming back to molecular motors, I think this is one of those things that's worth mentioning. I don't think we have to go into a great deal of detail about learning even a short list of the different kinds of molecular motors that have been identified or exactly how they work, but showing them maybe an animation of a molecular motor where some of them look like they're literally walking along a microtubule with a big sack on their shoulders, which, of course, is a vesicle that contains something. But when they see that, when they see that kind of action going on, then that is impressive to them.

(31:35):

That really gives them a mental picture that their mind's eye is triggered and they can see that hopefully. Those that are able to have and use a mind's eye are able to do that when they hear the term molecular motor. Molecular motors really do play central roles in some of the very basic ideas that we cover in A&P. For example, muscle contraction, that's all about molecular motors. Myosin is a molecular motor and it's ratcheting back and forth, and back and forth. It's a motor and it's a molecule, so yeah, it's a molecular motor. That's an important one. I just mentioned the role of that actin-myosin reaction

in other contexts as well in other kinds of cells so that we have those molecular motors there.

(32:26):

We have elements of the cytoskeleton moving around, and I use the analogy of puppets, like marionette puppets. But the thing you need with a marionette puppet, part of that system is the puppeteer whose muscles are moving. Well, like the puppeteer muscles, these molecular motors are part of the system of the cytoskeleton. They're part of the cytoskeleton if we're thinking of the cytoskeleton as the skeletal muscular system. Those little fiber-like structures like the microtubules and the microfilaments, those are sort of the bones of the skeletal muscular system, but it's the molecular motors that are the muscles of that system.

(33:13):

Molecular motors is something that I think that we should emphasize at the beginning and keep bringing it up again and again. Again, I'm not getting in into any details. Luckily, that term is an amazing term, molecular motor. Boy, that's like plain English, isn't it? Unlike a lot of the terms that we use in our course that we have to use because those are the terms that have been designated. But molecular motor is plain English. That was number four, and I'll have the rest of them in just a moment.

Sponsored by HAPS

(33:45):

Marketing support for this podcast is provided by HAPS, the Human Anatomy and Physiology Society, promoting excellence in the teaching of human anatomy and physiology for over 30 years.

(33:58):

Looking for teaching tips and articles outlining research about what works in teaching and learning anatomy and physiology? You need to check out the HAPS Educator available online at theAPprofessor.org/haps. That's H-A-P-S.

More Things We Forget to Tell Students About Cells

(34:21):

I've been discussing 10 things we forget to tell students about cells. Number five is the cells' interactions with the extracellular matrix. Sometimes we think of extracellular matrix as something very distinct from what's going on inside the cell. And I guess in a way it is. I mean, there is a boundary, the plasma membrane between extracellular matrix and the cytosol and the cytoplasm inside the cell. Yeah, sure there is that boundary.

(34:53):

But you know what? Is it really very much of a boundary? The thing is, is that a lot of times the extracellular matrix connects to proteins and other molecules that are part of the plasma membrane, which are in turn connected to elements of the cytoskeleton or other parts of the cell that are inside the cell. How distinct are they if they're really all connected to one another and they're all part of a system that functions together? Sometimes it's easy for us to forget that because it's only fairly recently in science that we've started to see some of the very critical functions that are going on in that interaction between the cell internal parts and the cell external parts.

(35:45):

But the more we recognize what those roles are, the more important it becomes. If we leave that aside entirely in our course, our students aren't going to be prepared for the coming future more prominent role between this extracellular matrix and the inside of the cell are going to play in our overarching story of human structure and function. I'm not saying get into all those details at all. I'm just saying point out that, yeah, here's the cell, here's the cell parts, but you know what, connected to all that and interacting with all of that and still a part of the system is this very complex network of extracellular structures.

(36:30):

That's item five on our list. Number six on our list that we often forget to emphasize and tell students about the cell is that it's really, really, really crowded inside a cell. All these cell cartoons and the micrographs where only a few things are stained make it seem as if the cell is this wide open space, sort of like a lava lamp where there's this one kind of liquid surrounding everything, and then there are these blobs inside that move around and join and split and so on. That's not really what a cell is like. There are all kinds of things, some of them tiny, some of them very tiny, some of them very, very, very tiny,

that are all mushed together in a big, huge crowd and they're all rubbing shoulders all the time.

(37:27):

You know what? That's a good thing. Otherwise, enzymes would never interact with substrates if they were floating around as if in a lava lamp situation. They need to be close and they need to bump up into other things. There's a lot going on in a cell, and this is a good way to emphasize how many things are going on and the complexity of the things going on, so much so that we still don't have it figured out in science. If we keep that in mind that it's way more crowded than it appears, I think that's going to help student understanding if they have that tucked in the back of their awareness. It's there, but it's not something you're going to necessarily be using all the time.

(38:18):

If we don't emphasize it at some point and say, "Don't forget this," and not only emphasize it at the beginning, but point it out from time to time throughout the rest of the course, then I think that we really need to do that. I think that we're doing our students a disservice if we don't do that. That's item six. It's really, really, really... That's three reallys. If you're taking notes, put down three reallys. Really, really, really, really crowded inside the cell. I wouldn't maybe even put a fourth really in there, because that's a serious thing. Number seven on our list is cells are not water balloons. We use that very often as a model.

(39:02):

Like any model, there are some elements of it that are useful, but there are some elements of it that are not useful. If our students always think of a water balloon when they think of a cell, fat plasma membrane in a cell is not nearly as strong or flexible as the wall of your typical water balloon. Of course, it's not water inside. It's jelly. Actually sometimes it's more of a hard gel inside that cell than it... Well, not hard, hard gel, but semi-hard gel inside that cell. Maybe another kind of model that we can add to the water balloon model to emphasize this thing that we often forget to emphasize about cells is the model of a chunk of jello that has been coated in a very thin film of butter.

(40:04):

That plasma membrane really isn't this elastic, but solid wall like a water balloon wall, it's more like a layer of butter that's a liquid. It's a fluid mosaic, remember? So yeah, it's a liquid. And yeah, it's going to stay a boundary. It's going to stay a membrane, that butter is, because it's not going to interact much with the jello inside. But it's going to be a very, very thin layer, and that's another thing that's useful about that model, is it's

much thinner proportionally than the wall of a water balloon would be, unless it's a really huge water balloon. When things are crossing the membrane, the barrier is more about it being a lipid barrier rather than it being a physical kind of barrier like a water balloon wall is.

(41:02):

When things are crossing, when we're talking about cell transport processes, we need to figure out how to get across a lipid barrier, not how to get across the wall of a balloon. And that's going on inside the body. I think discussing that very briefly, and that's not a complex idea, but it's something that we can use to help students realize the reality of these scenarios that we're describing as we tell the story of cell transport and other aspects of cell physiology. That was item number seven on our list. Item number eight is that cellular processes don't happen in steps. Explanations happen in steps, models might happen in steps, but the processes themselves are continuous.

(41:56):

They don't stop and start, and stop and start. I mean, there may be an occasional stop and start here or there as something needs to come into play that's not ready yet. There might be a pause in some process, and then it resumes. So yeah, we have those kinds of things, but we don't have individual steps. Those individual steps that we see in textbooks and explain to our students in class, like the steps of mitotic division and so on, they are more snapshots and time. This whole thing is just happening continuously, and it's a long enough and complex enough process that it's easier for us to break it up a little bit into pieces.

(42:38):

Most novels are broken up into chapters and sometimes the chapters are even grouped into parts. Sometimes novels are broken up into different parts so that you'll have a series of novels, number 20 in this series of novels. We do that as a convenience to help our brain organize the information and understand the information by breaking it down when it's complex. That's where the steps come in. The steps come in our attempt to try and understand it. But in reality, it's all like a novel without chapters. The story that just keeps going and going and going and going and going. It's not stopping and waiting for you. We have to stop it.

(43:23):

Stop the video. Pause it. Well, can I pause that movie? Let's go back and look at that, what just happened again. Steps are a convenience. They're a construct. That's not really what happens in cells. That's number eight. Number nine on our list is mistakes

happen. Mistakes happen everywhere in nature, but especially in biology, I think. Certainly in cells, we often think of cells just doing everything perfectly all the time. We think, well, if a mistake is made, then that cell's going to die. Everything's going to fall apart. Sometimes that does happen. Mistakes can have tragic consequences sometimes. But there are a lot of mistakes that are happening in ourselves that are not tragic mistakes. You know why?

(44:14):

Because we have systems in ourselves that are going to take care of that, and that leads us to number 10 on our list, and that is there are systems. We don't have to go into all the systems. I don't think we've discovered all the systems for making mistakes. Those that we have discovered, I don't think we really know all the ins and outs or even much of anything about how they work. But there are a few things that I think are worth mentioning. And among them, I'm not going to give an exhaustive list here, not that we need a really long list anyway, but there are mechanisms for repairing DNA when there are a little mistake here or there or in another place.

(44:54):

Now, yeah, sometimes DNA mistakes don't get fixed and sometimes we can live with that and sometimes we can't. But a lot of times DNA is repaired. Usually when we have a problem with DNA that is broken in some way and it has not been repaired, it's not so much about the DNA being broken, it's about the failure of our cell to fix it, because we do have fixes for DNA that gets messed up or DNA code at least that gets messed up. We have that. Another one that I like to mention are proteasomes and how they worked, but just in a very simplified version of proteasomes, very simplified explanation of what they are.

(45:41):

You can boil it down to something very simple, but proteasomes, they break apart proteins that got messed up, they got misfolded or something happened to them and they're in a way possibly, even potentially causing some kind of harm in the cell. This is a way to get rid of them. Lysosomes, of course, come into play in that story of how to get rid of things that have gone wrong. Yeah, okay, we have lysosomes. DNA repair mechanisms, proteasomes, lysosomes. Those are things that we probably already mentioned at least in passing in our course, and now we can go back and look at them again and see, are we really emphasizing what they're doing for the cell?

(46:25):

How do they fit into this overarching story of cell function? Yeah, you have processes that are important. Yeah, you have mistakes in those processes. Yeah, we have systems to help repair those mistakes. Of course, sometimes they don't work the way we want them to, so sometimes those mistakes have tragic consequences. Just reviewing very quickly our 10 items that we often forget to emphasize about cells. Number one is that cell illustrations are cartoons. Even micrographs are cartoonish in a sense. Item number two, cells are not multicolored like we see them in the book.

(47:03):

Item number three is we have a cytoskeleton and it is like our muscle and skeletal system combined, and it has lots of dynamic functions in our cell. We can certainly mention them as we go along the entire course, both semesters of a two semester course. Item number four is don't forget about molecular motors and identifying their role when there's an opportunity to do that, even if it's just a brief mention of them in passing. Not that it's going to be on the test or anything, just like all these things. A lot of these things, we're not going to be testing them on this information or going into great detail, but molecular motors are worth mentioning.

(47:43):

Number five on our list, interactions between the cell and the extracellular matrix. That's important. Number six is it's really, really, really crowded inside the cell. Number seven is cells are not really like water balloons. Yeah, okay, in one or two ways, but they're also kind of like a chunk of jellos that has been coated in butter or olive oil or something like that. Actually butter's probably better because it's more complex and there's other reasons too. But anyway, those are at least two different models that we can use, each of which tells us different things about the cell. And then we have item number eight on our list, and that is cell processes don't happen in steps.

(48:32):

Explanations of cell processes happen in steps. Number nine is when we're looking at processes in the cell, mistakes are going to happen and they happen all the time. And that leads us to number 10, which is that's okay because we have ways to fix mistakes, at least some of them get fixed. Otherwise, nothing would ever work for very long and we can't have that and still be alive. These are not the only 10 things that we forget to emphasize or at least clarify to our students, but these examples do remind us to think again about how we tell the story of cells and incorporate that story into all the other stories we tell in our A&P course.

(49:16):

Keep in mind that we don't have to go into great detail about any of these 10 things in our course. They need not be on our tester exams. I'm simply recommending that they be part of our story, perhaps as recurring reminders so that the essential concepts we're aiming at are better understood, better remembered, and better applied later on. I don't know. Maybe these are core concepts that are worth remembering on their own and then brought into later courses and clinical experiences for a clearer understanding in those situations. I'll leave that up to you.

Staying Connected

(50:02):

In this episode, I listed 10 things that we usually forget to tell our students about cells.

(50:09):

I also gave some advice on how any of us can make our office kind of like a forest retreat. And Margaret Reece commented about teaching urinary concepts, which then led to my rant about diversity among A&P course designs. And I mentioned that this is the last fresh episode of the year. That's because it's once again time for my long winter's nap. The next few episodes will be winter shorts, remixes of just one or two segments from our lib of episodes from the last five years. We'll start with fresh episodes again in late January when I once again give my predictions for the new year. Don't forget to comment or rate or review this episode at theAPprofessor.org/126 or wherever you're listening right now.

(51:08):

You're always encouraged to call in with your questions, comments, and your own reflections on the last year or predictions about the upcoming year in teaching A&P at the podcast hotline. That's 1-833-LIONDEN or 1-833-546-6336. Or send a recording or a written message to podcast@theAPprofessor.org. I'll see you down the road.

Aileen Park (51:41):

The A&P Professor is hosted by Dr. Kevin Patton, an award-winning professor and textbook author in human anatomy and physiology.

Kevin Patton (51:55):

Discontinue use of this podcast if a rash develops.