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PROFESSOR: Basically, you're not going to able to use Beatles clip, unfortunately. But can I hear what the song is?

STUDENT: Yes.

PROFESSOR: So the reason why this is under Creative Commons-- which, it's a little sketchy. I'm not sure if they ligitimately could have done that. But it's because they've transformed it so much, to the extent that it's, like, no longer the original work, right? So if you revert it to the original work, then you're also reverting-- you, like, taking away the Creative Commons work basically.

[MUSIC PLAYING]

And you like this instrumental?

STUDENT: Uh huh.

PROFESSOR: You could find something like this on ccMixter or a different music archive. It'll take a while, and unfortunately I don't have a short cut. That's a problem with music, is that it's not catalogued very well. So it's time consuming, because you just have to listen to everything.

STUDENT: What would be, like, a good mood to search for that?

PROFESSOR: I wouldn't necessarily search by mood. I would search by instrumentation.

STUDENT: OK.

PROFESSOR: So, have you looked at any of those links that were up on the syllabus?

STUDENT 1: Uh huh.

PROFESSOR: I mean, this is sort of, like, chill rock basically.

STUDENT 1: OK.

PROFESSOR: And that may not actually narrow it down. Go ahead and try to explore other genres, too. I-- unfortunately, there's no quick algorithm for finding good music. That's why it's so time consuming. But let me see what you've got cut so far.

STUDENT 1: OK, the video? All right.

PROFESSOR: Do you mind if I bump up your brightness a little bit so I can see it better?

STUDENT 1: Oh yeah. And I'll delete this song for now.

[VIDEO PLAYBACK]

-Hi, what do snowflakes and cell phones have in common? Well, let me start by drawing a snowflake first. First, I'm draw an equilateral triangle, divide each side into three parts, and draw another equilateral triangle on top of each one. Then, take out the middle and repeat the process. This time with one, two, three, four, times three, which is 12 sides. Eventually, the shape will start looking something like this.

In mathematics this is called a Koch snowflake. If I repeated my process again and again, I would see this same pattern anywhere I looked. This is a Koch snowflake, this time--

STUDENT 1: And this would be an animation. I just haven't inserted it.

PROFESSOR: Sure.

- --that on any scale, on any level of zoom look roughly the same, are called fractals. Computer scientists can program these infinite patterns by repeating an often simple mathematical process over and over. In the 1990s, a radio astronomer named Nathan Cohen, used fractals to revolutionize telecommunications

At the time, Cohen was having troubles with his landlord. The man wouldn't let him put an antenna on his roof. So Cohen designed a more compact, fractal radio antenna instead. The landlord didn't notice it, and it worked better than the ones before. Working further, Cohen designed a new antenna. This time, using the fractal called the Menger sponge.

The Menger sponge is not really the sponge you'd be scrubbing your bathroom with. But you can still think of it like that. Imagine both water and soap getting through your sponge's holes. Except the water is Wi-Fi and the soap is, say, Bluetooth. The fractal's infinite sponginess

allows it to receive many different frequencies simultaneously.

Before Cohen's invention, antennas had to be cut for one frequency. And that was the only frequency they could operate at. So without Cohen's sponge, your cell phone would have to look a hedgehog to receive multiple signals, including the one your friends use when they call.

Cohen later proved that only fractal shapes could work with such a wide range of frequencies. Today, millions of wireless communication devices--

[END PLAYBACK]

STUDENT 1:   Oh, sorry my bad.

PROFESSOR: Oh, was that the music?

STUDENT 1:   I was testing something.

PROFESSOR: OK, I was like, what's happening when you guys were recording.

STUDENT 1:   Yeah, I'm going to delete that. Come on.

PROFESSOR: Here, let's go--

STUDENT 1:   It was like-- earlier. Somewhere up there-- this.

[VIDEO PLAYBACK]

- --genuis invention, however, was not the first application of fractals in the w--

[END PLAYBACK]

PROFESSOR: Why is it doing this.

STUDENT 1:   Yeah, you can just do this. And it's around here. I guess it's--

[VIDEO PLAYBACK]

- --including laptops and bar code scanners used Cohen's fractal antenna. Cohen's genius invention, however, was not the first application of fractals in the world. It tuns out, nature has been doing it the whole time, and not just with snowflakes. Natural selection favors the most efficient systems and organisms, often of a fractal shape. For example, the spiral fractal is

present broccoli, seashells, and hurricanes.

The fractal tree is relatively easy to program, and can be used to study river systems, blood vessels, and lightening bolts. So many natural systems previously thought off limits to mathematicians can now be explained in terms of fractals. Plus, mathematics allows us to learn nature's best practices, and then apply them to solve world problems. Much like Cohen's antenna revolutionized the field of telecommunications, other fractal research is changing medicine, weather prediction, and building design-- here at MIT, and everywhere in the world. Look around you. What beautiful patterns do you see?

[END PLAYBACK]

PROFESSOR: All right, that's a good start. Good start. So I think in general, the transitions could be a little bit tighter. So, like right here. When you walk off-- well, this hiccup up is really noticeable. So either hide it by having an extreme close up before you leave, or just get rid of this entirely. Although, I know that you did that to show the walk off, so that you could show walking in.

STUDENT 1: And I can connect-- this is actually one video I separated so I could speed this up. And I guess I was just playing around with that.

PROFESSOR: I almost think this happens too quickly, though.

STUDENT 1: Yeah, it's at 140 right now. So I was just like--

PROFESSOR: Yeah, I would slow it back down, yeah. So let's go scene by scene.

[MUSIC PLAYING]

Is this track Creative Commons?

STUDENT 1: No, it's Aerosmith. I would take that out. I was just looking for an interem--

PROFESSOR: There's probably an iMovie sound effect, actually, that you could use.

STUDENT 1: OK.

PROFESSOR: For this part, where you're just, like, walking around, I would digitally zoom in close up. Because otherwise, you jump to talking all of a sudden. But your movement wasn't exaggerated enough to where you, like, get the joke that you're talking. So you can exaggerate it by changing the actual framing of the scene.

STUDENT 1:   So would I zoom in when I start talking?

PROFESSOR: I would stay zoomed in when you're talking, and then clean cut to a wider shot of you afterwards. So basically, I would cut, like, right there. I don't remember how-- my version's a little but different than yours. But I would cut right there. And for the preceding clip, do you know how to crop and zoom on clips?

STUDENT 1:   Yeah, I can.

PROFESSOR: You just go like that, basically. Yeah, for that. Now, for this I would also-- this is basically one, really long shot that is framed the exact same way. And it's very lectury, because you're literally at a blackboard. Although I think that that was a good set up for you guys, given the complexity of explaining this.

But I think you can avoid making it sound too chalkboard lectury by cutting in and out of your frame.

STUDENT 1:   OK.

PROFESSOR: Or, of your framing. So this is fine. Like right there, I would save your audio but just cut to a close up of your hand drawing it. Does that make sense?

STUDENT 1:   So kind of like with the phone? When I'm showing--

PROFESSOR: Yeah, yeah-- I would do more of that. I think in general, you have very static shots that last for a long time. So you can break that up by keeping the same track from your one long take, but mixing the extent to which you've zoomed in.

STUDENT 1:   OK, yeah, that's what I did with the phone, so I can definitely work on that.

PROFESSOR: I think that would help. Because this section is pretty long. Like, if you just even look at your project, this file is 32 seconds.

STUDENT 1:   Which, it's-- the video is about three minutes and 40 seconds right now.

PROFESSOR: OK.

STUDENT 1:   And then, like, this part is because I inserted the song.

PROFESSOR: Oh, OK, great.

STUDENT 1: So I guess you could zoom in at "this same shape."

PROFESSOR: I actually-- I feel like you're revealing this image too soon in your sentence. "If I repeated this process over and over again, I would see this image." And I almost don't want to see the image until you say "this image."

STUDENT 1: OK.

PROFESSOR: So maybe if you can zoom in, and frame, and crop out the fractal zoom in until you say "this." And then at "this" you can either pan to the drawing, or you can cut to a wide shot.

STUDENT 1: OK.

PROFESSOR: And anywhere you looked-- I mean, is there a way to, like, shoot footage of just close ups of the snowflake? Of you, like, going around the edge of the periphery of the snowflake?

STUDENT 1: So that would this part.

PROFESSOR: That would be that part, OK.

STUDENT 1: Yeah.

STUDENT 1: Which, this is a software-- a fractal drawing software. Am I allowed to, like, film the zoom in on that? And then use--

PROFESSOR: It depends on what license the software is released under, and who created that image.

STUDENT 1: OK. So, I mean, I didn't have to pay for it or anything.

PROFESSOR: Oh, you created the image.

STUDENT 1: No. Well-- so, kind of. It's just a software. And then you can do-- let's say you draw a Koch snowflake, and then you can just zoom in on it. And then I just--

PROFESSOR: And that is are free, open source software?

STUDENT 1: Yeah, it was free.

PROFESSOR: You know, what you should do is? You should just take a QuickTime recording of your screen. Like what we were doing.

STUDENT 1: That's what I was going to do.

PROFESSOR: And just, like, do a QuickTime recording of you zooming in.

STUDENT 1: And that's OK to use?

PROFESSOR: Yeah. All

STUDENT 1: Right.

PROFESSOR: Oh wow, this is so trippy. How do I make it stop?

STUDENT 1: I don't actually know. I haven't worked too much-- there is actually a video of somebody doing that, which is well done. So I may use part of that.

PROFESSOR: You-- ideally, you would make your own video.

STUDENT 1: Yeah, I'll work on that. Maybe I'll just, like, track their movements at least.

PROFESSOR: Yeah, because I don't know what the details of that would be. If you're actually allowed to use a video. Unless they've specifically released it under Creative Commons. All right, so you're here.

[VIDEO PLAYBACK]

-This is a Koch snowflake. This time, drawn on a computer. Such never ending patterns that on any scale, on any level of zoom look roughly the same are called fractals.

[END PLAYBACK]

PROFESSOR: OK, this is where you change your wardrobe all of a sudden. Ideally, that wouldn't happen. Wardrobe changes are OK if it makes sense. But here it seems, like, a little arbitrary. But it's not the end of the world. Does that makes sense why that seems a little bit weird, though? Because it's like, in your script there is nothing that sort of signifies or identifies that you've shot, like, at a different day. Or that you're in a location that requires a different wardrobe, you know?

[VIDEO PLAYBACK]

-This is a Koch snowflake. This time, drawn on a computer. Such never ending patters that, on any scale, on any level of zoom look roughly the same are called fractals.

[END PLAYBACK]

PROFESSOR: OK, I'm just going to say it. How do you pronounce Koch snowflake.

STUDENT 2: I think it's "coke," but I don't know.

PROFESSOR: I'm pretty sure-- it's K-O-C-H, right? Just cause I would imagine that it's educators watching this video, but if there are little children watching this one, there are going to be some, ha, ha-- she said cock snowflake comments.

STUDENT 1: I was actually thinking of doing-- because the sound changes so much, I was actually thinking of doing a voiceover of this. Because what I found-- I recorded this part indoors and outdoors, and I could match up the sound perfectly for what I was moving. So if I, like, do the same thing but somewhere else, I can probably match up the sound and change the snowflake part.

PROFESSOR: Helge von Koch. Yeah, I would just look up the pronunciation of that, just to--

STUDENT 1: OK, I will do that.

PROFESSOR: Just be careful. Yeah, and especially-- this is just video stuff anyway, so you can easily re-

record that. So wait for the reveal here. Basically, do a little more with cutting in and out of close ups and wide shots. OK, right here.

[VIDEO PLAYBACK]

- --are called fractals.

[END PLAYBACK]

PROFESSOR: So this reveal is a little awkward, because you're not looking at the audience when you're saying the big reveal. And then you have this sort of unnatural pause before you start the next sentence.

STUDENT 1: OK, I was actually originally intending to say fractals here, but I cut it--

PROFESSOR: Oh, OK, I see.

STUDENT 1: I thought, oh, well I'll just say that. But originally, it was going to be I finished saying fractals, and then I type on the computer and say--

PROFESSOR: OK, that will work a lot better.

STUDENT 1: So I can just redo that.

PROFESSOR: OK, cool. I mean, I think it's also-- I think ideally, you would say, fractals, and then you'd look down at your computer. But what you're saying now, that'll work too.

STUDENT 1: And that's how we filmed it, so--

PROFESSOR: Yeah, because this, like, gap in where you take a breath-- it sounds fine, but it looks a little awkward.

[VIDEO PLAYBACK]

-Computer scientists can program these infinite patterns--

[END PLAYBACK]

PROFESSOR: So this is super overexposed in the background. So I would try to see if you can bring the exposure down just a little bit.

STUDENT 1:   OK.

PROFESSOR: I don't remember how to do that on iMovie.

STUDENT 1:   It's on this. I actually increased the exposure, because there were some shadows. But I can play around with that.

PROFESSOR: I mean, the main thing is the whites, right? Like, you're super blown out in the window.

[VIDEO PLAYBACK]

- --infinite patterns by repeating--

[END PLAYBACK]

STUDENT 1:   No, it was different in the original one.

PROFESSOR: I don't know if there's a history on iMovie, but if you can somehow just, like, increase the blacks but don't blow out the whites, that might help if you have weird shadows going on.

STUDENT 1:   I think-- so it looked like this originally I think.

PROFESSOR: Yeah, that's better.

STUDENT 1:   Yeah, I don't know. I was playing around with that. But that's not the final version.

PROFESSOR: OK, cool.

STUDENT 1:   But that was the original.

PROFESSOR: Got it. Oh, yeah, I remember-- this one also feels pretty long to me.

[VIDEO PLAYBACK]

-Computer scientists can program these infinite patterns my repeating an often simple mathematical process over and over.

[END PLAYBACK]

PROFESSOR: So, for that line, do you have footage of you on MATLAB graphing a fractal?

STUDENT 1:   I can do that. Because that would probably be on the fractal software. I can just--

PROFESSOR: Yeah, even that. Like, just to break it up a little bit and give them, like, a visual association. Because this is one of those times where if you're like, again, in static place saying a big chunk of words to them, it's sort of easier to tune it out a little bit.

[VIDEO PLAYBACK]

- --fractals. Computer scientists can program these infinite patterns by repeating an often simple mathematical process over and over. In the 1990s--

PROFESSOR: Yeah, and then cut back out to you when you say-- I mean, because that's, like, a very separate thought.

- --a radio astronomer named Nathan Cohen--

PROFESSOR: Is there a picture of Nathan Cohen that could, like, pop up on the side?

STUDENT 1: I can probably find that, yeah. There is one, actually.

- --to revolutionize telecommunications.

[END PLAYBACK]

PROFESSOR: Oh, OK. So half way through the video, you switch to these, like, cube turn transitions. I mean, this is a personal preference. I don't know how you fell about transitions. But I feel like, either keep it all the same or use, like, this a little quirkier transitions for a very pointed reason.

STUDENT 1: OK, for this one, because it was such different locations, I used these to tell the story. So this is me introducing the story and telling the story. So just for that story I'm using those transitions.

PROFESSOR: Yeah, I think if you're going to do that, I much prefer a push rather than a cube turn. Because we've done that once before, and-- again, personal preference. George had to really sell me on the idea, because I was very opposed to it. But instead of doing a rotation, you just-- it's a wipe, basically. One frame pushes off and reveals the next one. I think that looks a little bit better.

STUDENT 2: Basically, I prefer as subtle of a transition as possible. And the animations are cool, but they remind people of, like, really flashy homemade videos as opposed to something professional.

PROFESSOR: Yeah, like this is a very iMovie transition.

STUDENT 2: Yeah.

[VIDEO PLAYBACK]

-At ths time, Cohen was having troubles with his landlord. The man wouldn't let him put an antenna on his roof. So--

PROFESSOR: There's some-- wait, let me listen to this again.

-Cohen was having troubles with his landlord. The man wouldn't let him put an antenna on his roof. So, Cohen designed a more compact fract--

PROFESSOR: There I would zoom in. Cut to a closer framing up that that's, like, just the wire.

- --radio antenna instead. The landlord didn't notice it, and it worked better than the ones before. Working further--

PROFESSOR: And then cut come back out.

- --designed a new antenna. This time, using the fractal called the Menger sponge.

[END PLAYBACK]

PROFESSOR: And again, I don't think it's necessary to do a rotation.

STUDENT 1: OK, and I was thinking here, while-- maybe have the Menger sponge increase in size, and then curtain as a background. So would that be another transition, to kind of have the Menger sponge expand and then have me wipe it off?

STUDENT 2: Are you drawing a Menger sponge?

STUDENT 1: Going to have a model of it, hopefully.

STUDENT 2: So you are-- sorry, are you going to re-film the part with, like, a model?

STUDENT 1: No, just like and image.

STUDENT 2: OK, OK.

PROFESSOR: So it would pop up in your hand right there. So the way this is framed-- I mean, the subject is really here-- is going to be here-- and you're so biased. I mean, this is beautifully framed in terms of, like, rule of thirds and everything. But because you held your hand out this way, it's going to look really fun-- like, the visual balance of that frame is going to look really funny when you're like, Menger sponge, and then all of a sudden this huge thing gets cut off on the side.

So either zoom in a little bit-- ideally, you would have held out this hand so that it would have been in the middle. Although the background is really distracting, so I don't know if--

[VIDEO PLAYBACK]

-Menger sponge. The Menger sponge--

[END PLAYBACK]

PROFESSOR: And are you going to hold-- so, I'm assuming the Menger sponge picture will be floating somewhere.

STUDENT 1: It would be here, yeah. But then I would get rid of that when I'm talking about the regular sponge.

PROFESSOR: Well here it would still be floating. Because I think when you say, the Menger sponge isn't exactly like a real sponge, right? But I think the Menger sponge needs to be shown.

STUDENT 1: OK

PROFESSOR: If you're going to show something, show it long enough to where the viewer can process it a little bit. Otherwise, it's like this blip that might distract them.

STUDENT 1: OK.

PROFESSOR: Did you cut right here, or is there a little bit more?

STUDENT 1: I think there's a little bit more.

PROFESSOR: OK, yeah. Hold it just a little bit, and maybe cut to-- again, cut to a close up shot. That can be sort of a workaround to the weird framing issue. Otherwise it's like, it's really nicely done.

[VIDEO PLAYBACK]

-The Menger sponge--

PROFESSOR: Yeah, you can say, the Menger sponge, and then pop up right there.

- --is not really the sponge you'd be scrubbing your bathroom with, but you can still think of it like that. Imagine both water and soap getting through your sponge's holes, except the water is Wi-Fi and the soap is, say, Bluetooth.

PROFESSOR: Yeah, so here the timing of you turning on the water is a little bit weird. Because you turn it on, like, way after you say water and soap. And I wonder, were you planning on doing an animation for this section?

[VIDEO PLAYBACK]

-Imagine both water and soap getting through your sponge's holes.

[END PLAYBACK]

PROFESSOR: Because I feel like this is a spot where it actually would be beneficial to not even have an overlay, but a completely separate animation of, like, a sponge with holes and, like, H2O and soap with arrows pointing. Like, going into the sponge holes. What do you think, Zoe?

STUDENT 2:   Yeah, or just to, like, demonstrate that concept. Because it's easier to understand when you read it than when you hear it in a couple of seconds.

STUDENT 1:   Yeah.

PROFESSOR: And I think, like, the visuals of this-- again, it's a pretty long-- it's, what, 14 seconds? It's actually kind of long to have the same sort of still framing.

STUDENT 1:   If you like how it's framed, it's another-- you could also just overlay like, a little arrow pointing in. Because you hold it pretty still.

[VIDEO PLAYBACK]

-But you can still think of it like that. Imagine both water and soap--

[END PLAYBACK]

PROFESSOR: Yeah, like, you could just have H2O and soap with arrows pointing into the sponge, and then

coming out of the sponge.

[VIDEO PLAYBACK]

-Except the water is Wi-Fi and the soap is, say, Bluetooth.

[END PLAYBACK]

PROFESSOR: Yeah but I would almost-- you can leave it in for the rough cut and we can see what other people say. But the movement of that is almost distracting, because it has nothing to do with what you're saying when you're saying it, right? Do you have another take of this?

STUDENT 1: All of them are kind of like.

PROFESSOR: Oh, the exact same. OK.

STUDENT 1: There might be one when I finish talking and then turn on the water, so I can use that.

PROFESSOR: Yeah, because if you cut it right here, and you didn't turn on the water, then that would have been better.

STUDENT 1: I think there are versions like that that I can use.

PROFESSOR: And again, this one-- like, I wouldn't even do it a push at all. I really think it looks a lot better when you do as clean transitions as you can.

[VIDEO PLAYBACK]

-The fractal's infinite sponginess allows it--

PROFESSOR: I would shave off, maybe, like a half second. Because you take a breath, and then it takes just a hair before you actually start talking. So I'd just snip the tiniest bit off of the beginning. Are you planning on doing any animations to the dies?

- --allows it to receive--

[END PLAYBACK]

STUDENT 1: I probably can put them in the sponge, there. And, like, signals coming inside.

PROFESSOR: Yeah, because otherwise-- again, like, nice rule of thirds. But you have a bath-- is that a

bathroom stall?

STUDENT 1:   Yeah.

PROFESSOR: Yeah, so it's like a really awkward visual. But if--

STUDENT 2:   It's a good background.

PROFESSOR: It's a good background if you want to put, like, a picture of a Menger sponge receiving different signal.

STUDENT 1:   All right, I can see that.

[VIDEO PLAYBACK]

-Before Cohen's invention, antennas had to be cut for one frequency.

PROFESSOR: Yeah, so show an old antenna.

-And that was the only frequency they could operate at. So--

PROFESSOR: And like, right here.

-So without Cohen's sponge, your cell phone would have to look something like a hedgehog.

[END PLAYBACK]

PROFESSOR: I would-- there's like, a bit of a hesitation before you say, "without Cohen's sponge." And I don't even think you need the so. So I would just cut out the pause and the so, and cut straight to, "without Cohen's sponge." And then to hide that cut, you can either zoom in little bit more--

STUDENT 1:   OK, that makes sense.

PROFESSOR: Yeah, and like, for that, since you're not going to have the animation, I would frame it and zoom in to where it's just you. And the resolution is going to look a little funky, but I think it's worth the compromise to do that.

STUDENT 2:   And it helps lead to start leading the viewer into seeing your phone. Because it's like, you're starting out with a wide shot, and now you're on you, and then eventually it will be your phone. And so it's like-- it just sort of helps the narrative along.

PROFESSOR: And again, I wouldn't ripple. I would just go straight to the cut into that.

[VIDEO PLAYBACK]

- --multiple signals, including the one your friends use when they call.

[END PLAYBACK]

STUDENT 1: So I'll take out that transition.

PROFESSOR: This one you could-- because it's such a different-- wait, is that the end?

STUDENT 1: The end of the story.

PROFESSOR: Yeah, maybe you can do a push.

[VIDEO PLAYBACK]

-Cohen later proved that only fractal--

[END PLAYBACK]

PROFESSOR: But it's still part of the same story, so I would say just do a clean cut there, too.

STUDENT 1: OK.

STUDENT 2: I like that background.

PROFESSOR: But it is a little-- it's still a little overexposed here, too.

STUDENT 1: Yeah, that was another one I edited as well.

PROFESSOR: Yeah, so clean transition-- I would cut out this gap, too. It's just like the slightest-- it's too long by just the slightest amount of time.

[VIDEO PLAYBACK]

-Cohen later proved that only fractal shapes could work--

[END PLAYBACK]

PROFESSOR: And that's actually what makes it read sort of newscastery. You know, like, have you ever seen the special segments, and the reporter is on their couch, and they're like, da dah da dah da

dah. And then this person did this. So it's just, like, those tiny little gaps that make it read that way. But if you get rid of it, then it will be a lot more natural.

- --such a wide range of frequencies. Today, millions of wireless communication devices, including laptops and bar code scanners, use Cohen's fractal antenna. Cohen's genius invention, however, was not the first application of fractals in the world.

STUDENT 1: So I'm going to change that audio as well, because I think I was too grand. And I have other versions that may work better.

PROFESSOR: OK, I like this a camera slow pan off, actually.

STUDENT 1: We did another version which had also this pan. It wasn't as good, but I said the next sentence after that. So it sounds more natural. So I'm going to see if I can trade off the visual for better--

PROFESSOR: Do you need something? OK, sorry. OK, so this is why this transition is a little bit funny here. The speed at which you're moving the camera when you pan off is way faster than when you pan down onto you. So what you could do is cut this clip into two, and speed up the first part. Like you did earlier. Also, is this broccoli?

STUDENT 1: It is broccoli. There's a mural, and stata.

PROFESSOR: I didn't know that was broccoli. It looked like bags of seeds or something.

STUDENT 1: And maybe it looked like broccoli enough.

PROFESSOR: It looks like cauliflower.

-Turns out, nature has--

STUDENT 1: It actually may be cauliflower. I think I confused the words when I was filming it. So yeah--

PROFESSOR: IMovie, I hate you. OK.

STUDENT 1:   So if you just press here.

PROFESSOR: I mean, it's indistinguishable. It looks like bags of stuff almost.

STUDENT 1:   I can still insert just an image of broccoli, so I don't-- if it's not broccoli.

[VIDEO PLAYBACK]

- --devices, including laptops and bar code scanners, use Cohen's fractal antenna. Cohen's genius invention, however, was not the first application of fractals in the world.

[END PLAYBACK]

PROFESSOR: Yeah, the pan just needs to happen sooner. I would even speed the pan off, and then speed up the pan down. Right? Cause it's like you're waiting for the camera to move off of you.

[VIDEO PLAYBACK]

-Cohen's genius invention, however, was not the first application of fractals in the world.

[END PLAYBACK]

PROFESSOR: Are you planning on re-shooting any of this for sure?

[VIDEO PLAYBACK]

-Turns out, nature has been doing it the whole time.

[END PLAYBACK]

STUDENT 1:   Some scenes. I can re-shoot this one, and the one in the classroom. The ones in east campus, I don't think that I can do that.

PROFESSOR: Yeah.

[VIDEO PLAYBACK]

- --organisms, often of a fractal shape. For example, the spiral fractal is present in broccoli, seashells, and--

[END PLAYBACK]

PROFESSOR: Yeah, because I think especially with this one, go ahead.

STUDENT 2: Oh, I know-- I think the broccoli-- the spiral fractals are most present, it's like romanesco broccoli or something like that. And so like,

PROFESSOR: It's a specific type.

STUDENT 2: And so people might be confused, and like look at their normal broccoli, and like--

PROFESSOR: I would show a picture of the romanesco broccoli. Especially because I don't think this is-- I think this is bags of barley, or cotton almost.

STUDENT 1: That would make more sense. It's also why the person is up there.

PROFESSOR: Yeah, and I think, also, it just like doesn't really look like a fractal. Whereas the broccoli actually-- there are visualizations of it where it actually looks like, oh, I can identify this as a fractal.

STUDENT 2: And so it will just be reassuring for your viewer when they can see the picture of the broccoli and be like, oh, I can totally see how that's a fractal. Rather than, like, squinting at your background and being like, is that-- did I learn anything from this video type thing.

PROFESSOR: If you're going to re-shoot this part-- and if you can't get it this weekend, that's OK. Remember, you still have Wednesday to do it. I would be careful about the way you're emphasizing words. It's kind of falling a little into the trap of what George was saying about how news presenters emphasize every third word, just a sound sort of-- they're emphasizing important thoughts, but they don't really make sense where they're emphasizing the words.

So I would just try a few different types of deliveries. One where you're actually emphasizing every other word on purpose. And then do something, like, completely exaggerated. And then try one where you're sort of more natural tone talking.

STUDENT 1: I think that's how I usually present. Like, even in real life.

[VIDEO PLAYBACK]

- --the whole time. And not just with snowf-- fractals in the world.

[END PLAYBACK]

PROFESSOR: Remember that eighth grade PHD Thing. You're talking for eighth graders, but you're not talking necessarily to a 10-year-old, right? So how would you say this line--

[VIDEO PLAYBACK]

-Turns out, nature has been doing it the whole time.

[END PLAYBACK]

PROFESSOR: How would you say that line to, like, your professor?

STUDENT 1: I mean, I wouldn't say this line to my professor.

PROFESSOR: How would you say that line to Jamie?

STUDENT 1: Turns out, nature has been doing it the whole time.

PROFESSOR: Yeah, that's a little bit different. Like, turns out nature's been doing it the whole time. It's such a subtle nuance, but it's just something about, like--

[VIDEO PLAYBACK]

- -- bar code scanners use Cohen's fractal antenna. Cohen's genius invention, however, was not the first application of fractals in the world. Turns out, nature has been doing it the whole time.

[END PLAYBACK]

PROFESSOR: I think it's the way you say time. Nature has been doing it the whole time. I mean it's OK to say the whole time, but it reads like a little Reading Rainbow when the intonation is like that. But again, maybe that's just my personal taste. In general, I think your enthusiasm is really, really good.

Like, you're taking a subject that's inherently a little bit hard to visualize. It's a little bit tedious. And because you have this enthusiastic delivery, it's a lot easier to follow along with you, which is good. So don't lose any of that energy, for sure.

[VIDEO PLAYBACK]

-And not just with snowflake. Natural selection favors the most efficient systems and organism,

often of a fractal shape. For example, the spiral fractal is present in broccoli, seashells, and hurricanes.

[END PLAYBACK]

PROFESSOR: If you re-shoot this, just make sure that you're framed more in the center, and there's enough room above you to accommodate for the animations. And this is actually something that you could, if you had to, you could do on your own. You just set up the tripod and flip the screen around you so you could see. You wouldn't have the pan down, but that's OK.

[VIDEO PLAYBACK]

-The fractal tree is relatively easy to program, and can be used to study river systems, blood vessels, and lightening bolts. So many--

[END PLAYBACK]

STUDENT 1: Yeah, I definitely don't think there is enough space there. But I wasn't the one directing.

PROFESSOR: The other thing is, like, if you end up filming this part on your own you don't necessarily have to have a pan down. You could just do a push down transition. That's where I feel like a transition would be OK, because you've got the camera tilt up previously. If you do this again, I would just look up instead of going like this. Because it's a little bit awkward to go like that.

[VIDEO PLAYBACK]

- --natural systems previously thought off limits to mathematicians can now be explained in terms of fractals.

[END PLAYBACK]

PROFESSOR: I wouldn't move off of this scene so quickly. Like, give it one more beat before you transition.

[VIDEO PLAYBACK]

- --and can be used to study river systems, blood vessels, and lightening bolts. So many natural systems previously thought off lim-- tree it is relatively easy to program, and can be used to study river systems, blood vessels, and lightening bolts.

[END PLAYBACK]

STUDENT 1: And I would re-shoot this completely.

[VIDEO PLAYBACK]

-So many natural systems previously thought off limits to mathematicians can now be explained in terms of fractals.

[END PLAYBACK]

PROFESSOR: Yeah, and right here I would just cut to, immediately, you talking. Because there's, like, a little bit too long of a pause before you start. And bump up the--

STUDENT 1: Yeah, I'll do a voice over for this one, because there's a lot of wind.

[VIDEO PLAYBACK]

- --learn nature's best practices, and then apply to solve real world problems. Much like Cohen's antenna revolutionized the field of telecommunications, other fractal research is changing medicine, weather prediction, and building design-- here at MIT and everywhere in the world. Look around you--

[END PLAYBACK]

PROFESSOR: When you say, "look around you," I would actually cut back to a close up of you. Look around you--

[VIDEO PLAYBACK]

-What beautiful patterns do you see?

[END PLAYBACK]

PROFESSOR: And just end it a little bit sooner. It's a good start-- really good start.

STUDENT 2: A good rule of thumb-- we never mentioned this in the editing lecture, but, like, you want to give the end of a scene a little room to breathe so people can process, like, what's going on. And then at the beginning of a scene, you want it to be, like, one or two frames before you start talking. So it's, like, almost immediately your voice.

PROFESSOR: Yeah, that's actually a very good point. And I should have brought that up during the editing

lecture. But I feel like the tendency is to do the opposite with what you've done with the scenes here, where you end too soon, and then you wait too long before you start the next scene.

STUDENT 2:	It's like-- it's counter intuitive, but it makes it flow better.

PROFESSOR:	But yeah, you're in really good shape in terms of, like, pacing what you need to do before next week. So I think, at this point, it's a matter of getting the animations in and the music.

STUDENT 1:	OK, think you.

STUDENT 2:	You're definitely, like, well on your way, on the right track to be done.

PROFESSOR:	This chair is bad news bears. I lean back to stretch, and I'm still leaning. I'm still leaning.

STUDENT 2:	This entire room is kind of--

PROFESSOR:	It's a little haphazard. How are you guys doing?

STUDENT 1:	Thank you.

PROFESSOR:	Yeah, good luck. You're still cutting and pasting the script?

STUDENT 3:	No--

PROFESSOR:	Oh, your scenes together. You guys finished filming everything, right?

STUDENT 4:	Yeah.

PROFESSOR:	This is nice framing.

STUDENT 3:	Thank you See, you should--

PROFESSOR:	Now, if you did it again, one cool thing that you could do-- and I'm not saying that you need to, because this is fine. But if you had moved him to the center of that picture, and you moved close enough, then this image could basically fill the entire background and you wouldn't have this weird gap, right?

STUDENT 3:	Oh, OK.

PROFESSOR:	I don't know if the image was big enough to do that, compared to the size of his body.

STUDENT 3:	The image was big enough. I didn't want to do that because I didn't want him to look like he

was in green screen.

PROFESSOR: That's a good point, actually. That is a good point.

STUDENT 3: That's the reason why. I have a bit OCD, so I can't stand what's on the right, actually. But I'm fine.

PROFESSOR: It's OK. It's OK.

STUDENT 2: Yeah it kind of-- it's blurry enough that's it's not distracting, because I'm not trying to read the words. Because I don't think they're, like, readable.

PROFESSOR: Yeah, I wish I could have given you guys lights, because that's what happens when you rely on the fluorescent. You get some weird shadows on your face from overhead. But it looks nice. Do you guys have any specific questions right now, or should we just let you work?

STUDENT 3: I'm planning to do animations all night, so--

PROFESSOR: I didn't see you guys film anything. I guess I saw you guys film that stuff.

STUDENT 3: Like, I plan to put animation here.

PROFESSOR: Yeah, that's definitely-- it's good. That's a good surface. As long as you keep the pictures small enough.

STUDENT 2: And you can adjust the size, like, even after you've done it After Effects-- and you've exported it or transferred over to Premiere-- you can change the size of it.

[VIDEO PLAYBACK]

-How much faster would that be?

PROFESSOR: Did you guys use the VIXIA for that one? Did you use the VIXIA in the hotel?

STUDENT 3: What is the VIXIA?

PROFESSOR: The Canon camera.

STUDENT 3: Yeah.

PROFESSOR: That's like, nicely lit. Surprisingly nicely lit. So it's like a lot of natural light, then. Yeah, it looks

really nice.

STUDENT 2: I think the white bed sheets help, because they're like a natural reflector.

PROFESSOR: Yeah.

STUDENT 3: So they're all natural light. And there was a lot of stuff here. That we threw away. I was like, oh, I can't stand it. It's too much.

PROFESSOR: And the other thing is, you might want to bring the exposure down just a tiny bit, because the whites here are really peaking pretty high. But everything from here is so nicely lit that I'm almost inclined to just, like, forget it. Just keep it the way it is.

STUDENT 4: How do you do the exposure on the--

PROFESSOR: In the editing software there should be a way to just, like, bring down the exposure. What are you using for yours?

STUDENT 3: I think the simplest way would be to tap the bright area, and then it would be--

STUDENT 4: You mean on the video camera itself?

STUDENT 3: Like, on the video itself-- on the touch screen-- you just tap your shirt. Then you will have dim down.

PROFESSOR: Nice job, guys.

STUDENT 2: You just kind of disappeared for a couple days, but you came back with really good footage.

PROFESSOR: I'll let-- you guys can just work. We'll stay out of the way.

STUDENT 2: If you have any questions, then-- and I'll be able to answer, like, any of the editing questions you have in Premiere.

PROFESSOR: This one, I would zoom in on you a little bit more. Because you're a little low. So I would crop in like that, to where the top of the frame is just above your head.

STUDENT 2: Usually do the rule of thirds with, like, eyes rather than the top of head. And I think. And if you look at your eyes. They're kind of in the middle so you want to adjust it so they're equal. Yeah, like that.

PROFESSOR: We'll let you guys work.

STUDENT 2: If that's all let me [INAUDIBLE] for today, actually.

STUDENT 3: What time is it?

STUDENT 2: It's 10 till 3:00.

STUDENT 3: OK.

STUDENT 2: OK, so now what-- the problem is, illustrator defaults to a brush. Which we don't want, because that will mess up when we redraw it in After Effects. So we select the arrow, we want to change Brush Definition to basic. Go into Stroke-- let's see, why are there not more options? There we go. Change the caps and corners to round, so it's, like, nice and smooth. Like, it looks like a brush.

Basically, we're making it look like a brush, while doing a basic shape. And then change it to, like, whatever weight you want. So you want it about that. And you can play around. Like, do you want it super thick, or do you want it not so thick? And then the last thing you need to do before going into After Effects, is go into this layer-- and so, see, it has the different parts of the arrow. You want to highlight everything, click this drop down menu, and click Reverse Order.

Because it stacks it from the last thing you drew to the first thing you drew, and you want to be first thing you drew to last thing you drew. Then you want to save this. We'll just save it in Documents for now. OK, and then you open up After Effects.

PROFESSOR: That's a nice pan, Joshua. This is nice camera work.

STUDENT 3: Oh yeah, I held the tripod to the right. I looked really stupid, though.

STUDENT 2: But it's really stead.

STUDENT 3: I didn't actually hold it like that. I knew that it would be bad.

STUDENT 2: If After Effects would open, and not give us the color wheel of death, then I can show you. I can get it. I have my computer. It's, like, open. It's about half an hour of video. OK, After Effects-- hurray!

OK, so we're going to import our composition as a composition. All right, double click it. I'm going to set it to a white background, just so we can see things. And depending on-- if you do it on the black portion, you might want to set the background to black and have the arrow be in white. Like, depending on how you want it to look.

OK, so this is the fun part. So we're going to turn the arrow layer into shapes. And then what we're going to do is, we're going to a add a Trim Paths. And basically what that means is, it's going to draw the line for you. And then under Trim Paths we're going to trim multiple shapes individually.

Because that means-- so, if you do it simultaneously it'll draw the arrow-- like, both lines at the same time. So it'll start drawing the long arrow and, like, the arrow head at the same time. And we don't want that. So change it individually. And then wherever you want it to start you turn the end down to zero. Set your key frame. And, say, we want it to draw in two seconds. You turn the end to 100.

And you go back to beginning and you press space. And it will draw the arrow is as much time. Is that like what you wanted to do?

STUDENT 3: Yeah, I wanted to do arrows.

STUDENT 2: Yeah, and then you can change it. Like there's some lines-- like, I like writing out handwriting a lot in animations in my videos. And so, like, for example, if you want it to pause on the store, you can set it-- OK, so it's like a 35%. So you can set a key frame there at 35%. And then you can set another one later on, also at 35%.

PROFESSOR: And then what it does is it, like, pauses at the door, holds it there, and then keeps going in remaining time.

STUDENT 2: OK, thank you.

PROFESSOR: Yeah, I don't know if you can remember all that. But if you forget the rest of it, write me and I'll redo it.

STUDENT 3: OK, thanks.

STUDENT 2: Yeah, let me know if there's anything else.