PROFESSOR: OK. Chris can you say that again? Was that close to what you wrote?

AUDIENCE: No. Mine's like five-year-old words.

PROFESSOR: OK, well tell us in five-year-old words and we'll see if they're the same.

AUDIENCE: [INAUDIBLE] I found that there was a lot of green counts in the green leaf.

PROFESSOR: OK. So there's lots of green counts in the green leaf. Were there lots of red counts in the green leaf?

AUDIENCE: There was a lot, but not as many as the green leaves.

PROFESSOR: Not as many. OK. Lauren, how does that fit in with what you said?

AUDIENCE: That's pretty much what I said, that there were more counts if, say, you're using the red filter, then there are more red counts.

PROFESSOR: OK.

AUDIENCE: But there are still green and blue counts.

PROFESSOR: OK. So, in other words, when we look at an object through a filter, if that object has a red color, if we look at the counts that we get through a red filter, that's going to be a lot. So by looking at these colors, you should be able to say, if I'm looking at a region that looks blue, I would expect that the counts from the blue filtered image are going to be a lot.

So what I want everybody to do is turn so that you can look this direction. Actually, I think we're going to put it over on the other table so that everybody can see. So you guys are going to have to scoot around this way.

So here we have-- I want everybody to still be able to see-- but we have three different light bulbs. We have a red light bulb, we have a green light bulb, and we have a blue light bulb. And you can see this indicates that blue is on, this indicates that green is on, this indicates that red is on.

Now, we are separating out the photons that are coming in. We're separating them out by energy. We're saying all the low energy photons, all the red photons, we're going to collect behind our red filter. But then when we turn on our image, we get not just red, because a couple of people were looking at yellow regions looking at the yellow sunflower. Jalen, what did you find when you looked at the yellow sunflower?

AUDIENCE: When [INAUDIBLE] it actually had the highest, which was 3.96 times [INAUDIBLE].

PROFESSOR: OK. But what did you find in green?

AUDIENCE: Green was about average, and it was 2.74 times [INAUDIBLE].

PROFESSOR: OK, so it's not that one was overwhelmingly red. But if we take red and we add in a little bit of green at the same time-- so I'm turning on both of these lights at the same time-- I can get a color that looks like yellow. Now, Jalen was saying it wasn't that here yellow's turned all the way down. In this case he said there was a lot of red.

So let's turn that up. And he said there was a little bit of yellow-- not as much, because this is the same-- but there wasn't as much green in the image.

So what we're doing here when we're putting these three images together, we're adjusting how bright each one of those pixels looks depending on how many counts that we get. So by adding in different colors, say we turn the red all the way down, we get green. But if we turn red back up a little bit, we get yellow again.

So by taking these three colors, red, green, and blue, and collecting photons that fall into those energy ranges-- remember, each photon has its own energy-- those filters let through a range of energies. They don't just let through one energy, because remember, when we looked at red, it wasn't that it was just one thin strip, it was that whole section of red. But by combining with other colors-- let's just take red. What do you think will happen if we take red and we combine blue with it? Did anybody find any regions that had a lot of red and at least some blue?

AUDIENCE: Purple.

PROFESSOR: You think we'll get purple. Did anybody see any purple regions?

So here we've got red and blue. Again, if we turn blue all the way up, we get something that looks like purple. But when we change the intensity, or we change the flux that we receive-- this is our little detector, there's just a light bulb inside here-- when we change that value, we change the color. We add in a little bit of green. If we turn them all all the way up, what color will we get?

AUDIENCE: White.

AUDIENCE: Brown.

PROFESSOR: I heard brown. I heard white.

AUDIENCE: [INAUDIBLE]

PROFESSOR: It's a little bit confusing. Because when you're combining colors, like if you're painting, it works kind of the opposite. When you add all the colors together you get black. When you're combining light together, if you add red green, and blue all the way, it's kind of as close to white as we're going to get. We turn the green down a little bit, and that's kind of white.

So we can rebuild these different colors by looking at these different filtered images. So in a way, what astronomers have to do is they have to break up the light. They have to somehow record something about the energy of the light. Because on most detectors, we just get the number of counts.

Well here what we've done is we've recorded the energy by saying, only let the stuff that's red-- where the photons that have energy that we see as red-- pass through here. And then we'll combine that with the green photons and the blue photons. And then we adjust our contrast and bias so that we can get a real representation of the actual color.

Now, in our eyes, we detect all those photons at the same time. There's three different little kinds of cells in the back of our retina, one of which responds to red, one of which kind of responds to green, and one of which kind of responds to blue. It's not exactly that, but it's close. So when all three of those cells respond, our brain says, oh, that looks white. When those cells respond at different levels, if we change this up and down, if the green responder doesn't ring, doesn't go off, we see that as purple because we've got red and blue together.

So what I want you guys to do now-- and when we analyze colors, we're going to do it in this way. We're going to create a true color image, and then we're going to get the number of counts. Because by looking at the relative numbers of counts-- are there more red than blue, are there more blue than green-- we can find out something about the color makeup of a particular object.