



Teacher's Guide for: **Black Light**

Note: All activities in this document should be performed with adult supervision. Likewise, common sense and care are essential to the conduct of any and all activities, whether described in this document or otherwise. Parents or guardians should supervise children. Rock-it Science assumes no responsibility for any injuries or damages arising from any activities.

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Title Page of Video

(Numbers in the text are **time codes**, so you can refer back to the video.)

[00:03;09]

Black Light
filmed July, 2009

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Releases have been obtained for all students who appear in this video, but their images should not be used publicly unless their nametags are rendered unreadable and their names are bleeped from the audio track.

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Intro Quick Recap

Lesson Intro: Light and Color

- Light is energy. When you turn off the light, there's less energy.
- Sometimes light is like the waves in the ocean; at other times, it's like the bullets in a machine gun.
- Light can be absorbed. Sometimes it gets absorbed and comes out as a different color.
- A green shirt absorbs all the colors except green, and the green bounces off and we see it with our eyes.

Experiment Quick Recap

Experiment: Painting under Black Light

- Each student gets a sheet of white cardboard and sees the shadow of their hand under various colored lights.
- Then they get blobs of paint in the three primary colors and three fluorescent colors.
- Students paint anything they like, blending the paints any way they like.
- Instructor illuminates the table with black light occasionally as the students are painting.
- Instructor shows students how three colored lights can create shadows of multiple colors.

Equipment List: "Black Light"

Items needed for Instructor:

- Red, Green, and Blue Floodlights
- Extension Cord
- UV Light
- Plastic Jack-o-lantern
- Pipe Cleaners (to show colors)
- Balloons, pink & orange (to show colors)

Items needed for Students:

Consumables (per student):

- White Cardboard (flattened boxes) about 1 ft square

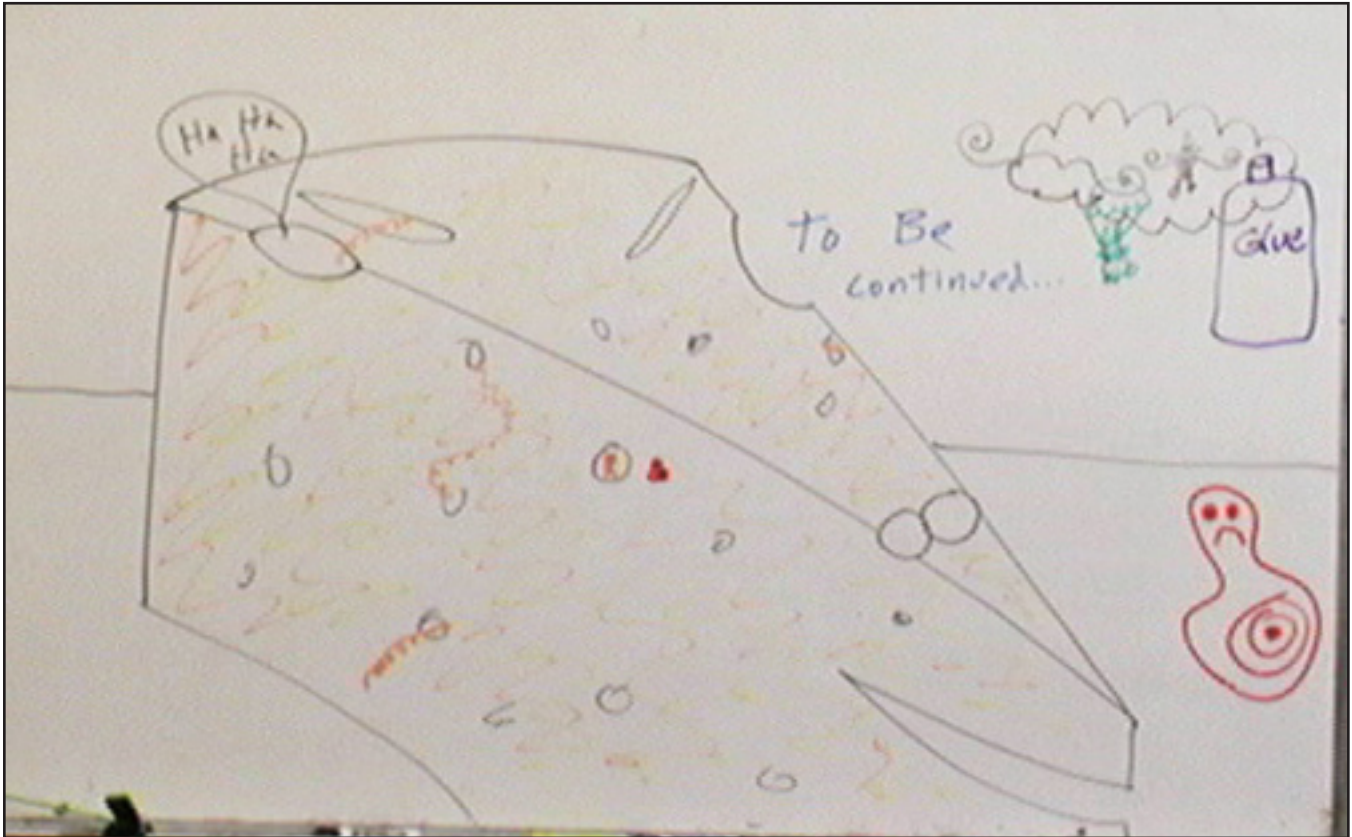
Other:

- Poster Paints (primary and fluorescent colors)
- Paintbrushes

Prep Work:

- None

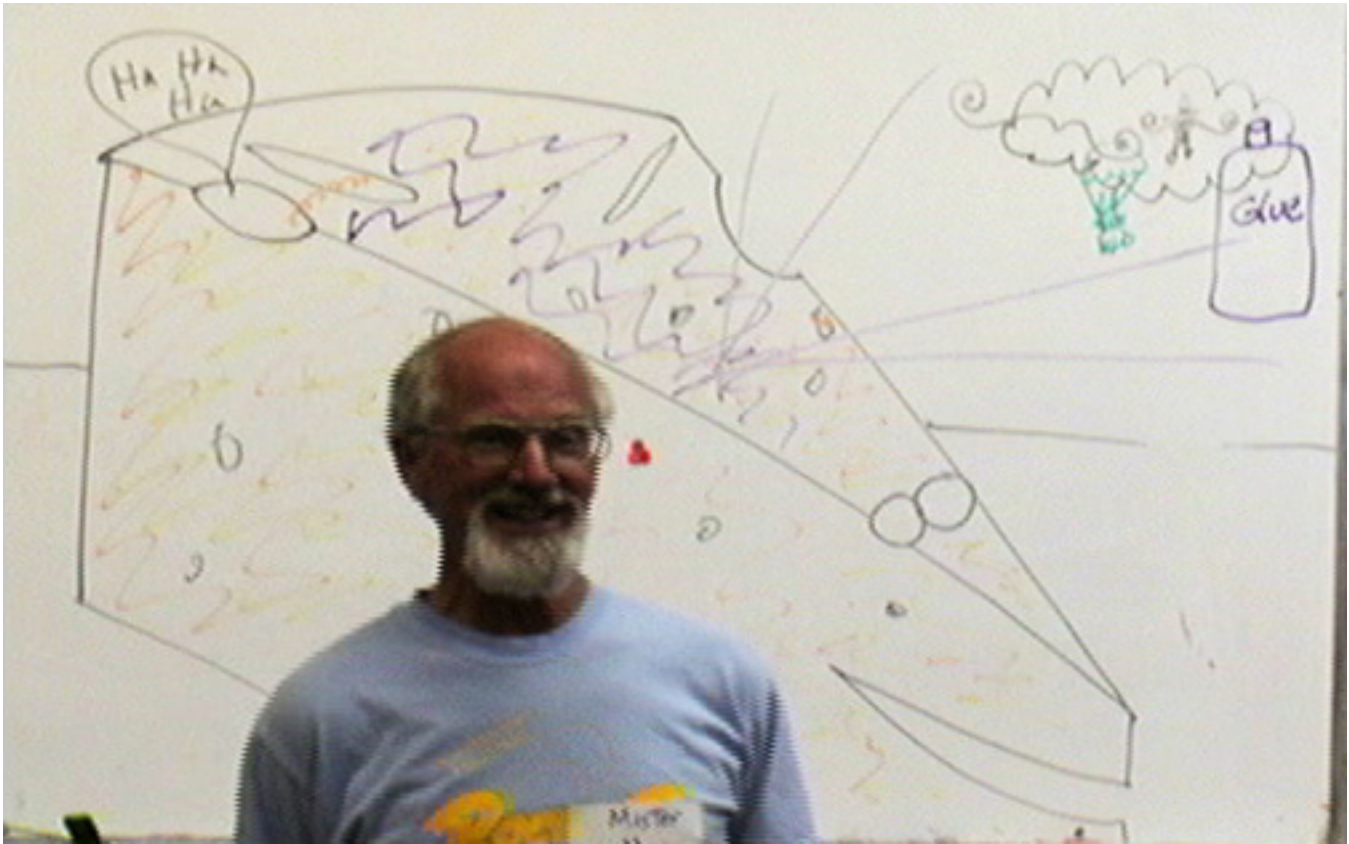
Story Quick Recap



Part 1:

- Jack & Jill are exploring the Great Swiss Cheese Caves with their Kick-Mes.
- The Kick-Mes are bouncing all around inside the caves and laughing really loud.
- Evil Mister Fred, flying on his cloud nearby, hears the laughter and wants to stop it.
- He calls the Acme Store of Everything and orders a big bottle of glue.
- He pours glue into the caves so the Kick-Mes will get stuck.
- At first, the Kick-Mes start to get stuck, but then they eat the glue and start having fun again.
- Then he ordered a lightning storm, and the lightning struck the caves and blew the Kick-Mes to smithereens, but they came back together again and loved it.
- Evil Mister Fred orders the Kick-Me manual from the Acme Store of Everything and learns that Kick-Mes are afraid of green bunny rabbits.
- He orders a bunch of bunny rabbits, attaches parachutes to their ears, and drops them into the caves.
- The bunny rabbits start running all around in the caves, and the Kick-Mes are terrified.

Story Quick Recap



Ending:

- The Kick-Mes become so scared, they start vomiting up the glue all over the outside of the swiss cheese, and the rabbits get stuck on it.
- Jack and Jill call the Acme Store of Everything and order a blanket to put over the sun.
- When the blanket starts to burn, the UV light comes through and makes the green bunny rabbits look black, so the Kick-Mes aren't afraid of them anymore.
- The Kick-Mes start trying to play with the stuck bunnies.
- The bunnies get so angry, they bounce right out of the cheese at supersonic speed.
- One of the bunnies hits Evil Mister Fred's bottle of glue, splattering it all over him and his cloud.
- Stuck to his cloud and unable to move, Evil Mister Fred drifts away.

Transcript: Introduction

[01:00:11;02] You are now surrounded by energy -- energy of light. See that, energy. *[Turns off lights.]* That's less energy, not as much as there was before. *[Turns on lights.]* And light can come in all sorts of energy types. Some of the light comes in waves, like waves on the water. Some light comes like machine guns -- dat-dat-dat-dat-dat-dat-dat! It acts like machine gun bullets in some cases. Sometimes light can get absorbed by you. When you go out into the sunshine and you're playing at the beach, you can get a burn from the light that comes from the sun. Sometimes light will get absorbed into something and come out as a different color light. Imagine that. That would be weird. If you look at your shirts, there's color on your shirts. Now, if you have a green shirt -- he's got a green shirt -- do you know why that shirt's green? You say, because somebody put green paint on it. Well, actually it's green because when the white light hits it, it absorbs all the colors except green. And the green comes back and we see the green with our eyes. So if it's bouncing off just green, we call it a green shirt, because it's absorbing every other color except green.

Today we're going to try to make light do some weird stuff for us. And we're going to play with it a little bit and see if our eyes get tricked when we do it. But first, we need a crazy story.

Story: "The Kick-Mes and the Green Bunny Rabbits"

[01:02:45;12] Caves come in swiss cheese. You've seen swiss cheese before -- it's got caves in it. So Jack and Jill were exploring the Great Swiss Chees Caves. There's a chunk of swiss cheese. We need a horizon for our swiss cheese -- there's a horizon. And there's places in swiss cheese with holes. And there's other holes all over the swiss cheese. I should have made it orange, because swiss cheese is kind of yellow or orangey. There.

And Jack and Jill are exploring the caves. Here's Jack. You can find Jill. You just follow the hair. And there's Jill's eyes. She's over there. And Jack and Jill have brought along with them their Kick-Mes. The Kick-Mes are funny little creatures that look kind of like that. They have a target on their stomach, and they're always sad. A Kick-Me is indestructible. You can kick him as hard as you want, and you know what he'll do? He laughs and giggles and flies through the air. If you kick a



A Kick-Me

Kick-Me into a fire, he'll burn up, and the smoke will appear in the sky and form itself into a Kick-Me up in the sky, and it'll fall down, bounce on the ground, and he'll laugh and giggle and bounce away.

And Jack and Jill are busy kicking the Kick-Mes throughout the caves inside of the swiss cheese. And they're having a great time. You hear all these sounds coming out where they're laughing. All these "Ha, ha, ha!" All these funny sounds are coming from



The Great Swiss Cheese Caves.



Jack and Jill in the Caves.

out of the holes in this cheese. In fact, there's so much noise coming out because the Kick-Mes are so happy, because they can bounce off the walls -- just go bong, bong, bong, bong, bong -- they're having the time of their life.

Whenever we have such happy sounds, this makes somebody else very angry and not happy at all. Evil Mister Fred has a cloud that he can fly around on. There's Evil Mister Fred. He heard all these sounds, and he said, "What's going on down there? Those people are having way too much fun. I'm going to go stop that right now." So he decided he was going to buy some glue. He's going to pour it down the holes, and the Kick-Mes are going to get stuck to the walls, and they won't be able to get kicked around because they'll be glued onto the cheese.

So Evil Mister Fred called the Acme Store of Everything and ordered a big bottle of glue, like that. And he just swooped right down and glug, glug, glug, glug, glug -- poured the glue inside of the cheese. And the Kick-Mes were getting stuck in the glue, and they're going, "Ohh, ohh, ohh, ohh, ohh!" And then the Kick-Mes ate the glue, because they're weird creatures. They said, "Oh, boy, we like glue!" And they just go bouncing around on the glue. It didn't work.

So Evil Mister Fred said, "I'll show them! I'm going to call Acme Store of Everything and order a lightning storm and have lightning shoot down into those caves and blow those Kick-Mes to smithereens." So he did. The lightning came. The lightning hit the Kick-Mes, and they blew to smithereens. And then they re-formed themselves and laughed and giggled and bounced away. And Evil Mister Fred said, "Ar-rghhh! I'll show them. I'm going to find out what scares Kick-Mes, and I'm going to put it in that cave and scare them to death."

So he called the Acme Store of Everything and he ordered the manual of Kick-Mes: Care and Feeding of Kick-Mes. What Kick-Mes like to eat, how they like to play, what they like to do, and what kind of animals eat Kick-Mes and make them run away screaming. And he discovered that Kick-Mes are extremely afraid of bunny rabbits. And he said, "All right! I'm going to get some bunny rabbits, throw them down into the hole, they're going to scare those Kick-Mes to death, they'll run away and won't be happy anymore.

So he called the Acme Store of Everything and he ordered the best, the highest quality green bunny rabbits. There. Bunnies. And he had to put parachutes on the bunny rabbits because they just get all flat if you just drop them on the ground. So he's got some bunnies with parachutes tied to their ears, like that. And he just drifted the bunnies down, and the bunnies landed in the holes in the swiss cheese, and they started hopping around inside. And the Kick-Mes saw the bunny rabbits and went "Aaaaaahhh!"



Evil Mister Fred on his Cloud



The Big Bottle of Glue



Bunny Rabbit with Parachute

and tried to run away from the bunnies. And the bunnies said, "I want to be your friend, I want to be your friend, I want to be your friend," and kept chasing the Kick-Mes all over the place.

And Jack and Jill heard all the Kick-Mes screaming and they said, "Oh, no. Do you suppose somebody found out the one thing that scares Kick-Mes is green bunny rabbits?" And sure enough, bop, bop, bop, bop -- there went a green bunny rabbit. And Jack and Jill had to do something to get those bunnies out of there and save the Kick-Mes so they could have fun. If you were Jack and Jill, what would you do to make life better and get rid of those green bunnies?

Imagination and Brainstorming Time

[01:10:01;06] *[Students make suggestions]* (THERE ARE NO WRONG ANSWERS! Whatever they say, you should reply: "That's a good idea," "They might do that," etc. After brainstorming, proceed with the experiments, then finish the story.)

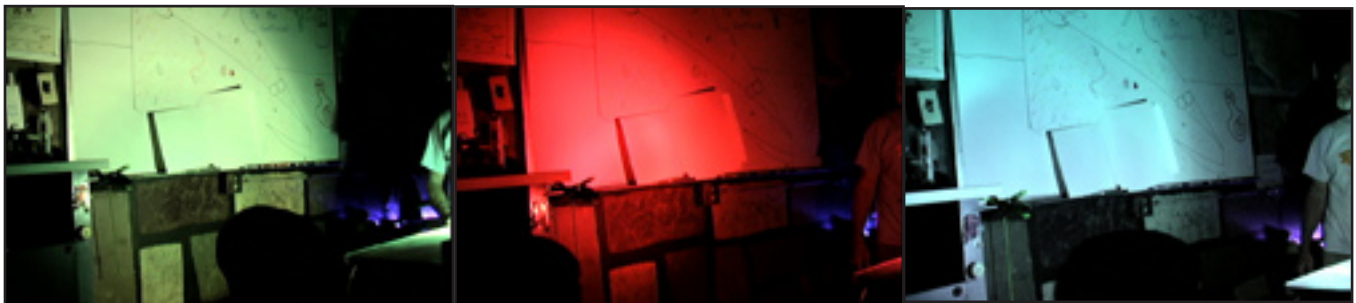
We'll leave this To Be Continued . . .

Experiment

Experiment: Transform Colors with UV Light

[01:13:20;27] We have all these nice, pretty useless white boxes. These are really skinny -- I don't know what they sold in them, but you can see they don't hold a lot. We usually just open them up and use them for projects because it's good quality cardboard. And we're going to put a box up here *[puts an unfolded box against the whiteboard]*, and we're going to shine these lights at it. You can see there's a green light, and a red light, and a blue light. Suppose you mix blue paint and red paint, what color do you get? Purple. If you mix red paint and green paint, what do you get? Brown. If you mix green and blue, what do you get? Greenish-blue, yeah.

Well, if you mix light, light doesn't often mix the same way that colors do, so I'm going to shine these lights at this piece of cardboard, and then we'll see what colors we get on it. *[Turns off overhead lights.]* I can't see! *[Turns on green light.]* That's more or less green light. Does that look kind of greenish? If I turn it dimmer, does it look more green or less green? *[Students: Less green.]* Okay, here's red light. Does that look red to you? Okay. And here's blue. Does that look blue? It's turquoise-ish.



Okay, now what color was Jack? *[Students: Orange.]* What color does he look now? *[Students: Red.]* Looks red to me. Okay, look at Jack again. Here's Jack under red. What color is Jack? *[Students: Red.]*



Red Light on Jack

Yellow.] He's practically invisible. He's almost there. Let's see if we can point the light a little bit more on Jack. There he is. Okay. Now, here's Jack under green. [Students: Orange.] Now we're going to mix some green and some red and see what we get. Here's the red full blast. [Students: Orange.] Here's the green and the blue. [Students: Still orange.] And here's red and blue. [Students: Red. Orange.] And now we'll do all of them. [Students: Orange.] Yeah, it looks orange.

[Turns overhead light on.] We're going to put a piece of cardboard beside each person. Set it down on the table. Hold your hand over your cardboard and make

your hand shadow, and we're going to see what it looks like. You're going to hold it up in the air like this, and I'm going to turn on just two lights, and we're going to see what your shadow looks like. We'll start off with blue and red, and I'll bring this around, and you look at your hand shadow and see what color it is. [Turns off overhead light and walks around the table with the light bar, shining it on the students' hands.] [Students: Red and blue. Red and blue and black. I see purple. I see green. It looks 3-D.]



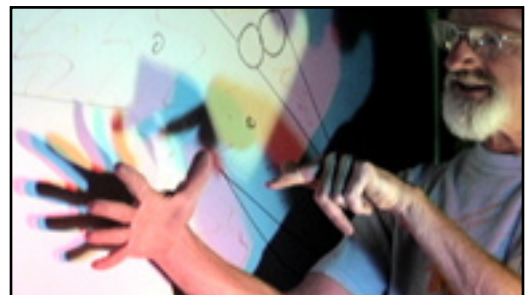
Hand Shadows under Colored Lights

Now we're going to try blue and green, even though it's not the world's best green, we'll just see if it does anything. Here's blue and green. [Students: It's orange. Yellow. Turquoise blue. Yellow, green, and blue. Turquoise and black.]

Okay, now here's the red and green. [Students: Black and red. All colors. Red and green.]

Okay, now we're going to do all three colors, red, green, and blue. Look carefully. There should be at least six colors there. [Students: Red, blue, black, green, orange, yellow, purple.]

[Instructor makes his own hand shadow on the white box in front of the whiteboard, with the three lights on it.] When you put your hand up there, you saw a bunch of different colors. So if you look at my hand, there's kind of a purple color, and kind of a turquoise color, a yellowish or orangeish color, there's some red in there. See, watch this hand as it crosses. You see my purple finger? It's going to come right over a yellow finger. What color will it make? Red. Isn't that bizarre? Watch my purple finger now. Here it comes past the yellow one, and it goes through the blue. Dark blue. Now it's going to come to a purple one. Stays purple. What if you take two hands and gush them around. [Turns colored lights off.] What do we see when we turn them all off? Nothing.



Purple Finger Shadow turns Red when it crosses a Yellow Finger Shadow.

[Turns on ultraviolet light.] What color is this? [Students: Blue.] Blue. We're going to shine blue light, and see what you see on your paper. Here goes. [Students: Purple.] Now look at your neighbors' shirts.

[Student: They're glowing.] Here's a jack-o-lantern. Blue light on jack-o-lantern makes bright light. Here's some pipe cleaners. *[Student: Everything glows.]* Not everything. *[Instructor blows up two different colored balloons.]* What color is this balloon? *[Students: Pink. Orange.]* What color is this one? *[Students: Pink. Orange. Orange and yellow. Orange and red.]* Okay, are you ready? *[Turns on overhead lights.]* Pink and orange.

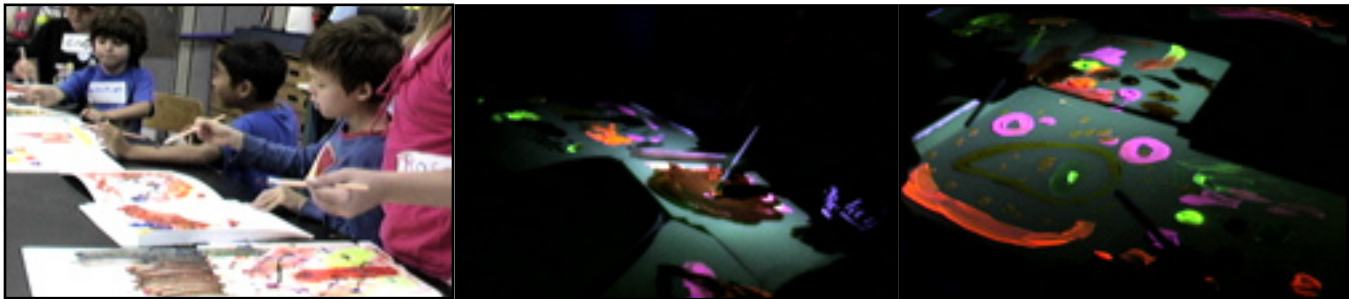


Shirts Glow under UV Light

Now we're going to give you some paints, and you're going to paint on your piece of cardboard. It's better if you can open your cardboard up. Look for the place where they glued the joint on and pry it off. They you can separate it out, with the dull side up or the shiny side up, whatever side you want.

In this experiment, you do not get to paint your neighbor. You don't paint your chairs. You don't paint the floor. You can paint your face if you want. You're going to paint your cardboard mostly, but you only get one brush. So sad. We're going to come along and we're going to pour puddles of paint on your cardboard. And then you're going to paint them the way you like to paint them. And then we're going to look at them with ultraviolet light to see if they look the same as they do with the white light.

Let's use primary colors, red, yellow, and blue. There wasn't any red in neon. We'll use orange, yellow, and purple for the neon colors. *[Instructors put globs of each color on students' cardboard and pass out brushes. Students blend colors on their cardboards any way they like. Occasionally as they are working, Instructor turns off overhead lights and walks around the table, shining the ultraviolet light on the students' artwork so they can see how the colors change.]*



Painting under Normal Light . . .

. . . and under Ultra Violet Light

End of Story

*** DO NOT * present this part of the lesson until after the experiments!**

[01:42:02;17] Evil Mister Fred was shooting green bunny rabbits down into the swiss cheese, and they were chasing the Kick-Mes all over the place. The poor Kick-Mes were not happy at all about this. Remember, the Kick-Mes had already eaten a whole bunch of glue that he's poured down in those holes. And the Kick-Mes didn't know what to do, and Jack and Jill said, "We've got to stop that Evil Mister Fred with those mean bunny rabbits." But before Jack and Jill could do anything, the Kick-Mes started spitting glue all over the surface on the outside of the cheese. They're just going brrrrssssshhhh! They were so afraid it was like Kick-Me throw-up everywhere. And the glue was purple glue. The purple glue was coming out, and some of the bunnies were getting stuck in it and some weren't. And the bunnies realized that they could see where the glue was. So Jack and Jill called the Acme Store of Everything and they ordered a really big blanket. And then they put the blanket over the sun, and it became perfectly dark. Then some of the blanket started to burn. And then only the ultraviolet from the sun came through. And when the ultraviolet light came through, the glue disappeared. You couldn't see it anymore, even though it was still there. And the green bunnies didn't look green anymore. Under ultraviolet light they looked black. So the Kick-Mes weren't afraid of them, and the bunnies were going boing, boing, boing, boing, scrrrch! Stuck in the glue. And the Kick-Mes saw all of the stuck bunnies. And they said, "Bunnies! My favorite guys!" And they bounced over there, and they didn't get stuck in the glue, and were playing with the bunnies. And the bunnies didn't like this. When you play with bunnies like that, they get really mad. And the bunnies went, "Urrrghh!, Urrrghh! Urrrghh!" And all of a sudden, boinggg! The bunnies bounced right through the glue. And they took off at such high speed, it was like supersonic bunnies. And the supersonic bunnies were flying out of the cheese -- zzeew, zzeeww, zzeeww! And one of them hit Evil Mister Fred's glue bottle -- zzeew, pssshhkk! And the glue exploded all over Evil Mister Fred and the cloud. And he got stuck to his own cloud, and he couldn't move. He couldn't do anything. And he just drifted off into the sky. And everybody lived happily ever after, except Evil Mister Fred.

[Student: And the green bunnies.]



A Supersonic Bunny Hits the Glue Bottle.

End of Lesson