



Teacher's Guide for: **Glow Sticks**

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.

NOTE: This is the transcript of a lesson that was videotaped during an actual Rock-it Science class with real students, not actors. The students' brainstorming comments are included on the video, but are not transcribed here because they're not part of the lesson presentation.

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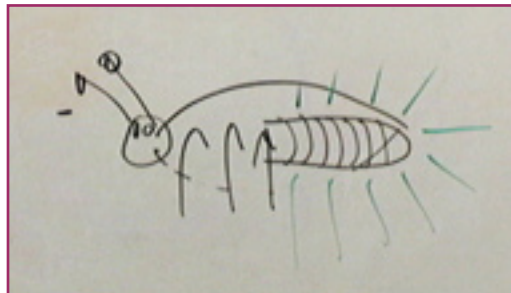
Glow Sticks
A Rock-it Science Lesson
Filmed July, 2009

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Intro Quick Recap: "Glowing Fire Brick"

- Draw a firefly on the board, showing how the tail end glows because of chemicals that mix together in the tail end.
- Ask students what other kinds of things glow at night.
- It usually takes a lot of energy to make something glow.
- Apply a propane torch to a fire brick to make it glow.
- The torch takes two thousand degrees to make the brick glow a little bit.
- Fireflies figured out how to do it without a lot of energy.



Experiment Quick Recap: "Glow Sticks"

- Chemical reactions can go slow or fast. If you don't like it going slow, you can make it go faster by heating it up. Ask student what they would do to make it go slower.
- A glow stick contains a bunch of little tiny glass tubes full of one chemical. The plastic part contains another chemical that's makes ultraviolet light. The light hits the liquid in the plastic, which has flourescent stuff in it, so it glows.
- Demonstrate how to bend and shake a glow stick to make it glow. (Turn off the lights.)
- Let each student select their favorite color glow stick, bend it, shake it, and fool around with it for a few minutes.
- Set out tubs of icy water and have students put their sticks in the water to see what happens (they get dimmer).
- Later, set out cups of very hot water and have students put their sticks in it to see what happens (they get brighter again).



Toy light stick



Light sticks in icy water



Light sticks in very hot water

Demo Quick Recap: "Bright Glow Stick"

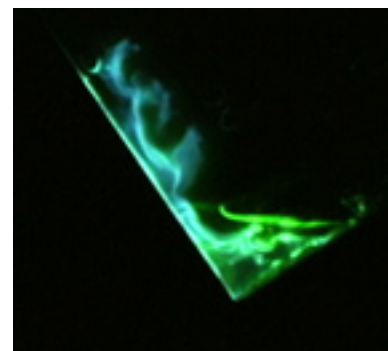
- Take an emergency-type glow stick and cut the tip off without breaking the glass.
- Pour the contents of the tube in a zip lock bag so that it pools in one corner.
- Turn off overhead light and turn on black light to see if the tube glows under black light. Then turn lights on again.
- Put the glass tube in the opposite side of the plastic bag and break it with a hammer. Collect the yellowish liquid in the opposite corner from the clear liquid. Turn the lights off again.
- Tilt the bag so the clear liquid pours into the yellowish liquid. Take it around so the students can see but not touch it (because of the broken glass).
- Drip a few drops on the table. Put a drop in each student's hand, if they want it.
- Dip the bag into hot water to see if it gets brighter.
- Pour hot water into the plastic bag to speed up the reaction. Liquid starts to dim.
- Pour some on the floor and let students track it around on their feet.



Cut off tip of Glow Stick



Clear Liquid and Plastic Tube inside zip lock bag.



Tilt bag so chemicals mix.

Equipment List: "Glow Sticks"

Items needed for Instructor:

- "Toy" light stick
- Emergency light stick
- Clear plastic tubs, 2
- Cold water, about 5 gal.
- Hot Water, about 6 cups
- Cutter to snip top off light stick
- Ziplock Bag, 1-qt.
- Hammer

Items needed for Students:

Consumables:

- "Toy" Light Sticks (one per student)
- 6 small bags of ice
- 4 @ 12-oz styrofoam cups (one for each table)

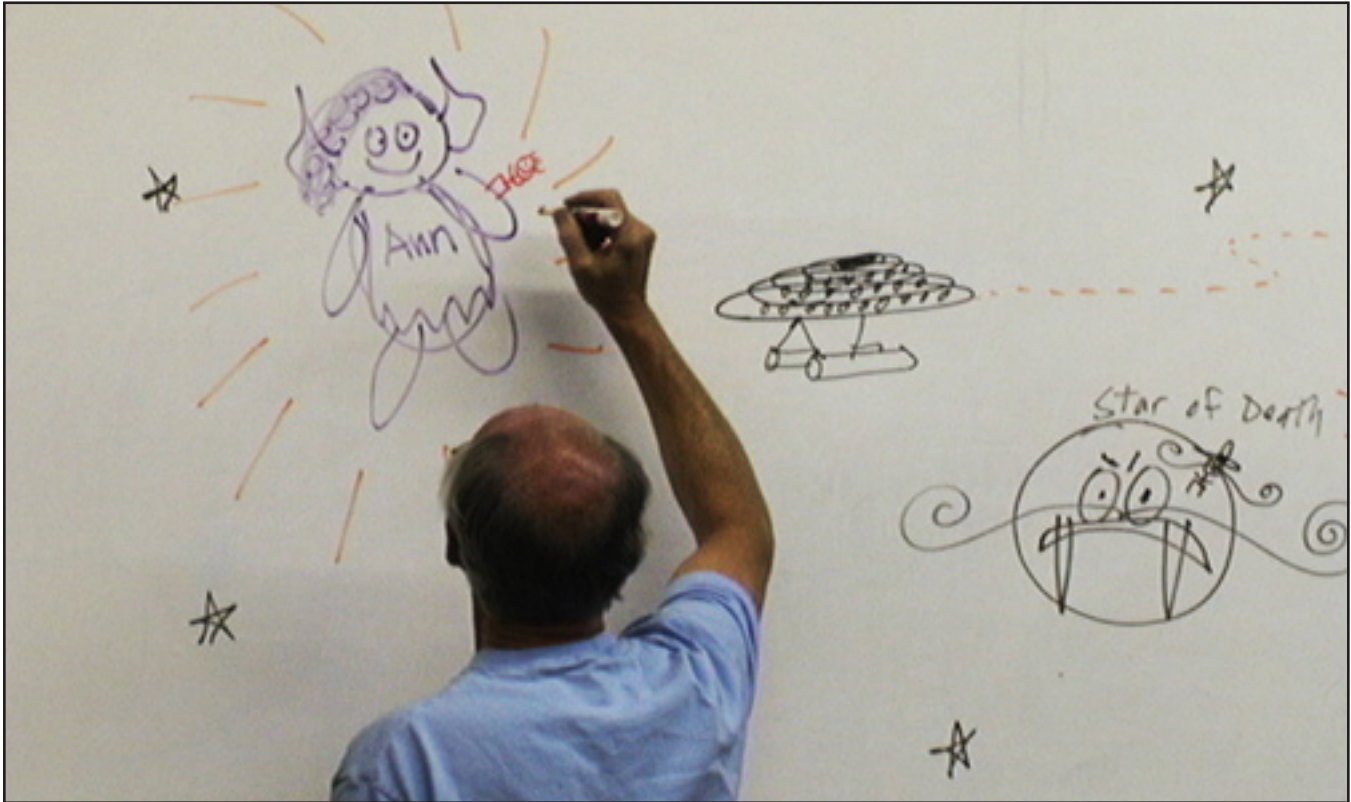
Other:

- None

Prep Work:

- Buy small bags of ice

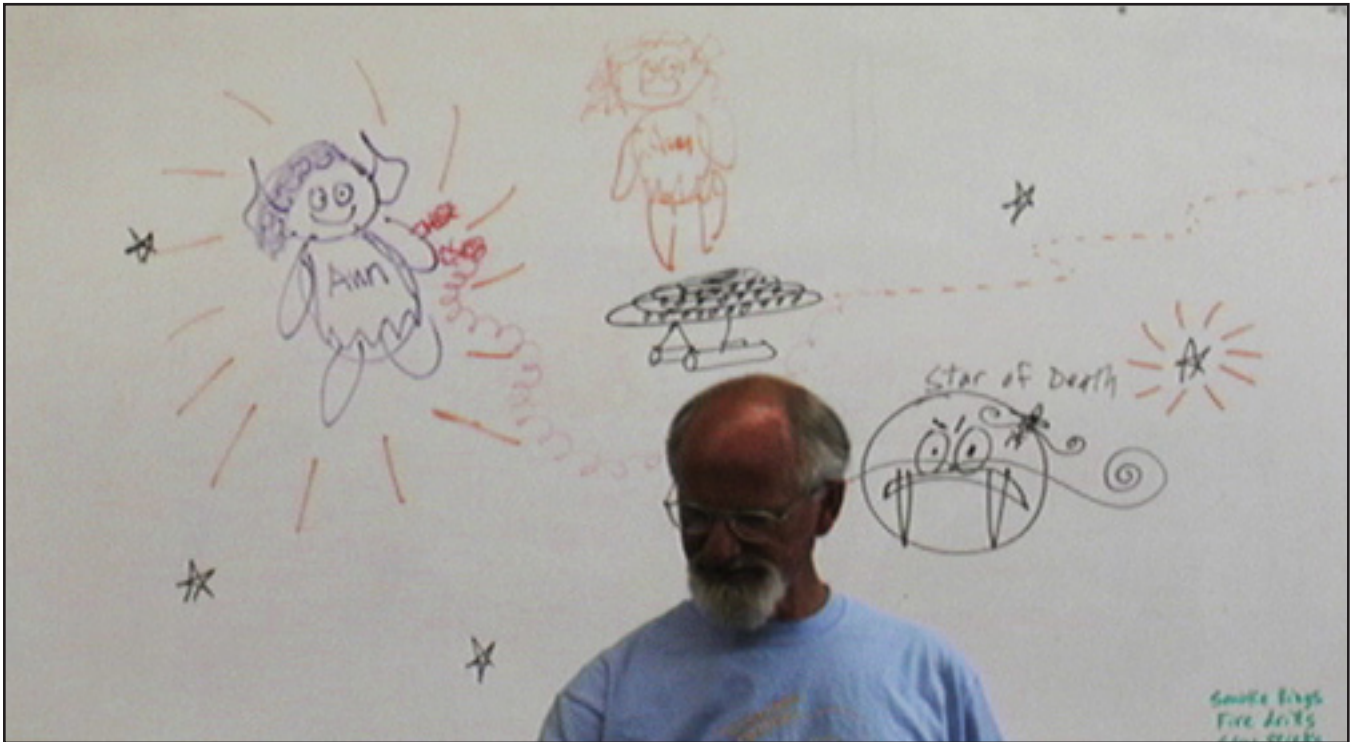
Story Recap: "Jack & Jill and the Star of Death"



Part 1:

- Jack and Jill live in space, flying in a spaceship made from a cow poop (a road apple).
- They take tourists for tours of outer space.
- They go to the Andromeda Galaxy, which looks like a giant Raggedy Ann doll. Because of the low gravity, the games and rides are a lot of fun.
- Evil Mister Fred has a Star of Death that sucks the light out of all the stars and suns. Only the light, not the heat, so people continue to live, but in darkness.
- Jack and Jill are getting thought reports from other galaxies, and they hear people moaning and screaming about what's happening, and they realize what Evil Mister Fred is doing.
- He's heading for Andromeda to suck out its light.

Story Quick Recap (cont.)

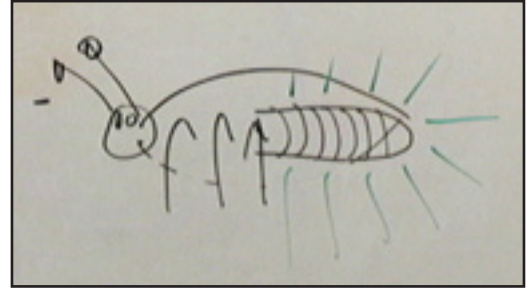


Ending:

- Jack and Jill tell everyone to get all their old newspapers. They dip the newspapers in glue and make a second Andromeda Galaxy that looks just like the first one.
- They call the Acme Store of Everything and order Super Glow Sticks.
- They cut them open and spread the stuff all over the newspapers so the second Andromeda glows as brightly as the first one.
- They fill it with dynamite.
- They turn off all the lights in the real Andromeda and everyone sits very quietly so Evil Mister Fred won't know it's there.
- Evil Mister Fred starts to suck the light out of the second Andromeda. As he sucks, the galaxy gets closer and closer, until it explodes.
- Evil Mister Fred was consumed with death because of the energy of his own death star.
- After the story, remind students to wash their hands.

Transcript: Intro:

Have you guys ever lived somewhere where there are bugs that fly around at night and the bugs glow? Well, usually it's someplace back East or down South. They have them, and they call them fireflies. But really, they're a type of beetle. And the beetles are little guys, maybe only about that big. But if you blew one up, he's got a little head, and they have a tail end. And there are chemicals in their tail end. And the chemicals, when they mix them together, make light glow, so that the tail end of the beetle glows. It glows kind of a yellow-greenish color, like that. Have you ever seen anything else glow at night? [Student: Flashlights.] Flashlights glow at night. [Student: Glow sticks.] Glow sticks glow at night.



Firefly with glowing tail end.

I'll show you what it takes to get something to glow. We'll switch off the lights. [Instructor holds a fire brick in one hand and applies the flame from a propane torch to it so that it glows.] Usually, it takes a lot of energy to make something glow. This propane torch makes two thousand degrees. I'll point it at the brick, and we'll see that the brick is starting to turn orange. It's getting close to a thousand degrees. And the brick can glow for a little while after I take the flame away. Well, that's a lot of energy to make a brick glow. And these bugs, ordinary beetles, have figured out how to make a glow without using all that energy. [Turns lights on.] They're pretty clever little guys. Today, we're going to try to make something glow and see if you can make it glow brighter or not so bright. But first, we need a crazy story.

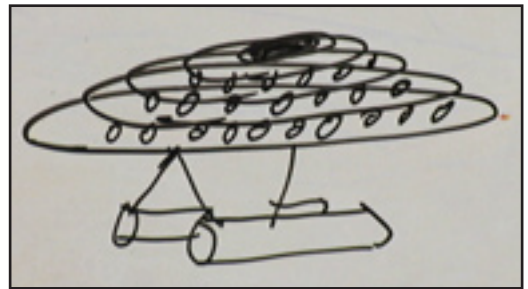
Story: "Jack and Jill and the Star of Death"

Once upon a time, Jack and Jill were living in space. There are stars in space, and they were flying along on an old -- what's something that is really old and usually doesn't fly? [Student: Cow poop.] Cow poop. They're flying around on an old flying



Andromeda Galaxy

cow poop. They call it a road apple. There, there's a flying road apple, and they've equipped it with rocket engines. And they dug a cabin inside with lots of windows, and they're taking tourists for tours of outer space in the flying road apple, like that. And they can go faster than the speed of light. They can go warp nine in this thing. Nine times faster than the speed of light. And they're zooming around, and you can always tell where they've been, because there's a trail of Jill hair, because it grows infinitely fast.

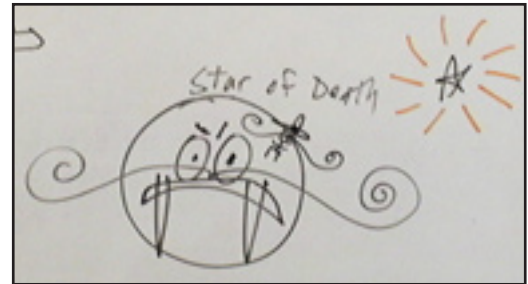


Jack & Jill's spaceship.

And Jack and Jill are heading off towards the Andromeda Galaxy. And the Andromeda Galaxy looks like a great big Raggedy Ann doll. And it's got curly hair, and big ears. His name is Ann, short for Andromeda. And they're going there to have lunch and run around, have some eats,

play some games, and ride on the rides. At the Andromeda Galaxy, the rides are really easy, because the gravitational pull is very low. So if you could throw a baseball a hundred feet here on Earth, you could throw it a thousand feet on Andromeda. And roller coaster rides are really spectacular there, because you can go really fast and not hurt yourself.

So they're heading off towards there, and Evil Mister Fred has created a Star of Death. There, a Star of Death for the Evil Mister Fred. He's going throughout the galaxy, and he's sucking up light wherever he goes. He makes everybody live in total darkness because he puts out their sun. Every star is a sun, right? So if a star is glowing really bright, Evil Mister Fred will fly over there, suck away all of their light, and the people will have to live with no light at all. He doesn't suck all their heat, because light and heat are a little bit different. He takes away just the light, so they can still live in darkness, and suffer and have no fun at all. And he's heading towards Andromeda Galaxy as well, to suck away all the light that comes from it.



Evil Mister Fred's Star of Death

And Jack and Jill are already there. They're having a good time. And one of the rides that they have there is called the Wormhole Ride. And all it is, is a hole in the ground. And you just say, "Cool!" And you jump in -- badoom! And you never know where you're going to end up, because the other end of the wormhole kind of flails around and goes to all these weird places in space. You might jump in there and end up on the Moon, or Pluto, or on a completely different galaxy. And then, when your game ticket runs out, it throws you back where you started from. So the more money you pay, the longer you get to stay wherever it sends you.

Now let's put Jack and Jill there somewhere. There's Jack. And they're getting thought reports from other galaxies. Thought can travel faster than the speed of light. And they're hearing people saying, "Aaaaaaahh! Our light -- it's gone! We're doomed! There's nothing but darkness!" And they hear it coming from galaxies from this way, and galaxies that way, and then somebody said, "That Evil Mister Fred! Arrrrrrgghh!" And then they looked out and they saw Evil Mister Fred's Star of Death heading towards them. If you were Jack and Jill, what would you do?

Imagination and Brainstorming Time

[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: *Glow Sticks*

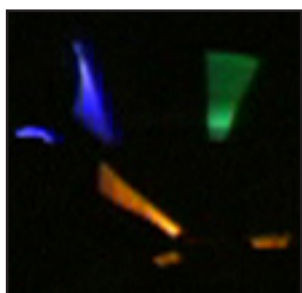


Glow Stick

When you get into high school or college and you take a chemistry class, they tell you that there's things called chemical reactions. Chemical reactions can go fast -- like explosions -- and they can go really slow. And if you have a slow one and you don't like it going slow, you can make it go faster by heating it up. Or if you've got a fast one and you don't like it going fast, you can make it go slower by doing what? Yeah, cooling it down.

We're going to work with some chemical reactions. The stuff we're going to be using today is glow sticks. It's non-toxic, luckily. But inside of this, there's a bunch of little tiny glass tubes full of one chemical. And then outside of them, inside the plastic part, there's another chemical that makes ultraviolet light. And the light hits the liquid in the plastic, and the liquid has fluorescent stuff in it so it glows. We'll turn off the light and

see if this one still works. Does it work? *[Students: No.]* No? *[Student: You have to crack it.]* You have to crack it, so I'm going to bend it. *[Students: It's working!]* When you bend it, you'll hear the stuff inside break. Then you can kind of shake it a little bit. Now you've got a glow stick that's pretty bendable. You can bend it into a circle. Some of these are kind of bluish, some are yellow, some are green, I think there are some red ones in there. Yes, you get to keep one. After you get yours glowing, we're going to put a couple of tubs here with ice packs in them, and you can put your glow stick in the ice pack and swish it around. And try to get your glow stick cold. We just want to see how cold they can get. So we're going to maybe stick it in there and count to a hundred and see how it changes. Oh, count to a thousand. No? Okay, I'll let you off -- you can count to ten thousand. After you get it cold, you want to see if it changes. And then we'll put away the icy stuff, or at least we'll move it to those two tables, and then we're going to put out some water that's really hot. And so be careful with the hot water so you don't burn yourself. And you stick it in the hot water and stir it around and see what that does. So we're going to take our chemical reaction and make it cold first, and then we'll make it hot. And then you can make it cold again, and then you can make it hot again, back and forth and back and forth, and see what it does.



Waving Sticks around.

First you play with them a little bit before we do the icy stuff. *[Turns light on and lets each student select whatever color light stick they like.]* And you guys can go and break them if you like. *[Turns light off.]* Test yours, see if it works. Don't try to get all the bubbles out because there are always some bubbles in there. *[Students bend their sticks to make them glow, then wave them around for a few minutes.]*

[Turns light on.] Okay, I'm going to put one icy water over here and one icy water down here. *[Puts one tub on a table, the other on the floor.]* Okay, go dip yours in some icy water. *[Turns light off and students put their light sticks in the icy water for a few minutes to see what happens.]* Have they gotten dim yet? They should have gotten darker.



Put Sticks in icy water.

Okay, I'm going to give you hot water. *[Turns light on]* I need your attention, please. We're going to be using water that's very hot. If you



Dipping Sticks in Hot Water

spill it on yourself, you'll do the ooh!-ah!-ooh!-ah! dance, guaranteed. Would you rather have the water sitting on the floor or on your table? *[Puts hot water in styro-foam cups and places one on each table.]* Everybody stand up. Don't be sitting in your chair, because if it spills on your lap it will hurt. So stand up, off of your chair. *[Students put their sticks in the cups and Instructor turns off light for several minutes.]*



Glow Sticks in Hot Water

Demo: "Bright Glow Stick"

Okay, everybody sit down. *[Turns light on and removes cups of hot water from tables. Holds up a different kind of glow stick.]* This kind has quite a bit more chemical in it. Let's try cutting the lid off of it and

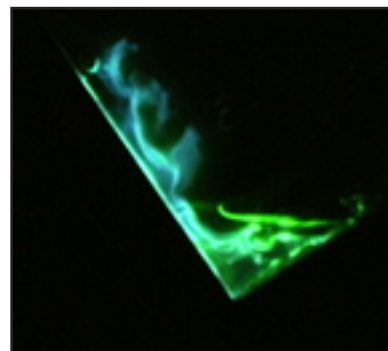


Cut the Tip off a Glow Stick

see if we can do it without breaking the glass tube inside. There. And we're going to pour what's in it into this bag *[pours contents of light stick into a zip lock bag]*. So we had ordinary colored plastic. There's a glass tube there that's got some yellowish stuff in it, and a clear liquid. So I'm going to put the clear stuff over here *[in one corner of the bag]*, and I'm going to put the glass tube over in this corner. You remember our black lights? Let's see if our glass tube glows under black light. *[Turns off overhead light and turns on black light.]* See, our glass tube glows. *[Turns off black light and turns on overhead light.]* Now, I'm going to hit the glass tube with a hammer. There. Now you can see that the liquid in the glass tube is kind of a greenish-yellow stuff. Now, most of the clear stuff is there *[points to lower left corner of bag]*. Most of the greenish-yellow stuff is over here *[points to lower right corner of bag]*. Now we're going to tilt it so the clear stuff goes and meets the greenish stuff and they mix together. *[Mixture glows brightly.]* Is that bright? No, don't touch it because there's broken glass. *[Instructor walks around so students can get a close look at the bag.]* Now I'm going to drip some of the glowing liquid on your table. Let's see if we can get it to drip. Here comes the drip. There's a drip, there's a drip. If you want a drip, put your hand out. There's a drip. Don't eat it. *[Student: Can we rub our hands?]* Yeah, you can rub it.



Clear Liquid and Glass Tube inside zip lock bag.



Tilt the zip lock bag to make the two liquids mix.

Now I'm going to dip it in the hot water. It's easier than dipping your hand in the hot water. Okay, here goes. *[Dips corner of bag in cup of hot water.]* Let's get some to drip in the hot water. Can you see it in the hot water? *[Takes it around so the students can see it in the hot water, then drips drops on the table in front of the students.]* What do you think will happen if we pour water into it? Are you ready? We'll pour hot water into the stuff. Here goes. Five, four, three, two, one -- hot water. Let's see how long it goes. It's slowly going away. The hot water is diluting the action and it will stop. Anybody want a paper towel? Here you go.

[Instructor deliberately pours some of the glowing solution on the floor.] Oh, no! I spilled some on the floor! How terrible. Whatever you do, don't step in it and make glowing footprints. *[Students walk through the puddle and track it around.]**[Turns on light.]* Okay, everybody sit down. We're going to finish our story.

End of Story

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

So Evil Mister Fred is flying around in his Star of Death, sucking the light out of all of the stars, the suns, and every one of these galaxies. He's coming to the Andromeda Galaxy, where everyone is having a great time riding their rides. And Jack and Jill said, "Oh, no. We don't want that to happen to us. We've got to do something." They said, "Everybody, go get all your newspapers!" So they got all their newspapers. And they dipped their newspapers in glue. And they created another Andromeda Galaxy made out of newspapers, like this. So here's the second one, right next to the first one, that looked just like it, except it was made out of newspapers, like that. And then they called the Acme Store of Everything and they ordered Super Glow Sticks. And they cut them all open, and they spread the stuff all over the second one so it was glowing really bright. What should they fill it with that Evil Mister Fred wouldn't like? *[Student: Dynamite!]* Dynamite, okay. Let's suppose they fill it full of dynamite. And then they turned off all the lights and made everybody sit really quiet.



The fake galaxy

And they put black cloth over all their houses and their cars so you couldn't see this one at all. It was hidden. And Evil Mister Fred came along and saw that one. And then he says, "Wa-ha-ha-ha! I'm going to destroy that one completely with my Star of Death. And he started sucking the light out of it. And as he sucked the light out of it, it came closer and closer to him, and he says, "Just a little bit more." And then the dynamite went ka-boom! And Evil Mister Fred was consumed with death because of the energy from his own Death Star. And they all lived happily ever after, except Evil Mister Fred.

Now, even though this stuff says it's non-toxic, it's a good idea to wash your hands before you have lunch. And I don't think there are any other problems with it. *[Students: Turn off the light.]* Oh, yeah, you'll probably need it dark to see if you got your hands washed.

End of Lesson

If you have questions about this lesson, please ask them through the online [Teacher Support Forum](#) on our web site.