



Teacher's Guide for:  
**Tricking Your Eyes**

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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**(NOTE: There is no story, just a slide show.)**

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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]

Tricking Your Eyes

filmed July, 2009

For Rock-it Science Internal Use Only

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

- Magicians use sleight of hand. They distract you with one hand so you don't notice what the other hand is doing.
- They also have ways of tricking your eyes, so things that are still appear to be moving, and things that are moving appear to be still.

## Experiment Quick Recap: "Tricking Your Eyes"

- Instructor presents a slide show of various optical illusions, and students try to figure them out.
- Then, Instructor shows a series of photos that all look the same, but something has changed in each one. Students try to notice what's changed.

## Equipment List: "Tricking Your Eyes"

### Items needed for Instructor:

- Laptop computer
- Projector for laptop
- Cables to connect laptop to projector
- Projection screen
- Computer files of optical illusions. Most are jpg files, two are QuickTime (.mov) video files, and one is a PowerPoint document.
- Rolling cart for computer and projector

### Items needed for Students:

#### Consumables:

- Printout of "Checker Shadow" Illusion

#### Other:

- Scissors

### Prep Work:

- Set up laptop and projector and make sure the connections work.
- Make sure optical illusion files are on the computer and will open correctly.
- Print out a color copy of the "Checker Shadow" Illusion for each student. Make sure the print quality is accurate enough to show that square "A" and square "B" are the same shade of grey when "A" is cut out and placed on top of "B".

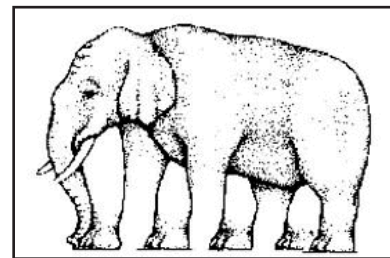
## Transcript: Intro

[01:00:11;02] When you hear about magicians, you always hear the words “sleight of hand.” And what they mean is, the magician has learned to distract people with one hand and do something else with the other hand. *[Student: So they can get stuff ready.]* Yeah, so they can get stuff ready. So if they're doing this, “NOW! I want you to pay attention to this!” *[Instructor waves one hand wildly in front of students.]* He's busy fishing in his pocket, you know, taking out a gun, shooting the neighbors over there, doing something with his other hand. And you don't notice it because he's waving this one and looking at you. So you either look at his eyes or his hand, but not at his other hand. So if I came up to someone and said “HI! How are you doing?” *[Instructor gets right up close to a student and waves one hand in his face while talking loudly and pulling a pen out of his pocket with the other hand]* and threw that pen in your face, you wouldn't know it until it hit you. So it's a very clever way to distract people.

A magician also knows that if he can have you look at something and then have you look away for a second, he can change that and you won't notice. Do you think that's true? And he also has ways of tricking your eyes so that things that look like they're standing still are moving, and things that are moving are standing still. Could that happen? Well, we're going to try a couple of things. We have a video that we'll show you. None of the pictures will actually be moving. First we're going to show you a few optical illusions. *[Instructor projects images from a laptop onto a pull-down projection screen.]*

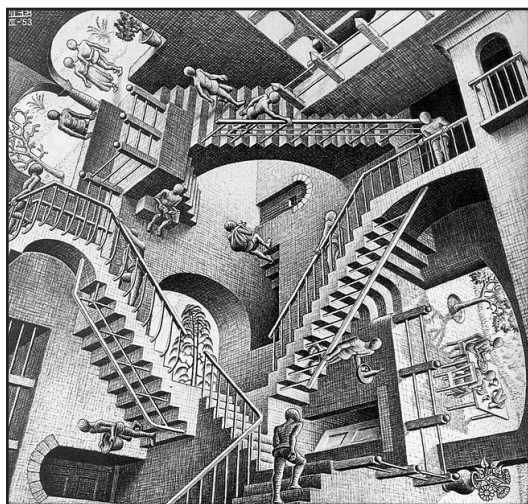
## Experiment: “Tricking Your Eyes”

[01:01:47;28] Let's see what “Elephant” looks like. Does this elephant have anything odd about itself? *[Students: Yes. It has more legs.]* Does it have the wrong number of legs? *[Students: Yes.]* Do the legs attach properly to the body? *[Student: No.]* Oh, poor elephant. Are there five legs? How many do you see? *[Instructor moves the mouse over each foot.]* There's one foot, two foot, three foot, four foot, five foot. *[Students shout out how many feet they see, ranging from four to seven.]*



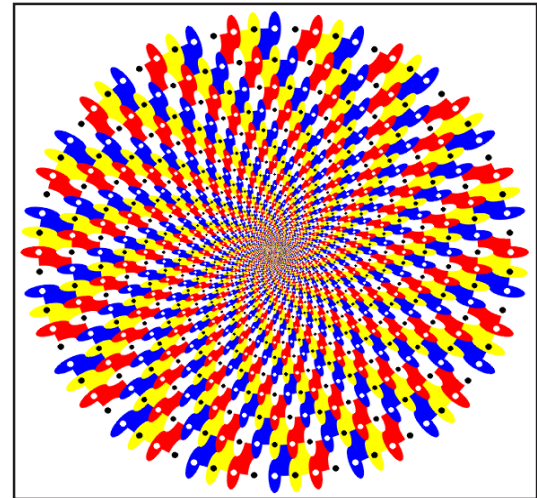
Elephant's Feet Illusion

[01:02:37;20] Okay, we're going to look at a staircase now, and what I want you to do is pick what you think is the lowest spot and walk to the highest spot. Okay, now walk the staircase. Let's start with this guy here *[moves mouse over person at bottom center of picture, then traces the path he would take if he followed the staircase to the left]*. He walks up, and then he goes up this staircase, and then he walks across here and he goes up this staircase. And then he goes up there, and now he's going to climb . . . what? He's kind of stuck. He can go down there, but he's mixed up. *[Student: Are they at Hogwart's?]* Yeah, this is kind of like Hogwart's. *[Student: How could they be sideways? You tricked us!]* Well, of course. They're going sideways. *[Student: You tricked us!]* Well, yeah, that's the whole idea. We'll make that one go away. **[NOTE: On the DVD, there is a video clip showing this image being rotated so students can see how the perspective looks from different angles.]**



Staircase Illusion

[01:03:37;26] Here's something that's "Hatching." What on earth could be hatching? Stare at the center and tell me whether it looks like it's moving or not. [Some students see movement; other don't.] Focus right in the center. Don't move your eyes. Okay, we're going to make that go away.



"Hatching" illusion

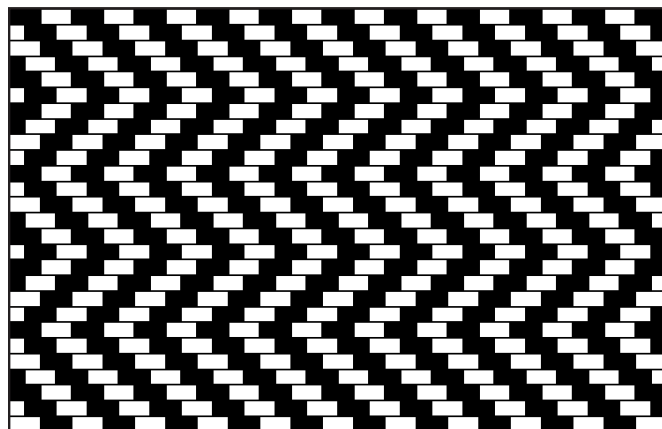
[01:04:15;05] This is a chair you can sit on. There, look at the chair. Is that a nice chair? Would you like to have that? Is this a good sofa for your living room? [Students: Yes. No. That's not even a chair.] Now look where the girl is sitting. She's sitting in a trough, it's lower. Now look where the boy is sitting. He's sitting on the top of the sofa. Let your eyes wander from the girl to the boy. [Student: You tricked us.] Could you make that sofa? [Students: No.]



Impossible Seat

[01:05:03;28] Let's look at kindergarten. Oh, look. Are the squares straight or are they tilted? [Students: Straight. Crooked.] Looks crooked to me. [Students continue to disagree about whether they're straight or crooked.]

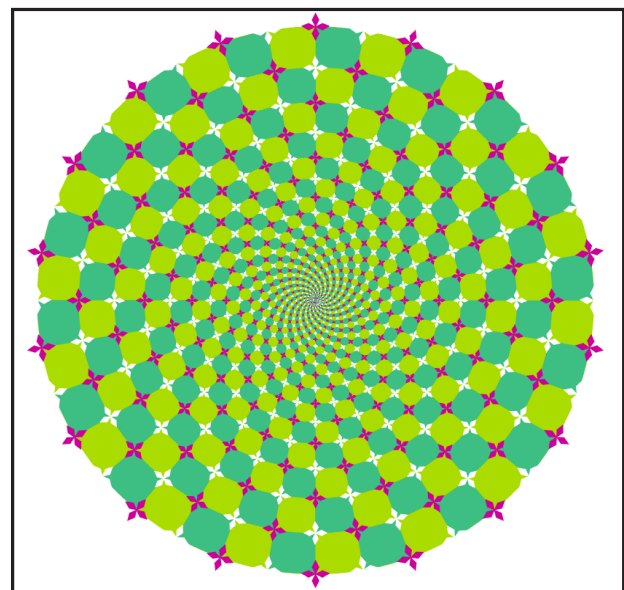
Look at the bricks on the bottom row. Are they straight? Look at the ones on just the bottom row. Are the bottom row bricks straight or crooked? [Students: Straight.] Now, look up just one row. Are these bricks the same size and same shape as the ones below them? [Students: Yes. No. Yes, but they start in a different spot.] Now look at these bricks [points to the third row]. [Students:



"Kindergarten" illusion. Are the bricks straight or crooked?

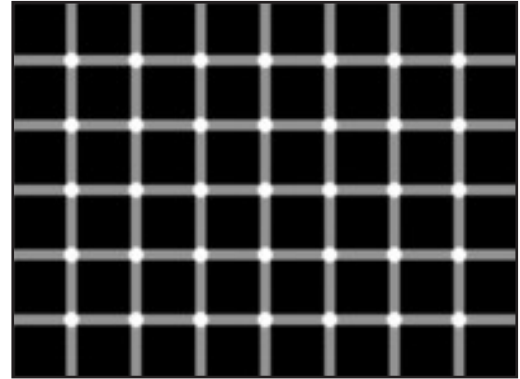
They move. They're moving bricks.] They're moving bricks. Let's make that one go away.

[01:06:12;22] Let's look at a spiral. Is that doing anything? [Student: It's not a spiral.] It's not a spiral? Is it a spiral? [Student: No, it's just a big circle.] How did you know that? Yeah, you're right. It's just a lot of circles, but there's no spiral there. [Student: There's a pattern of the dots that look like it's coming out.] Ah, it has a pattern that makes it look like it's a spiral.

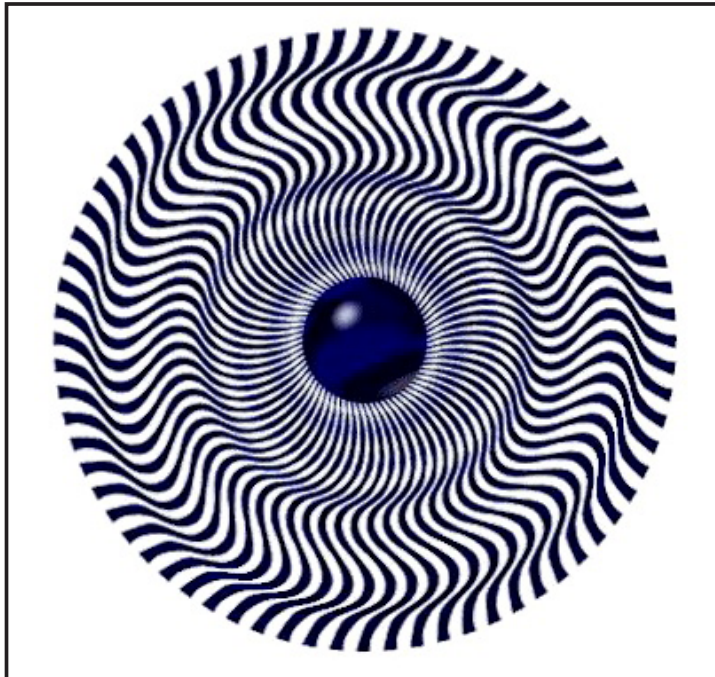


"Spiral" illusion (there's no spiral)

[01:07:12;29] This one is plain old black dots. Now, look between the squares. Stare at the middle. Let your eyes wander around it, looking between the squares. Do you see any black dots? *[Students: No. Yes.]* When you see a black dot, try to look right at the black dot. *[Student: You can't.] [Student: Hey, they're black dots but they're white!]* Suppose you had to catch one of those black dots with your fingers. That would be hard. As soon as you look at it, it's gone. *[Student: They keep going to different places around and around.]*



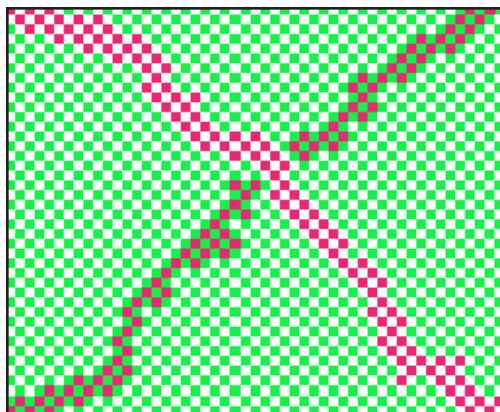
"Black Dots" illusion



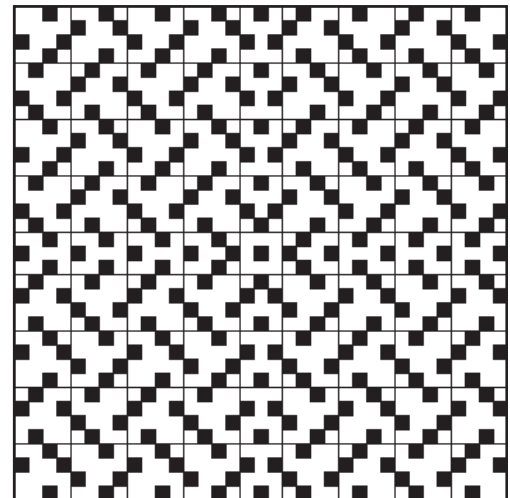
"Circle Eye" illusion

[01:08:07;13] Let's see what this one looks like. There's a nice eye. Is it doing anything as you stare at it? *[Students: No. Yes, it is. The inner part spins.]* Yeah. Look carefully. If you stare right at the center, you might see it start to turn. *[Students: Yeah. It's starting to turn. It's turning really fast and we can't see it. I can!]* You can.

[01:08:50;12] "Perfect Square." I wonder what that is. Those don't look like perfect squares. Look at the thin lines. Are the thin lines straight? *[Students: Yes. No.]* What if I told you those are perfectly straight lines? *[Students: They are. That's impossible. The middle line is bent. Some of them are shorter squares.]* They're all straight lines. *[Students: No, they're not. Yes, they are.]*



[01:09:44;27] "Red, Green." That's just a color blindness test.



"Perfect Square" illusion

[01:09:54;02] Here's a picture of a street, and it should look like a fairly ordinary street. There's a car sitting there. And you see the buildings and stuff. Okay, look at it carefully. Notice that there are buildings, windows, a street light, flags, water tower, street, car, stuff. Memorize the picture. Now I'm going to show you a slide show, and all you have to do is tell me what changes. *[Instructor goes through a series of photos that are all variations of the first one. The screen goes black between the pictures.]* Something just changed. Can you tell what it is? Something new changed. *[Student: The water tower doesn't have the name on it.]* Ah. Each picture has something different than the previous one. Pretty soon one of the buildings is going to go away. See if you can find which one. *[In various photos, the lamppost disappears, the colors of buildings change, the flag disappears, windows disappear, the water tower disappears, etc.]*

Now we're going to go through it one at a time. There's the first picture that we saw *[Slide #1]*. *[Instructor flips back and forth between the current photo and the previous one each time, with no black screen in between, so students can see the changes more easily.]*



Slide #1

Slide #3 - Window's gone  
(slides #2, 4, 6, etc., are solid black)

*[Slide #3]* *[Student: Oh, the window's gone.]* Window's back. Window's gone. That was the second picture.

*[Slide #5]* Now, here comes the third picture. Watch carefully. *[Students: Window's back. Flag's gone.]* Ah, did you see the flag is gone?



Slide #5 - Flag's gone



Slide #7 - No name on water tower

*[Slide #7]* Flag's back. The name on the water tower went away.

[Slide #9] Okay, here comes the next one. What just happened?  
 [Students: *The windows disappeared on that building. And the name is back.*]



Slide #9 - Windows are gone



Slide #11 - Paint extended downward

[Slide #11] Here we go to the next one. Watch that one carefully. [Student: *Window's back.*] Window's back. Something else changed though. [Student: *The top part of the paint came down.*]

[Slide #13] Okay, we're going to go to the next one. [Student: *The green part changed color. The red building changed.*]



Slide #13 - Red bldg. is all red now



Slide #15 - Orange stripe appears

[Slide #15] Okay, here we go to the next one. [Student: *Now it turned blue again.*] Something just changed. [Students: *The color came back.*]

[Slide #17] [Student: *The pole!*] Ah, somebody saw it. The pole went away. See the light pole? Light pole there, light pole gone.



Slide #17 - Pole's gone



Slide #19 - Water tower's gone

[Slide #19] Here's the next one. Light pole back. Something else changed. [Student: The water tower.] Water tower's gone.

[Slide #21] Here we go to the next one. [Students: Water tower's back. The building's gone.] Ah, yes, the building disappeared. Look for the building that goes away.



Slide #21 - Building's gone



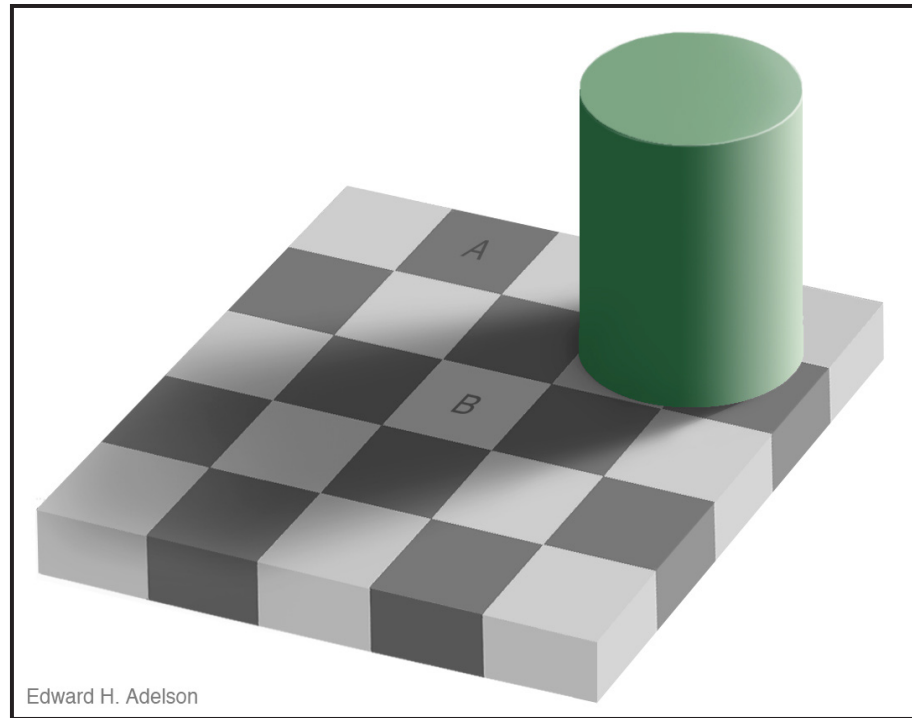
Slide #23 - Orange stripe back; signs gone

[Slide #23] Okay, and this is our last one. [Students: The color changed and the building came back. And the signs went away on the building.] Yeah, the color changed, and the signs, yes. The signs changed in the windows.



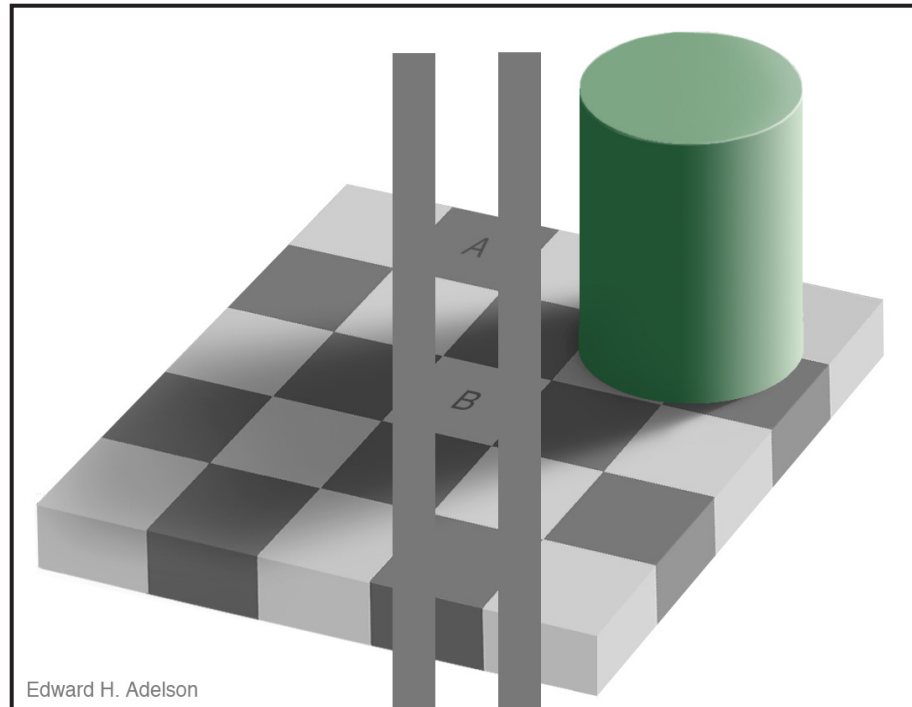
[01:16:03;11] Let's see, let's try "Checker Shadow Illusion." Now, there's a square labeled "A" and a square labeled "B". Do you see those two? *[Points with mouse cursor.]* There's the A and there's the B. And then there's these other guys out here *[indicates other squares]*. Which square is darker, the A or the B? *[Students all say "A".]* Okay. What color is the cylinder? *[Students: Green.]* Green. Okay. What if I told you A is the same darkness as B? What if I said I'll bet you a thousand dollars A is the same darkness as B? *[Students: No way!]* You'd say, "No way, Jose!" So we need to make this one go down *[minimizes picture to move it offscreen]*. That one was called "Checker Shadow Illusion 4".

Now there's one called "Checker Shadow Proof 4". The proof has a way that they're going to try and prove to you that they are the same color. *[Instructor opens another version of the picture, with two vertical grey stripes running alongside the A and B squares.]* There's A. There's B. Does A look darker than B? *[Students: Yes.]* Here's a grey stripe here, and here's a grey stripe there. Is that grey stripe the same grey from top to bottom? *[Students: No.]* Is it the same grey here as it is down there? *[Students: Yes. No.]* Is it the same grey there as it is there? *[Students: No.]* Ohhh. Actually, it is. The same grey from top to bottom. And A is the same grey as B. *[Students: No, it's not!]* So we don't agree. *[Students: No, it's not!]*



Edward H. Adelson

Checker Shadow Illusion (Squares A &amp; B are the same shade of grey)

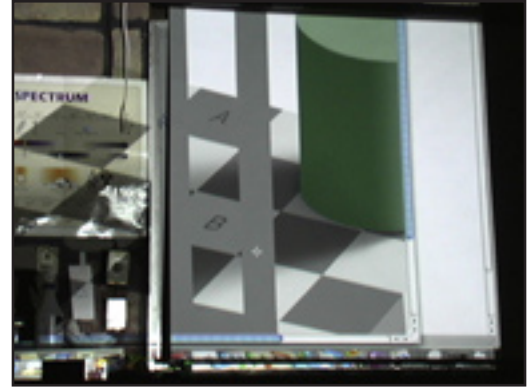


Edward H. Adelson

Checker Shadow Proof (Vertical stripes are the same color as squares A &amp; B)

No, it's not. Then you don't believe the proof. So you think A is darker than B. *[Students: Yes!]* That's why this is one of the world's best illusions, because A is the same darkness as B. *[Students: Is not!]*

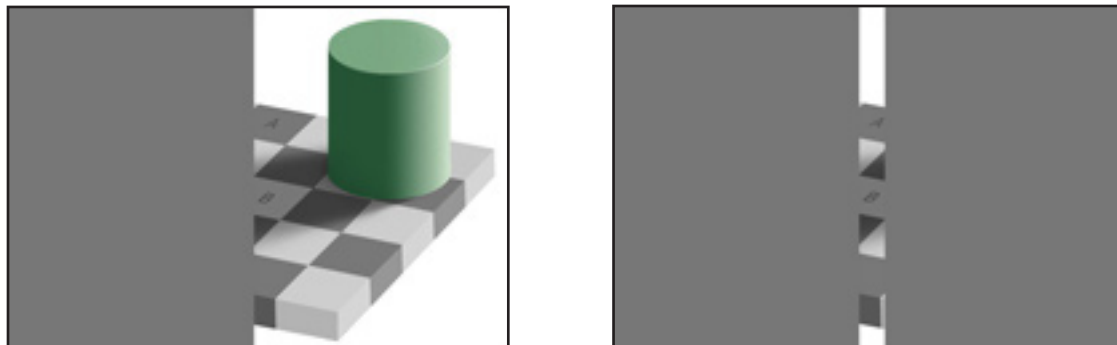
Wonder if there's some easier way to make them believe that. Let's see. *[Instructor shifts the projector so part of the image is off the screen and one of the vertical grey lines is at the edge of the screen.]* If I put it over here, does the grey look the same from top to bottom? *[Students: Yes.]* That grey stripe, right here, is the same grey from top to bottom. *[Students: Yes.]* Now, when you compare that grey stripe to A, it's the same greyness as A. When you compare it to this square *[points to a dark square]*, it's lighter than that square, right? *[Students: Yes.]* When you compare it to B, it's the same greyness as B. *[Students: Yes.]* So A is the same greyness as B. *[Students: No. Yes. No.]* Well, this is the world's best illusion. You can look this up on the computer.



Projected image offset to one side.

*[NOTE: The two following parts of this lesson are not on the video.]*

*1) On the DVD, there is a video clip that shows the Checker Shadow image gradually being covered with gray until only squares "A" and "B" are visible. Play this clip to show the students that the two squares are the same shade.*



The video clip shows the grey gradually covering the left side of the image, then the right side, showing that "A" and "B" are the same shade.

*2) As a final proof, pass out a color printout of the "Checker Shadow" illusion to each student. Ask them to cut out square "A" and place it on top of square "B" to see if they're the same.]*

Well, we just wanted to show you some ways that your eyes can be tricked. When you see a magician doing tricks, he knows all this stuff. And he can use illusions of various sorts to make your eyes see something that you really didn't see.

## End of Lesson