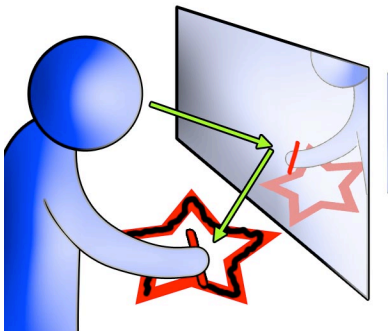
“Can you trace a star?”

Mirror drawing and brain learning

Because of our brain we can do many things without thinking (walk, chew, ride a bike). But what exactly goes into such “automatic” motions? This experiment shows students how their brains rely on a familiar setup of sensory information to coordinate actions with ease: when you change something slightly, such as flipping visual information with a mirror, simple tasks become much more difficult. Luckily our brains can learn and adjust to new information. *The overarching theme of this lesson is that our brains can learn and adapt to new information.*



Grade Level: K-5+

Presentation time: 30-45 min, depending on age

Lesson plan organization:

Each lesson plan is divided into three sections: *Introducing the lesson*, *Conducting the lesson*, and *Concluding the lesson*. Each lesson has specific principles with associated figures, class discussion (D), and learning activities (A).

Materials:

Several small, square mirrors, approx. 6” x 6”
Several cardboard boxes, approx. 6” high x 12” wide x 8” deep, with lids (optional)
Shape printouts – [see pgs. 7-9]
Pencils or markers
Stopwatches for groups of 2 (optional)

This lesson plan is provided by the Neurobiology and Behavior Community Outreach Team at the University of Washington: http://students.washington.edu/watari/neuroscience/k12/LessonPlans.html

Preparation

There are two options for making mirror stations: (1) A mirror station is created by one student holding a folder above the hands of the student that is drawing. In this way the student that is drawing cannot see his/her hands unless s/he looks into the mirror. (2) Students and/or the teacher create mirror stations out of cardboard boxes. Tape or glue a mirror on the inside wall of a box, then cut a slot along the bottom of the box so a student can insert their hands to draw – but not so big that they can easily see through the slot. Then cut the box lid in half and replace it so that the student's hands and workspace will be hidden, but the reflection in the mirror is visible. [See diagram on page 5.]

Introducing the lesson

Principle 1: You can do many things without thinking because of your brain.

D: Your brain and movement

Ask students to think about how their brain guides their actions. The following sequence is a guide:

1. I want you all to do something for me right now. Take your hand, raise it in the air, and draw a little circle for me. *(Do it with them.)*

2. That was pretty easy, right? Now, I want you to think: how did you do that? When I told you to draw a circle in the air, what steps happened? *(Answers may range from listening to you, to muscles being used, to thinking of the shape of a circle.)*

3. And when you drew the circle, how did you know you got it right? *(They'll probably say they could see their hand, although they might also have felt it move.)*

4. So for all of these things you've done just now – listening to me, moving your hand, seeing it make a circle – can you think of one thing that helps you do all of that? It's part of your body… It's the brain!

5. Usually when we talk about the brain, we talk about how it helps us *think*, right? But we also need our brain to do things that don't make us think a lot. Quick, on the count of three, clap your hands: one, two, three. [*Clap!*] Now, did you have to think really hard about where you were going to put your hands? Did you have to watch them? No? Then how did you do it? *(General idea: your brain just does it for you.)*

6. Our brains usually have a pretty good idea of what's going on, so we can do a lot of things without thinking very hard. But what might happen if you changed what your brain saw, so your eyes told it one thing, but your sense of touch told it something else? *(It might get confused, and then you'd have to think harder.)*

7. Explain to students that this lesson will explore how our vision guides our movements and that our brain can adapt and learn when it gets new information.

Conducting the lesson

Principle 2: **When you change the information the brain receives, you make mistakes**

Principle 3: **The brain can learn and adjust to new information.**

A: Mirror drawing

1. Explain to students: Today we're going to test our brains, to see if they can figure out what to do when your eyes tell it something different from what they usually say. Everybody knows how to trace, right? We're going to trace shapes, but instead of looking at our hands, we're going to look in a mirror!

2. Group students in pairs and give each pair a mirror, stopwatch, and a stack of objects to trace.

3. Demonstrate to students how to use the mirror station or how to hold a folder such that the person drawing cannot see their hand unless they look into the mirror.

4. Have students trace the star while they can look at their hands. Tell them to record the time it took.

5. Now tell students to take turns tracing the star, square, or plus sign by only looking at the reflection in the mirror and have them record the time it takes on each trial. They should trace an object at least three times.

Concluding the lesson

D: Mirror drawing

1. When everyone has traced an object at least three times bring everyone back together for a discussion. The main point to bring up during the wrap-up is that your brain can adapt and learn when it is presented with new information.

a. So what did you notice? Was it hard to trace the shapes by looking into the mirror? Why do you think that was? *(Their brain couldn't do it automatically because it wasn't getting its usual information.)*

b. What does the mirror do to the image? (show how a mirror makes a "p" look like a "b" using the diagram on page 5 to help make this point)

c. Did you get better at tracing with the mirror over time? *(At least some of them probably did.)* Why do you think that is? Do you think that eventually you would be able to trace just as easily by looking at the mirror? *(You will – over time, your visual*

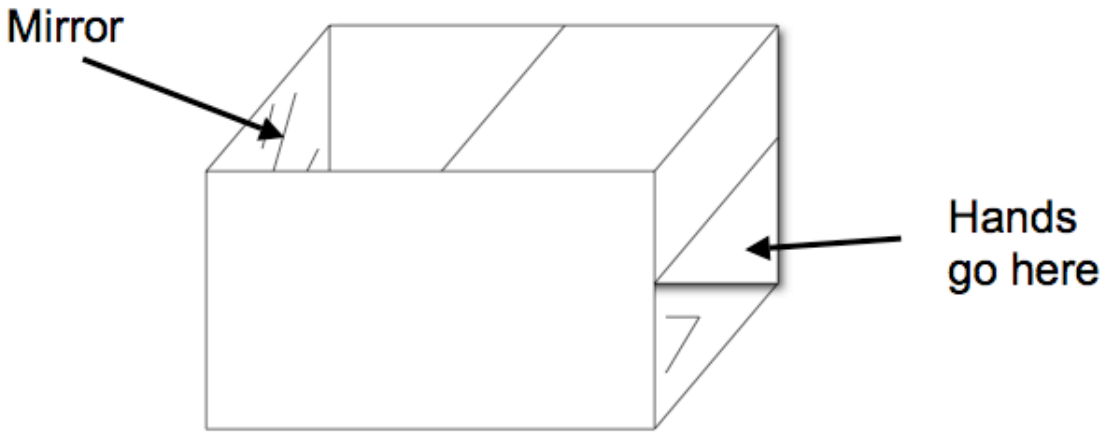
system will readapt to new conditions, and your cerebellum will help you to coordinate your movements even faster.)

d. What do you think might happen if you did *everything* by looking in the mirror for a long time? Like a week? What would happen when you stopped using the mirror again? *(Your brain will actually adapt to the mirror world, and when you take the mirror away, there will be a short time when it's just as hard to trace a shape without the mirror, as it was at first* with *the mirror. There have been interesting experiments involving prism goggles – another lesson plan of ours – demonstrating this effect.)*

e. Do you think what we did is good for our brain? *(yes, it is kind of like brain exercise.)*

f. After doing this activity, do you think it is important to make mistakes? *(yes, by making mistakes and recognizing those mistakes, we can adjust and learn. It is important to recognize mistakes.)*

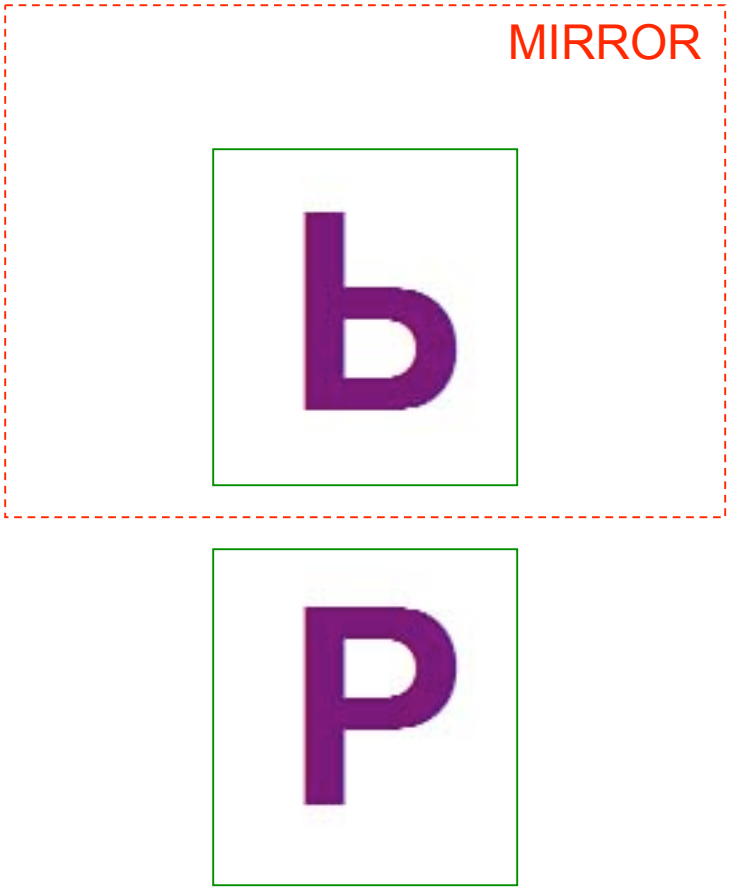
g. Good job, everybody; I think we learned a lot about the brain today. Your brain gets used to the way you look at things, which helps us do everything more easily. But if you change the way you look at things, like by looking in a mirror, it gets confused and has to think hard to do the same tasks. Fortunately, over time, it can get used to a new way of looking at things. That's why our brains are so great! Can you think of a reason it might be good for your brain to get used to a new way of looking at things? *(Examples: if one of your eyes gets hurt and you can't see; if you go blind altogether; if you're underwater; etc.)*


Mirror
Hands
go here

Drawing Challenge!

Can you trace a star using a mirror?

Have you ever tried to read a sentence in a mirror? The letters look different because the mirror has flipped the letters. If you take a piece of paper with the letter “P” and place it next to a mirror, the image in the mirror will look like a “b”.



What you see guides your movements

When you try to trace the star that you see in the mirror, your brain thinks that it is looking at the real image, not the flipped image. This is why you make mistakes. If you keep practicing, your brain will learn that you are looking at the flipped image and you will get better.