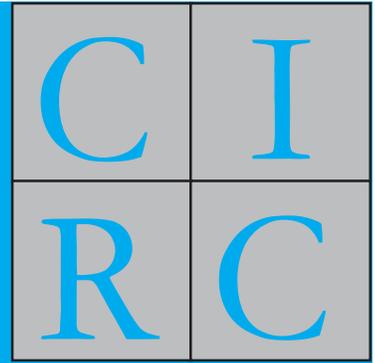


Will These Pills Make Me Smarter?



Source: Gold, P. E., Cahill, L., & Wenk, G. L. (2002). Ginkgo biloba: A cognitive enhancer? *Psychological Science in the Public Interest*, 3, 2-11.

Goals:

Teach the importance of evaluating claims.

Teach the importance of evaluating sources of information.

Teach about potential bias of sources.

Teach the general procedure to conduct a double-blind experiment.

Basic Idea:

Many companies advertise “miracle drugs” that claim to make people smarter. This lesson discusses the scientific method used to test the truth of these claims for one of these drugs.

Gain Attention/Interest:

Vignette

Tonya has a big math test tomorrow and she needs to study tonight. While at the grocery store she sees a Ginkgo Biloba advertisement that claims it will improve her memory. Because she wants to do well on her test, she buys the Ginkgo Biloba, goes home, and reviews the same math she has studied for the last three weeks for two hours everyday instead of going out with her friends. The next day, Tonya does very well on her test, while her friends do not do as well. Tonya tells all her friends she bought Ginkgo Biloba and used it to raise her score.

Should her friends go out and buy Ginkgo Biloba? Will you?

Ginkgo Biloba is an herb that comes from the Ginkgo tree. When it is sold in stores it is usually in the form of an extract from the leaves of the tree that is made into a pill.

Companies that sell Ginkgo Biloba often make many claims about what it can do. These claims can include:

- improved short- and long-term memory
- improved alertness
- faster reaction time
- energy boost
- better mental clarity
- decreased anxiety

These are some pretty impressive claims. However, are they true? Before purchasing such a product, wouldn't you want to know whether or not it actually worked, or even if it might hurt you? How can you check?



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Think & Write #1

Would you buy ginkgo biloba? Why or why not?

Some students may need a more specific question, such as, would you want to use it to prepare for finals? How would you feel if everyone in your class but you was taking it?

Ask: What is Science?

“Checking” is exactly what scientists do. It is their job to eliminate all other possible answers and figure out the most likely answer. A nonscientist, like Tonya, might notice her performance improve after taking Ginkgo Biloba, and attribute the success to having taken Ginkgo Biloba.

Should we believe Ginkgo can do all these great things just because the bottle says so? No. Scientists formulate **hypotheses**, or predictions, about what they think is the case, and then formulate ways to test their guesses. This may sound strange, but nonscientists try to prove themselves right, while scientists try to prove

themselves wrong. Scientists believe they may have the right answer only if they can find no way to show that their hypothesis is wrong. This is called the method of **proof by disproof**. Scientists gather proof for their hypotheses by disproving all other possible answers.

HYPOTHESIS

A hypothesis is a prediction about how and/or why things will happen.

1

Ask:
What
is
Science?

2

Define
the
Problem:

See
Many
Sides.

The lab for this lesson approximates the procedures scientists have used to test whether or not Ginkgo Biloba works.

Define the Problem: See Many Sides

What is our problem here?

Solicit responses. Does Ginkgo work?

What does it do?

As a potential consumer who might buy Ginkgo at the store, you may look at the problem from a different perspective than other people. What are the different groups of people who might look at the situation differently?

People who might look at the situation differently include:

- store owners
- the government
- insurance companies
- manufacturers of ginkgo
- marketers of ginkgo
- manufacturers of other products (e.g., drug companies)
- doctors
- memory researchers

Manufacturers and marketers of Ginkgo want to sell as much Ginkgo as possible, while it's the government's job to protect consumers.

Scientists look for problems, or things we don't know, and try to solve them. Imagine we are Tonya's friends and she has just told us of the fantastic powers of Ginkgo Biloba. This is an important part of science: clearly defining the problem with which you are working.

CONSIDER THE SOURCE

Some people or groups of people may have different motivation than others, so knowing the source of information is important when evaluating how you should interpret it.

CONSIDER THE SOURCE

An independent scientist does not usually have an investment in how an experiment turns out. Scientists are usually trustworthy sources.

With so many interested parties all looking at the situation from different perspectives, there is a lot of information out there. Much of this information contradicts what some other groups claim. What kind of information is best?

Distinguish Fact From Opinion: Learn What Constitutes Scientific Evidence

If we want to find out whether Ginkgo really works, we need to separate facts from opinions. This is exactly what scientists do.

What is the difference between a fact and an opinion? (**Solicit responses.**) An opinion might be what a person thinks about a certain topic; different people can have a variety of opinions. On the other hand, a fact is not something that changes; it is the same for all people.

Scientists want to know the facts about whether or not Ginkgo Biloba really works.

3

Fact Versus Opinion: What Constitutes Evidence?

Activity

Have the class listen to a string of numbers read aloud, then have them write down the numbers, in order, as best they can remember them.

Example: instructor, “This is a method similar to the one scientists use to test whether taking Ginkgo improves performance. I am going to read aloud 12 digits. When I am finished speaking write down as many of the numbers as you can in the order in which they were read.

98074713568” (students write).

Be sure digits are read evenly and with no emphasis. Alternately, you may consider writing the digits down on an overhead and showing them to the class for 1 second each.

Think & Write #2

Hypothesis formation

Form a hypothesis about Ginkgo Biloba that scientists could test using a procedure similar to the one the class just performed.

Next, split the class into two groups. The left half of the class receives “Ginkgo” (orange tic tacs) and the right side of the room gets a “fake pill” (white tic tacs). Do not tell the class the significance of orange or white until the end of the activity. After each half takes their “pill”, repeat the activity with a new string of numbers: 80645265921. To show an example of bias, select a student who took a “fake pill” and be very generous in giving him/her credit for a correct response, i.e., if she had 8046 as the first four numbers, say she got it close enough. Then, select a student who took the “Ginkgo” and be more strict with his score, i.e., having 5912 at the end would be incorrect. In this case, the bias is against Ginkgo. Using similar methods, the bias could be in favor of Ginkgo. [As an alternative to using tic tacs, you could have half the class stand up and do jumping jacks or some other physical activity.]

Methods Used by Scientists

To combat bias, scientists frequently use something called a **double-blind** test. A double-blind test does not mean that both people involved are blind. Double-blind means that neither the person taking the medicine nor the experimenter giving the tests knows if the participant is taking the actual pill (in this case Ginkgo Biloba) or a fake pill called a **placebo**. A placebo contains no active ingredients (like taking a breathmint to heal an

ear infection). Performing double-blind tests prevents both participants and scientists from being biased in how they act or record data.

For example, a scientist who really wants to show that Ginkgo does not work could be more likely to look for mistakes made by a participant taking Ginkgo. Similarly, if a participant knew she had taken ginkgo, she might expect to do better, and maybe not try as hard. Knowing what outcome is expected can influence your behavior; this is called **response bias**. Biases such as this are not possible in a double-blind test. Remembering a list of numbers is just an example of how scientists can test memory. They can also use lists of words, have participants listen to stories and then write them down, or ask them to remember lists of letters. If the group that took Ginkgo performs better than the group that did not, then it is believed that Ginkgo improves memory.

Frequently, studies like this give different amounts of the drug to different people, predicting that people who receive more of the drug will show greater effects. In this case, people receiving more Ginkgo would be expected to show greater mental ability.

Some studies use only a single dose while studying Ginkgo. They compare people who either have just taken Ginkgo to those who have not. They can also vary the amount of Ginkgo they give participants, giving a little to some and more to others. Yet another method of testing Ginkgo is to have people take Ginkgo over a period of time, say 6 months, and then compare them to another group of people who have not been taking Ginkgo, to see if there is a long-term effect.

Example: Long-term Effects

If you eat three double cheeseburgers in one day, it won't drastically alter your weight. However, if you eat three double cheeseburgers everyday for six months, you would probably see a bigger difference.

There are a lot of different ways to test Ginkgo's effects. Here is a quick review of how scientists check to see if Ginkgo actually improves performance.

- Give Ginkgo to half the group and a placebo to the other half.
- Give more Ginkgo to some people than others.
- Give Ginkgo to people over a long period of time and compare them to people not given Ginkgo.

Weigh Evidence and Make Decisions

The results are in: Ginkgo does improve performance on memory tests! So, go out and buy a lifetime supply and you'll remember everything you could possibly want. But wait: how much does Ginkgo improve memory performance? It turns out, not very much at all. In fact, some studies have found that Ginkgo improves memory performance about as much as drinking something with sugar in it, which is not very much. No one is trying to sell sugar as a way to make our brains work better.

Think & Write #3

How about now?

Have students write about what they think about Ginkgo Biloba now that they know what scientists have found.

4

Weigh
Evidence
and
Make
Decisions.

Move From Science to Society

5

Move
From
Science
To
Society.

Imagine if one of your friends started taking Ginkgo and then made the honor roll for the first time in her/his life. Or think about seeing a commercial on TV showing testimonials from people who have tried Ginkgo and have experienced miraculous changes in their lives. With all these people saying it works for them, how can they be wrong? A variety of factors could explain the difference. For example, going out and buying Ginkgo is a sign that they were looking for ways to improve their performance, so maybe they started working harder. Or perhaps taking Ginkgo raised their confidence in themselves and so they started performing better. What does this mean for us? Well, it means that companies have some research that they can try to use to sell us a product for \$10 a bottle. No studies have shown Ginkgo will hurt us, so some people believe that there should be no restrictions on its sale. If people want to pay for it, and get what little benefit it has to offer, they should have that opportunity. However, when companies advertise Ginkgo, they don't usually say that it improves performance as much as drinking a glass of fruit punch. Can you imagine a fruit punch label claiming to improve your memory?

As you can see from this discussion, whether or not Ginkgo Biloba works can influence a lot of people in a lot of different areas and careers. **To foster potential interest in such careers, the educational requirements of each field are also included.**

Advertising: A person working in advertising needs to understand the results of scientific research so he/she can accurately market the product. Advertisers typically attend four-year colleges and work for large advertising firms.

Drug Company Representative: Drug companies spend billions of dollars researching how potential new medicines help people. People who work for drug companies and make their products need to know which drugs are backed up by scientific evidence.

Test Prep Instructor: A person who prepares students for taking standardized tests wants to give her/his students as much of an advantage as possible. Thus, knowing whether or not Ginkgo Biloba improves test performance is important. Test prep instructors attend four-year colleges.

Fruit Punch Salesperson: If companies can market Ginkgo as improving performance when a glass of fruit punch helps just as much, a fruit punch salesperson needs to know this.

Revisit, Review, Reflect, and Re-evaluate

Even though many companies advertise its magical capabilities, scientific investigation shows us that Ginkgo is not the wonder pill many companies would like us to believe. There are still relatively few scientific studies that investigate Ginkgo Biloba. Scientists continue to revisit and review how Ginkgo influences performance, and reflect on how previous research could be improved. By re-evaluating what they have already learned, scientists can formulate new ways of testing Ginkgo and new ways to improve performance.

6

Revisit,
Review,
Reflect,
and
Re-evaluate.

Think & Write #4

What's next?

Now that you know what scientists have found, where do you think research regarding Ginkgo Biloba and performance enhancement should go?

Discussion Questions

1. What can scientists do differently to test Ginkgo Biloba/performance enhancement?
2. Would it be fair if there was a pill people could take to make them perform better, but only some people took it? How does this compare to some students taking test prep classes?
3. Should the government be stricter on companies that mislead the public?

Homework Questions

1. Are there other products similar to Ginkgo Biloba that try to market themselves as miracle products? What exactly do they claim and how do they support these claims?
2. Should the government pass a law regulating how companies can market products like Ginkgo Biloba? How might such a law influence the following groups of people: the elderly, teenagers, and advertising firms?

Cornell Institute for Research on Children

Quiz Questions

Version A

1. What is an alternative explanation for why taking Ginkgo improves performance on memory tests?
 - a. It does so about as much as drinking something with sugar in it, such as fruit punch.
 - b. Taking Ginkgo raises people's confidence, so they remember more.
 - c. Buying Ginkgo indicates that people are looking for ways to improve their performance, so maybe they also started working harder.
 - d. All of the above.

2. What is the difference between a fact and an opinion?
 - a. An opinion is something someone else believes, a fact is something I believe.
 - b. A fact is something someone else believes, an opinion is something I believe.
 - c. Facts are things scientists use to sound intelligent, and an opinion is something non-scientists have.
 - d. Facts remain the same for all people, opinions can vary from person to person.

3. Imagine you are helping your friend prepare for a big test. Your friend sees an advertisement for extra strength Ginkgo Biloba. Should she buy it?

Quiz Questions

Version B

1. Does taking Ginkgo improve performance on memory tests? Explain. What are some of the limitations of this evidence?

2. What is the difference between a fact and an opinion?

3. If you were a governmental regulator, would you change the ways that Ginkgo is marketed or advertised? Explain.

4. If you were going to design a study to test the effectiveness of Ginkgo, what are the 2-3 most important hypotheses to test?

Quiz Questions

Version C

1. If you were going to design a study to test the effectiveness of Ginkgo, give two hypotheses that were not discussed in class.

1

2

2. Choose one of the above hypotheses and explain a procedure a scientist could follow to test it.

3. How could someone check to see if an opinion is also a fact?

4. What are some potential ways a scientist could “cheat” on a double-blind experiment?
