

How do we know if something makes us better or worse?

1. Introduction (10 minutes)

How do we know if works?

- Have you ever taken medicine or had a vaccination or an operation? Do you know someone who has had an operation or acupuncture or used something like an herbal remedy or homeopathy?
- Did it help? Were there any side effects? How do you know that?

2. Some teenagers have discovered that bright Smarties (blue, pink, yellow, orange, pink, red) have some good and some bad effects. They think it is something in the colouring. You are going to figure out whether they are right or wrong. (10 minutes)

They think that the bright Smarties help them to do their homework better.

When they eat the bright Smarties

- Have a good feeling in their body
- Write and draw more quickly and better (straighter lines)

But there are also some bad effects

- They can have a little pain in their stomach
- They get dizzy if they stand up quickly

You are researchers and are going to find out whether the bright Smarties actually have those effects.

Do you know what a researcher is and what they do?

3. How will you know if the bright Smarties caused the good or bad effects? (10 minutes)

[Divide them into 7 small groups]

- Try a couple of Smarties and see what happens.
- Ask if anyone experienced any of the effects.
- How do you know if the bright Smarties caused the good or bad effects? For example, if you have a little pain in your stomach, how will you know that it was the bright Smarties and not something else that caused it?
 - Every time you get up the sun comes up. Does that mean the sun comes up because you work up? (an effect has to come after the cause)
 - When school starts in the fall there are a lot of kids who get colds. Does that mean that they get colds because of school work? (there can be other causes)
 - If you exercise a lot you get stronger. Does exercise cause you to get stronger? (How do you know? If you weren't sure, how would you test this?)
 - If you eat a lot and don't exercise you'll probably get fat. Does eating a lot and not exercising cause you to be fat? (How do you know? If you weren't sure, how would you test this?)
 - Can you think of other examples of something that causes something else? (Discuss examples)

4. How do you know that the effects did not happen by chance (10 minutes)

- A boy I know ate Frosted Flakes and then he scored a goal when he played football. Does that mean that he scored the goal because he ate Frosted Flakes? (maybe it was just by chance)
- [Toss a coin, say that it was heads and ask if they believe me. Flip it again and ask . . .]
- Explain that it is not unusual to get heads once or twice in a row. Getting 5 or 6 in a row is more unusual, but it happens sometimes.
- Now I want you to toss a coin 8 times and write down how many times out of 8 it was heads. Then do the same thing over again several times.
- [Record and discuss results]

5. Was what you did a fair test of the Bright Smarties? How can we test whether the bright Smarties have the effects that the IB teenagers think they have – and make sure that it was a fair test? (10 minutes)
- **Need for a comparison**
What are you going to compare the bright Smarties to?
 - **Fair comparison**
Would it be a fair test to have a group of girls and a group of boys?
Would it be fair if you always ate the bright Smarties first?
When your teacher divides you into teams by taking every other one, is that a good way to get groups that are the same?
How else might you get groups that are the same?
How are you going to decide who gets bright Smarties and who gets the other ones, or when they get them – to make sure it is a fair comparison?
 - **Fair expectations and behaviours**
If you know what colour Smarties you're eating and you think that the bright ones will give you a good feeling in your body, what might happen?
What if the teenagers always drink coke when they eat bright Smarties?
How are you going to make sure that you don't have different expectations or behave differently because you know what colour Smarties you're eating?
 - **Fair measurement**
What might happen if you just look at lines that someone drew after eating a bright Smartie and you believe that the Smarties help her to draw straight lines?
What might happen if you use a ruler to check if the lines are straight for the bright Smarties, but not for the other ones?
How are you going to make sure that you measure the lines, whether you have a good feeling or stomach pain, and whether you get dizzy when you stand up fairly?
6. Now you're going to test whether the bright Smarties have those effects. First write down your plan for testing them and how you will make sure it is a fair test. Then test whether the bright Smarties have any of those good or bad effects (20 minutes with help + 20 minutes discussion)
- [Pass out work sheets]
[Collect results]
What do you think?
Were the teenagers in BI right?