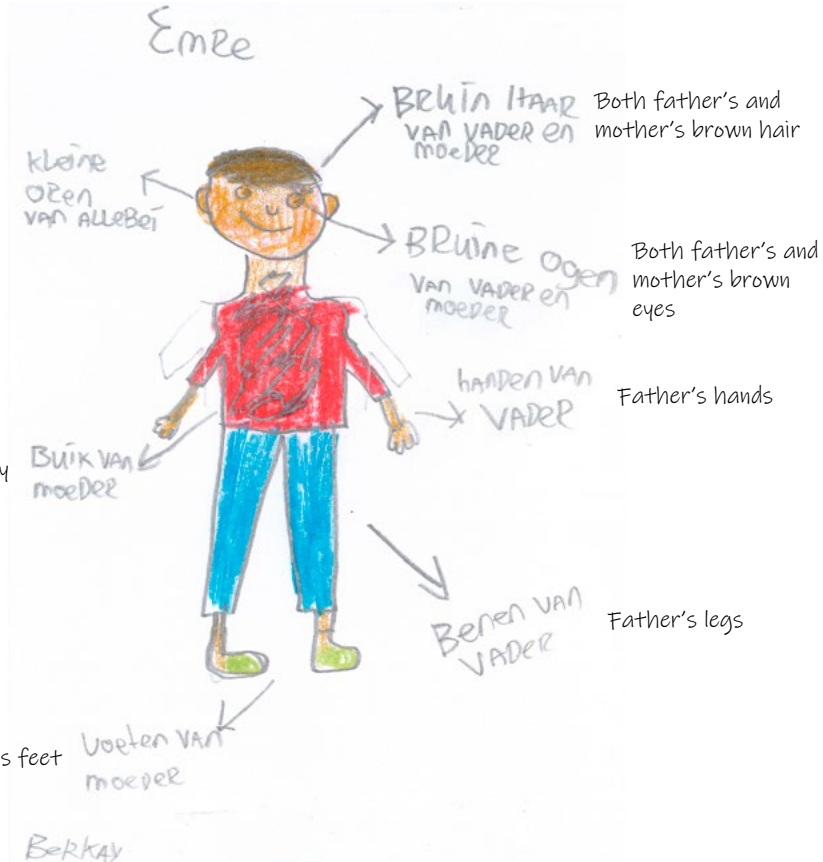
Science Education Hub
Radboud University

7 X curious

A series of short activities to stimulate students' curiosity in primary education

Science Education Hub Radboud University
Sanne Dekker, Anneke Stoffels-Engering & Margarita Melnyk



Example theme DNA: a student has thought of which features a new brother would inherit from his mother and father and draws what his brother would look like.

Colophon

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Introduction

Curiosity motivates to learn and it helps to remember information. Teachers often acknowledge the importance to stimulate curiosity of the students, yet find it hard to bring this into practice. The didactics of inquiry-based learning can be a useful way to elicit curiosity in students as their own questions form a central component in this approach.

We offer seven short activities that teachers can use to stimulate curiosity among their students. We will use examples from four themes that are discussed in the book 'Scientific breakthroughs in the classroom!'. Yet, the activities are compatible with a wide variety of themes that can be used for instance during projects on inquiry-based learning. The activities can be performed in all grades of primary school; the examples are suitable for children aged ten to twelve.

You can find more information about the Science Education Hub, the phases of inquiry-based learning and our book series 'Scientific Breakthroughs in the Classroom!' at www.wkru.nl/english

Background information

Curiosity

What do we mean when referring to 'curiosity'? Its definition as found in the dictionary is 'the strong desire to know or learn new things'. Teachers see curiosity as the willingness to know something, combined with enthusiasm, concentration and persistence, initiative and an investigative attitude[1]. A recent working definition in the scientific literature states: 'curiosity is the desire for new knowledge, information, experiences, or stimulation to close knowledge gaps or experience the unfamiliar'[2]. In short, if you are curious, you want to know more and you adopt a pro-active attitude towards finding the answer to your question.

How do students become curious?

Before addressing curiosity it is important to realize a safe classroom environment. Students should feel free to ask questions and appreciate and respect all other students' opinions[3]. A certain level of learner autonomy is of importance as well: curiosity will be promoted if students can make their own choices and decisions[3]. Give the students the opportunity to choose their own (research) questions and ways to answer them, give them choices in how they work on an assignment, or which materials they use. Mind that the amount of stimulation is particularly important: if you give the students too little information or keep them in suspense for too long, they can lose focus.

Show your own curiosity
As their teacher you are a role model for the students, likewise regarding curiosity.[4] Show that you are curious about the theme, the activities, the questions and the research of the students. This way you can actively stimulate their curiosity.

If you would like to read more on curiosity or collect ideas for other activities we would like to refer you to the corresponding edition of 'Scientific breakthroughs in the classroom!':
• Dekker, S. (red.) (2017). *Scientific breakthroughs in the classroom! Language of the senses, DNA, Understanding each other & Higgs boson.* Nijmegen: Science Education Hub Radboud University.

Additional reading, seeing and experiencing
More information about Science Education Hub, our book series 'Scientific breakthroughs in the classroom!' and inquiry-based learning can be found at www.wkru.nl/english. You can find additional video-material containing examples of curiosity in the classroom at www.wkru.nl/english/videos.

1 Trouw, A., Dekker, S., & Jolles, J. (2015). *Nieuwsgierigheid een basis in de school?* [Curiosity a basic principle in school?] Centrum Brein & Leren, Vrije Universiteit, Amsterdam.
2 Grossnickle, E. M. (2016). Disentangling Curiosity: Dimensionality, Definitions, and Distinctions from Interest in Educational Contexts. *Educational Psychology Review*, 1-38.
3 Arnone, M. P. (2003). Using Instructional Design Strategies to Foster Curiosity. ERIC Digest. Ericdigests.
Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, *25*, 54–67.
4 Engel, S. (2011). Children's need to know: Curiosity in school. *Harvard Educational Review, 81 (4)*, 625-645.

Get to work!
How do you trigger curiosity in the classroom? In this booklet, we provide seven activities that can be used in the classroom to encourage the students' curiosity. Every activity starts with a general introduction that can be used as a guideline and is linked to the phase(s) in the cycle of inquiry-based learning in which you could implement the activity. Subsequently four examples are provided from themes included in the book 'Scientific breakthroughs in the classroom!': Language of the senses, DNA, Understanding each other and Higgs boson.

Using the descriptions of the activities and inspiration from the examples you can think of your own activities for other projects and themes. End every activity with a group discussion with the students to ensure that they understand the link between the activity and the theme.

Experience of teacher Josje Dinghs:
I performed the activities of the theme DNA and expected that these activities would be something that would add extra workload to the project. However, it soon became clear that the activities matched the subject matter that the pupils were learning or had already learned during the project. The activities stimulated the students and made them enthusiastic and curious about the theme. The activities often gave a different outlook on the theme, ensuring that the information was repeated more frequently, which resulted in a better remembrance by the students. The students' creativity was stimulated in different ways during the project, both in creative thinking as well as in creative working. These activities do not take a lot of time to prepare or execute, but they do provide more depth.

1. Attractive posters

Before you start a new project, put up posters that are connected to the theme. They can contain for example numbers, illustrations, abbreviations, proverbs or words with missing letters. Use your learning goals to decide what you put on the posters, but ensure there is room left for guessing. Something new in the classroom draws attention, it marks a clear start of a new project and makes curious. Ask the students which thoughts come to mind when looking at the posters, and whether they can guess the new theme.

During the explanation of the theme you can refer to the posters and explain why you chose a number, illustration, proverb, ..., to make clear what its link is to the theme.

Tip: If you prepare a project from the series 'Scientific breakthroughs in the classroom!', you can use illustrations and texts for the posters from the chapters.

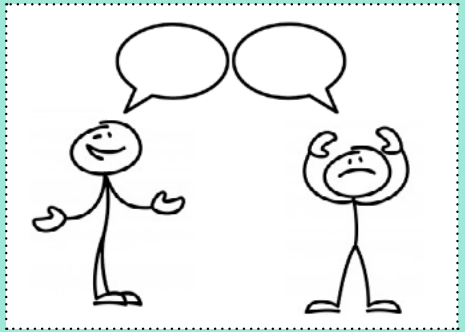
When? Put up the posters before you start with **phase 1** of inquiry-based learning. Provide for **phase 1** and **phase 2** the link between the posters and the explanation of the activities. During **phase 7** you will return to the posters; can the students explain them in their own words now?

1. Introduction 2. Exploring 7. Deepening/broadening

Examples

Language of the senses
Create a poster that raises questions about how you can talk about color, sound and smell, a poster that connects language and observation, and a poster to visualize the senses.

Understanding each other
Create a poster of two people with empty speech balloons, a poster with animal species that communicate differently and a poster with a homonym, for example nails.



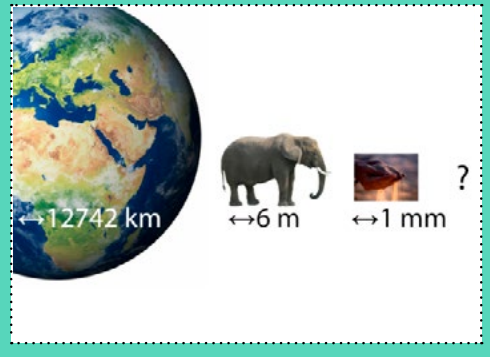
DNA
Create a poster to introduce the concepts 'chromosomes', 'heredity' and 'genes', a poster with proverbs about heredity and a poster to visualize the cell, chromosomes and DNA.

chr_m_s_mes

her_dit_

g_n_s

Higgs boson
Create a poster that shows the size of the Higgs boson by a ranking of concepts from large to small, a poster showing a magnifier with small particles and a poster with an invisibility cloak.



More ideas for posters can be found in the back.

2. Stories about your own curiosity

Introduce a new project with an anecdote about something you experienced. Express your curiosity by addressing a lot of questions during the story. Curiosity is catching and can be stimulated by active encouragement and support. Telling students about your own experiences concerning the theme and the questions that you had, makes them actively curious.

When? Tell about your own curiosity concerning the theme as an introduction to the project or after **phase 1.**

1. Introduction

Examples

Language of the senses

Tell the students about the dish “sertéspörkölt” you saw on the menu during your holiday in Hungary. Pronounce this word slowly, a few times. You had no idea what it was, if it would contain meat, fish or cheese, or what it would taste like. What do the students think it is? What does it sound like? You thought it sounded like something with roasted pork. What you were served was quite similar! Sertéspörkölt turned out to be pot roast with pork, paprika, tomato and a mix of spices. Amazing, you almost guessed it right! It is quite odd, that you could guess the dish by only the name. How is that possible? The food tasted good, but you cannot compare the taste and find it hard to describe what you just tasted. How do you find which words are suitable? Would that be the same in all languages of the world? You got curious about the language that is used to describe taste, and decided you wanted to study this with the students! Did the students ever have a similar experience, tasted something without being able to describe the taste in words? Or having a certain taste in mind for an unfamiliar dish?

DNA

Tell the students about a family gathering where you met some aunts and uncles you had not seen in a while. Your aunt told you that you looked a lot like your mother, while your uncles from your father’s side told you that you were just like your father. How is that possible? Why do you look like your father or mother? Apparently they transfer their characteristics, but how? You decided to study this with the students! Did the students experience something similar? Did they notice that they look like their father and mother? Or that they look like their brother and sister, or not at all?

Understanding each other

Tell the students how you explained the word ‘tsunami’ to a 7-year-old child. You used simple words and you described it using a lot of imagination. Then tell about how you explained the same word to a teenager. You used a lot of synonyms and described the word without a story. You noticed your approach differed, and wondered why. Is it harder to explain a concept to a child, or to a teenager? In which ways can you adjust your explanation to someone’s age? Why would that be?

Higgs boson

Tell the students about the time you were on the beach. You were lying on the beach and playing with sand. Then you grabbed a small grain of sand. You thought of how small a grain of sand actually is and asked yourself: could there be something even smaller than this? Could something that you cannot see with the naked eye exist? But how can we know that this exists?

3. Give a preview

Something that is filled with mystery makes people curious. You can make the students curious with a strange object in the classroom. Why would it be there? What can you use it for? You can choose something that you use later. During the day you can give hints and cues. Ensure a right balance between keeping and revealing the secret to keep the students excited. See for yourself how long you can and want to keep them in suspense. If it takes too long the students will lose their focus and get demotivated, especially in the lower grades.

Refer to the previews when you start an activity, for example by saying ‘Now I am finally going to tell why...’

When? Give a preview in the morning or the day before the activities in the exploring phase (**phase 2)** are planned.

Examples

Language of the senses

Ask beforehand if the students can bring a dishcloth for the activities, but tell them it is still a secret how they will be using it.

Put a tray with jellybeans on your desk before the students get into the classroom; if they do not see it, you can make a comment about it.

Put color swatches on the board, together with the text: ‘What would we be doing with these?’

At the start of the activity, tell the students: ‘Now I am finally going to tell you why you brought a dishcloth.’

DNA

Put some packages of stickers on the board with the text: ‘What do you think we are going to do with these?’

Before students enter the classroom, put a bag with marshmallows on a discrete location; if they do not see it, you can make a comment about it. What would we be doing with these?

At the start of the activity, tell the students: ‘Now we are going to do something with the marshmallows.’

Understanding each other

Make an activity announcement that can be interpreted in different ways, for example ‘We are going outside with hula hoops’. All the students will form their own ideas about what they are going to do. Some may think they will actually go hula hooping while others may think you will play a game during which you throw items through the hoops.

Ask the students why they think you are going to do this and how the use of language affected their interpretation. What would they have thought they were going to do if you said: ‘We are going outside with hula hoops and balls’? How would this information affect their guess on what they were going to do?

Higgs boson

Tell the students to bring the smallest thing they can find at home. Then discuss what the students have brought. Decide on which item is the smallest. Does something smaller than this exist?

4. Tell a story without an ending

Through a story, students can explore the theme playfully. Choose a story with a cliffhanger that suits the theme and fits in the world of the students. Stop at the cliffhanger and make the students use their fantasy to finish the story, either in writing or in a drawing. They can share their stories in smaller groups. Finish with a discussion about the different possibilities to end this story and connect them to the theme.

When? A story without an ending is told after **phase 2** or during **phase 7**.

2. Exploring

7. Deepening/broadening

Examples

Language of the senses

Start telling a story about a group of animals: 'One day a few animals sat together in de forest, taking shelter from the rain. Underneath a large bush, a fox, a squirrel, a blackbird, a mouse and an ant sat down. Just as it stopped raining and the sun came through again, they saw a large and beautiful rainbow. They admired the bright colors. The fox said: 'If I were to choose a color that suited me, I would pick red. A sturdy color, but also a bit malicious. That color would represent my personality well.' 'What about you?', he asked the other animals, 'Which color would you pick?'.' The students can think about which color the other animals would pick and why. Afterwards they can discuss it in smaller groups. Did they pick the same colors? Discuss with the class which different choices they made and why. Which color would the students choose for themselves?

DNA

Start telling a story about a new brother or sister: 'One day, Katie's parents tell her that she is going to have a new sibling. She fantasizes about what her new sibling would look like. Would the baby also have blond hairs? Would she, just as Katie, look mostly like her mother, or would the baby resemble her father more? If a baby was born in your familiy, what would he or she look like?'. The students can now draw their 'new sibling' and what they expect him or her to look like. What would the baby inherit from their father and what from their mother? In the drawing they can assign every feature to their father or mother (for example: mother's brown eyes, father's black hair). Also make them think of personality traits that the baby would inherit from their parents. They can assign new character traits as well, as 'a new variation in the DNA'. Finally, they give the brother or sister a suitable name. Discuss their choices with the class.

Understanding each other

Start telling a story about a tourist on vacation: 'A French man could not speak the native language, nor did he understand it. As he was hungry, he wanted to ask for directions to the bakery.' What do the students think he would do? Would he use hand gestures or would he try to speak his own language and hope that someone will understand him? What would the students do if they were him? Discuss with the class what choices they made. Have they ever been in such a situation themselves?

Higgs boson

Start telling a story about someone who is invisible: 'A boy named Casper was walking in the woods. He saw something shining and it was not the tooth of the scary evil wolf. No, this was something far more precious. Our Casper reached it and picked it up from the ground. He looked at the ring and immediately put it on. Our Casper was invisible and gone!' What do you think Casper would do with his invisibility ring? What kind of adventures would he experience with it? Would he be honest and tell people about the ring, or would he keep it a secret? Would he use this ring to steal, or would he use it for good causes? Discuss with the class what choices they made. What would you do if you were Casper?

5. Did you know?

Look for surprising trivia about the theme. Choose stimulating facts that claim something you did not expect. In this way you confuse the students for a second, creating a conceptual conflict. This conflict arises when the expectations or the viewpoints of the students get disturbed by new knowledge that proves the contrary. Choose a surprising statement, controversial research, news facts, or a crazy picture, photo, or comic that matches the theme. The students can talk about their astonishment: did they expect this? What do they think of it; do they think it is true? Did they ever experience something that does or does not correspond with the statement? Vary between statements that are true and false, otherwise you risk that the challenge is lost because the students find out that all statements are true. Try to find scientific facts too, and emphasize that there are researchers who try to find the answers to those questions.

Tip: If you are working on a project from the series 'Scientific breakthroughs in the classroom!', you can use the background information from the chapter to collect facts.

When? Talk about stimulating facts before you start with **phase 3** or at **phase 7**.

3. Designing research

7. Deepening/broadening

Examples

Language of the senses
1. There are people who can see colors if they hear music
2. It is possible to smell with a tongue
3. The Italian word 'sentire' means hearing, smelling, feeling or tasting
4. In Dutch, words for sounds are more important than words for smell

DNA
1. Not only the color of your hair is inherited, but also the maximum length of your hair
2. You can create a new dinosaur from fossil DNA of dinosaurs
3. When copying the genes of the parents to the child, on average one mistake is made in one gene
4. Professional athletes can use DNA tests to determine what they should eat

Understanding each other
1. When you tell a robot a story, it understands you
2. If you do not know a word, you can always find the meaning in a dictionary
3. If a dog feels scared, he can signal his emotions to other dogs
4. Smileys are interpreted differently among the world

Higgs boson
1. Your weight changes in space
2. Earth is a magnet
3. Your weight changes when you are in an elevator
4. If you dropped two marbles, one big and heavy, the other small and light, the smaller one would fall faster

Getting curious? The answers can be found in the back of this booklet.

6. Do something crazy

Deviating from normal and usual evokes curiosity. Organize the classroom differently, form new groups, do something unusual yourself, or surprise the students. Ensure that it suits the theme. It is important to maintain balance; too much deviation or too little explanation may lead to negative feelings such as insecurity and anxiety. Have a discussion with the class about the connection with the theme.

When? During all phases of inquiry based learning you can do something crazy to reinvolve the students in the theme

Examples

Language of the senses
Spray with air-freshener or deodorant before the students arrive in the classroom. Do they smell something and do they start guessing the smell? Act as if you are unaware and make them describe the smell. Which description do they come up with? Do they agree with each other? Tell them what you did and have them smell again. Do they still smell the same?

Understanding each other
Enter the classroom without saying a word. Communicate with the class without using words. You can make hand gestures or do something else to explain something to the students. Try to be as clear as possible with your communication. Ask the students afterwards if they understood you. What kind of hand gestures would they have used if they were to communicate without words? Do they think it would be easy?

DNA
Reorganize the classroom by grouping the students per hair type (straight or curly), hair color or eye color. Point out their new seats without telling the seating criteria. You can look at their hair and eye color in an obvious way, or change the seats while you think out loud. Are they aware of why they are seated in these groups? Ask them questions to make them find out.

Higgs boson
Introduce a new, invisible student. Tell the students that there will be a new student in their class whose name is Higgs. Open the door and introduce Higgs. Pretend that he really exists, talk to him and assign him a seat. Do the students believe he exists? If not, what would be needed in order for him to exist? What would the students do if they woke up being so small they would be invisible?

7. Philosophize this

Philosophizing can make students look differently at something, viewing it from different perspectives. Fantasy is also a major contributor. Fantasy contributes to curiosity as it leads to newly arising questions and ideas. Think of a theme that suits the students and start a discussion. Keep asking questions to keep the discussion going and challenge the students to look at the concept from a different viewpoint. For younger students, you can choose a question that stimulates their fantasy.

When? Fantasizing and philisophizing are necessary in **phase 2** to come up with questions and research ideas or in **phase 7** to get more into depth about the theme.

2. Exploring

7. Deepening/broadening

Examples

Language of the senses

Philisophize with the students about what it would be like if we only had three colours in Dutch. Use the example of the tribe in Australia, where they only use white, black and red to indicate colors (see page 45 of the book *Scientific breakthroughs in the classroom!*). What could happen, which misunderstandings could occur, what could go wrong? Are there also things that would be easier if we would only use three distinct words for colours?

Other possible questions are:
Can you explain colour to someone who is blind? Or smells to someone who cannot smell? What would be your approach in trying to?

Understanding each other

Philosophize with the students about what it would be like if we all had the same language. How would our everyday life change? How would this affect different cultures? What would the advantages and disadvantages be? The students can give their opinions about this subject - make sure they come up with the same number of advantages as disadvantages.

Other possible questions are:
Can we communicate with only sign language? Does the use of smileys influence digital communication? How would daily life change if you spoke a different language than your parents?

DNA

Philisophize with the students about what would happen if we all had the same DNA. What would be the pros and cons if we all had the same DNA? If the discussion tends to involve a lot of disadvantages ('We will go exctinct, because if we are all the same, then there is only boys or girls. We would not be able to reproduce'), make the group think of possible advantanges.

Other possible questions are:
Predict which heritable features you can change/ influence in the future. Would we be able to exactly determine all characteristiscs of a baby? How did people evolve over 300 years of time? Did we change at all? Why do you think so?

Higgs boson

Philosophize with the students about how we can know that something is real. Can we believe something is real/true because someone said so? Or because we trust the research that is done to prove it? How do other people's beliefs influence our opinions? And how do we decide whether something is true or not? Do the students just assume something is true or do they question everything until they are a hundred percent sure?

Other possible questions are:
How can you discover something that was not discovered before? Could there exist something even smaller than Higgs?

Language of the senses

In the blink of an eye

To follow your nose

To keep your ear to the ground

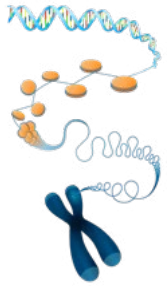
A bad taste in your mouth

To hit a nerve

Language of the senses

All posters can be found online

DNA



DNA

The apple never falls far from the tree

Like father, like son

In one's blood

Understanding each other

Understanding each other

Higgs boson

Higgs boson

Language of the senses

Fact 1: See https://www.newscientist.com/article/dn14459-screensaver-reveals-new-test-for-synaesthesia/
This is **true**. Some people receive mixed information from their senses: an observation in one sense organ is combined with a supplementary observation from another sense organ. In that way they can see colors as they listen to music or taste colors: this phenomenon is called synesthesia.

Fact 2: See https://www.nationalgeographic.com/news/2014/11/141122-crabs-snakes-smell-taste-nose-science-biology/
This is **true**. There are animals, like snakes, that can smell using their tongue.

Fact 3: This is **true**. 'Sentire' means 'experience' and is used to describe a sound that you hear, a scent that you smell, a taste that you taste or a touch that you feel.

Fact 4: See chapter 'Language of the Senses', page 43 of 'Scientific breakthroughs in the classroom! *Language of the senses, DNA, Understanding each other & Higgs boson*'.
This is **true.** In Dutch and many other languages there are more words to describe sounds than there are to describe scents. This is probably a result from the fact that we depend more on sound than scents. The research was done by Asifa Majid's team and is described in the book 'Scientific breakthroughs in the classroom!'

DNA

Fact 1: See https://www.zmescience.com/other/science-abc/how-fast-hair-grows-042394/
This is **true**. Not only hair color but also hair length is heritable. Not everyone is able to grow their hair to a length of 5 meter and 63 centimeters, which is the world record. It is possible that you would like your hair to grow longer than is possible. The students can ask their (grand)mother or (grand)father what the longest hair length is they ever had.

Fact 2: See https://www.newscientist.com/lastword/mg23030731-000-dino-dna/
This is **not true**. Research shows that it will never be possible to create a dinosaur like in Jurassic Park: the DNA is too far degraded. After 500 years DNA is broken down by 50%, and after another 500 years only 25% is left. Dinosaur DNA would be 65 million years old now.

Fact 3: See chapter 'DNA', page 84 of 'Scientific breakthroughs in the classroom! *Language of the senses, DNA, Understanding each other & Higgs boson*'.
This is **true**.

Fact 4: See https://www.businessinsider.nl/personalized-nutrition-dietary-advice-dna-test-microbiome-2017-6
This is **true**. There are companies that can give nutrition and health advise based on DNA-tests. However, there is also criticism. Some researches state that there is too little evidence that there is a link between DNA and nutrition, and not only the DNA should be taken into account when giving advice.

Understanding each other

Fact 1: https://www.newscientist.com/article/mg24332421-900-the-hardest-thing-about-robots-teaching-them-to-cope-with-us/
This is **not true**. Robots can understand the words you say, but they are not capable of understanding or interpreting human emotions and nonverbal communication.

Fact 2:
This could be both **true or not true**. You can find the definition of the word in a dictionary, but you need context to know how you can use it in the correct way.

Fact 3: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6116041/
This is **true**. They do so via visual, acoustic and olfactory communication.

Fact 4: See https://journals.sagepub.com/doi/full/10.1177/0022022117734372
This is **true**. People who rarely use emoticons (for example in Cameroon and Tanzania) have difficulty reading emotion from emoticons, while they are able to read emotions on real faces.

Higgs boson

Fact 1: See http://www.spacecenter.org/docs/Activities-HowMuchDoIWeigh.pdf
This is **true**. Our weight does change in space because there is no gravity, but out mass will always stay the same.

Fact 2: See https://science.nasa.gov/science-news/news-articles/earths-magnetosphere
This is **true**. The magnetic field is extremely important to sustain life on earth, as it protects from harmful UV-radiation.

Fact 3: See https://demonstrations.wolfram.com/WeightOfAPersonRidingInAnElevator/
This is **not true**. It does feel like your weight changes when you are in an elevator, but your weight does not vary with speed or acceleration.

Fact 4: See https://physics.info/falling/
This is **not true**. The bigger marble would fall faster. Because of air resistance, lighter objects fall slower. The air can resist a lighter object more easily than a heavy one.

Word of thanks

We would like to thank the teachers that piloted our activities and gave us feedback: Josje Dinghs (primary school Laurentiushof, Vierlingsbeek), Monique Schaminée (Montessori school Westervoort), Ilse Jager (primary school Het Talent, Lent), Jeanneke Leijten (extracurricular education Groep DOEN, Vught), Marij Persons (extracurricular education Groep DOEN, Vught).

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Photo- and illustration accountability

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“You can teach a student a lesson for a day, but if you can teach him to learn by creating curiosity, he will continue the learning process as long as he lives.” Clay P. Bedford (1903-1991)

Curiosity offers motivation to learn and contributes to a better remembrance of the information. In what ways can you stimulate curiosity in the classroom? In this booklet you will find seven activities that teachers can use in their class to make students curious.

Experience of a teacher: “The activities stimulated the students and made them enthousiastic and curious about the theme, resulting in them wanting to know more. These activities do not take a lot of time to prepare or execute, but they do provide more depth in the project.”