# Is science for me?
## Science and scientists in the answers of European pupils

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In order to investigate the imagery of children and adolescents as far as science and scientists are concerned, we set up – along with the "Draw a scientist" test – a simple and brief questionnaire, reproduced in the Appendix, that was first tested on a small group of classes and subsequently distributed to the selected sample, as previously mentioned.

While the drawing test directly provides a highly dreamlike imagery, a non-verbal one, that draws on contemporary popular culture, as much as on the archetypical one rooted in the mythological heritage, questionnaire draws, at least partially, on explicit, verbal knowledge. Indeed, some of the questions were about the young people's interests vis-à-vis science, their expectations regarding research and the European Union, whereas some others were about their knowledge on the nature of a scientist's job and their instruments.

This chapter will deal with the analysis of the answers by the respondents.

### European scientists: who are they in the eyes of children?

The first question of the questionnaire required the children to name "three European scientists". The purpose was not only to understand what and how many scientists are known within the two age groups taken into consideration, but also to understand whether the addition of the adjective "European" would affect the answers, in order to detect some information about the children's imagery on the European dimension of research.

The first thing to be noted is that slightly less than half of the sample wrote all three requested names and that up to 27% of the respondents did not name anyone. Unfortunately, there are not many scientist names known to children and adolescents, irrespective of the "European" adjective, as explained below with reference to the Italian case.

When answers are sorted by country, the evidence is that 80% of the Polish and Romanian children and adolescents could mention three scientists, while in the other four countries this only applies to 30% of the sample. The Czech and Portuguese pupils are the ones that gave the smallest number of responses. Indeed, nearly 60% of the former did not write anything, whereas this is true only for 50% of Portuguese respondents.

In Poland (2.7 scientists per pupil) and Romania (2.6), pupils are apparently more familiar with the names of scientists and are more able to identify a class of "European" scientists. This familiarity

is satisfactory in Italy (1.9) and France (1.7) and below standard in Portugal (1.3) and in the Czech Republic (1.2). As shown also in drawings, the eastern European countries appear to be more active in dealing with the national historical scientific heritage at school, and it can partly account for this result. The data regarding Poland and Romania are considerable also in terms of variety: indeed, the 591 Polish responses make up a list of 65 scientists*; and the 440 Romanian responses compile a list of 53 scientists**.

The total number of names mentioned is 2,101 (1.8 per pupil on average) and they refer to 199 different people. They are more or less well-known scientists, more or less frequently selected – on average slightly more than ten occurrences per name – but undoubtedly they make up a very broad and diversified range. The only name that has a stronger representation is Einstein, the icon of science par excellence, although his name does not show any special European characterisation.

Poland and Romania also stand out for the high number of national scientists, some of whom are not particularly well-known throughout the rest of Europe, and also for mentioning historians, geographers, leaders – especially historical ones – who cannot be strictly defined as scientists (Alexander Macedon, Demokrit, Sofocles, Vasco da Gama). In any case, the presence of people other than scientists is also frequent in the answers by pupils from other countries.

All the names are listed with their rankings in table 1.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Einstein | 44,47% | Sofocles | 0,60% | Otto | 0,17% | Saindler | 0,09% | Haldane | 0,09% |
| Newton | 17,44% | Ohm | 0,60% | Napoleon | 0,17% | Sadoveanu | 0,09% | Greenwhich | 0,09% |
| Marie Skłodowska-Curie | 12,52% | Ampere | 0,60% | Müller | 0,17% | Rousseau | 0,09% | Giovanni | 0,09% |
| Kopernik | 9,67% | Réaumur | 0,52% | Mme Lemoine | 0,17% | Riquiet | 0,09% | Galet | 0,09% |
| Archimedes | 6,82% | Euclid | 0,52% | Mariucci | 0,17% | Rici | 0,09% | Gagarine | 0,09% |
| Pascal | 6,13% | Eminescu | 0,52% | Lucia | 0,17% | Ptolomeus | 0,09% | Franck | 0,09% |
| Pythagoras | 5,35% | Sara | 0,43% | Lamark | 0,17% | Prof Vendrec | 0,09% | Ford | 0,09% |
| Leonardo da Vinci | 4,58% | Mme Riquiet | 0,43% | Indiana Jones | 0,17% | prof Rainer | 0,09% | focolle chag | 0,09% |
| Galileo Galilei | 3,80% | Magellan | 0,43% | Hermaszewski | 0,17% | prof Tournesol | 0,09% | Flannery | 0,09% |
| Armstrong | 3,37% | Śniadecki | 0,35% | Hamilton | 0,17% | Palacky | 0,09% | Fermi | 0,09% |
| Edison | 3,28% | Proust | 0,35% | Freud | 0,17% | Oudini | 0,09% | Fabre | 0,09% |
| Mendeleiev | 3,20% | Nieves | 0,35% | Fred et Jamie et Sabine | 0,17% | Newton, Kepler | 0,09% | Espettore Gaged | 0,09% |
| Pasteur | 3,20% | Mozart | 0,35% | Frantisek | 0,17% | Mr. Mircea | 0,09% | Enzo | 0,09% |
| Lavoisier | 2,59% | Mościcki | 0,35% | Franklin | 0,17% | Montgolfier | 0,09% | Eiffell | 0,09% |
| Coulomb | 2,33% | Kołodziejczyk | 0,35% | Dexter | 0,17% | Modrzewski | 0,09% | Duss | 0,09% |
| Dalton | 2,25% | Knobel | 0,35% | Cosbuc | 0,17% | Mme Kislin | 0,09% | dottor Jack | 0,09% |
| Wolszczan | 1,81% | Gutenberg | 0,35% | Cartier | 0,17% | Mme Bormann | 0,09% | docteur Chmit | 0,09% |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fleming | 1,73% | Gagarin | 0,35% | Carducci | 0,17% | Mle Belanger | 0,09% | Divens Homor | 0,09% |
| Frankenstein | 1,64% | Creangă | 0,35% | Buffon | 0,17% | Mihai | 0,09% | Descartes | 0,09% |
| Watt | 1,55% | Celsius | 0,35% | Bill Gates | 0,17% | Melania | 0,09% | Demokrit | 0,09% |
| Herodotus | 1,38% | Amundsen | 0,35% | Bell | 0,17% | Maxwell | 0,09% | de la Tour | 0,09% |
| Volta | 1,30% | Alexander Macedon | 0,35% | Beethoven | 0,17% | Martin | 0,09% | Cook | 0,09% |
| Thales | 1,30% | Vuia | 0,26% | Babes | 0,17% | Mariotte | 0,09% | Colonel Giuliacci father | 0,09% |
| Mendel | 1,21% | Vlaicu | 0,26% | ana rita rodrigues | 0,17% | Marconi | 0,09% | Colonel Giuliacci son | 0,09% |
| Joule | 1,21% | Strandvist | 0,26% | Wichterle | 0,09% | Lous XVI | 0,09% | Those who make the weather forecast | 0,09% |
| Pierre Curie | 1,12% | Natta | 0,26% | Watson | 0,09% | Louis XI | 0,09% | Caraliov | 0,09% |
| Nobel | 1,12% | Marie e Pierre Curie | 0,26% | von Hubrick | 0,09% | Litellaistaim | 0,09% | Cantacuzino | 0,09% |
| Chasles | 1,04% | Łukaszewicz | 0,26% | Voltaire | 0,09% | Linneusz | 0,09% | Brown | 0,09% |
| Aristoteles | 0,95% | Lomonosov | 0,26% | Vlahuta | 0,09% | Lamarck | 0,09% | Bogdanov | 0,09% |
| Spallanzani | 0,86% | Kuciński | 0,26% | Viteazu | 0,09% | Koch | 0,09% | Bernisou | 0,09% |
| Laplace | 0,86% | Hertz | 0,26% | Vincent | 0,09% | Kelvin | 0,09% | Becquerel | 0,09% |
| Bohr | 0,86% | Diesel | 0,26% | Veverka brothers | 0,09% | Kant | 0,09% | Bartolomeu | 0,09% |
| Vasco da Gama | 0,78% | Angela Piero | 0,26% | Toma | 0,09% | Justin | 0,09% | Archimedes, Sofokles | 0,09% |
| Olszewski | 0,78% | Victor | 0,17% | Tiago | 0,09% | Joao | 0,09% | Angela Alberto | 0,09% |
| Kepler | 0,78% | Vichterle | 0,17% | Stein | 0,09% | Jeanne d'Arc | 0,09% | andre pacheco | 0,09% |
| Cousteau | 0,78% | Rutherford | 0,17% | Stanilas | 0,09% | Irwin | 0,09% | andre | 0,09% |
| Darwin | 0,69% | romania | 0,17% | Stalin | 0,09% | Irene Joliot-Curie | 0,09% | Amerling | 0,09% |
| Colonel Giuliacci | 0,69% | Religa | 0,17% | Smoluchowski | 0,09% | Hyppocrates | 0,09% | alessandro | 0,09% |
| Coanda | 0,69% | Purkyne | 0,17% | Simone | 0,09% | Herakles | 0,09% | Aconite | 0,09% |
| Wróblewski | 0,60% | Pedro | 0,17% | Schumacher | 0,09% | Hentotoun | 0,09% | | |

Table 1. *All the names mentioned by the pupils in the questionnaire*

*. **Scientists mentioned by Polish pupils:** Archimedes, Aristoteles, Armstrong, Becquerel, Bohr, Celsius, Cook, Coulomb, Dalton, Darwin, Demokrit, Edison, Einstein, Fleming, Ford, Frankenstein, Franklin, Gagarin, Galileo Galilei, Gutenberg, Herakles, Hermaszewski, Hyppocrates, Irene Joliot-Curie, Kant, Kelvin, Kepler, Knobel, Koch, Kołodziejczyk, Kopernik, Kuciński, Lamarck, Lavoisier, Leonardo da Vinci, Linneusz, Łukaszewicz, Marconi, Marie Skłodowska-Curie, Marie Skłodowska-Curie, Maxwell, Mendelejev, Modrzewski, Mo$cicki, Newton, Nobel, Olszewski, Pascal, Pasteur, Pierre Curie, Proust, Pythagoras, Religa, Smoluchowski, Śniadecki, Sofocles, Strandvist, Vasco da Gama, von Hubrick, Watt, Wolszczan, Wróblewski.

**. **Scientists mentioned by Romanian pupils:** Aconite, Alexander Macedon, Ampere, Amundsen, Archimedes, Babes, Bill Gates, Cantacuzino, Celsius, Coanda, Cosbuc, Coulomb, Cousteau, Creangă, Dexter, Diesel, Edison, Einstein, Eminescu, Enzo, Euclid, Fleming, Frankenstein, Franklin, Galileo Galilei, Herodotus, Irwin, Joule, Kopernik, Leonardo da Vinci, Marie Skłodowska-Curie, Mendeleiev, Mihai, Mozart, Mr. Mircea, Napoleon, Newton, Nobel, Otto, Pascal, prof Rainer, Pythagoras, Sadoveanu, Sofocles, Stein, Thales, Toma, Viteazu, Vlahuta, Vlaicu, Vuia, Watt.

Einstein was mentioned the most, namely by 44% of the respondents in the sample. Obviously, Einstein is something more than a famous scientist: in some respects, he stands for the idea of science itself. Similarly to the case of drawings, his smiling face, his genius and flexibility, as much as his dual nature as the inventor of a new power, but also of new dangers for humanity, are the qualities universally supposed to be typical for all scientists.

Einstein is seen as an icon rather than as a person really known for his life and works, and this is evident when you consider the long list of different spellings provided for his name: this may imply that his name was only absorbed through brief mentions and was not really read or studied. This research alone gathered an astonishing 76 spellings.

The highest number of references to Einstein was found in Romania (Einstein accounts for 66% of the answers), in Italy (54%) and France (50%). On the other hand, his presence is less relevant in Portugal (30%), and diminutive in the Czech Republic (11%) and Poland (17%). In the Czech Republic he is the most selected person, but only a little more than Newton and Pascal; in Poland he ranks only third, coming after Marie Skłodowska-Curie and Kopernik and, once again, it shows the special focus given to the national scientific tradition, which is stronger in these countries.

Living scientists are missing from the first positions, if not missing from the entire list at all: the children and adolescents' imagery (and maybe the adults' one too) is probably not made of a real and factual knowledge of scientific work (a data confirmed also by the analysis of the drawings), rather by a pantheon of legendary figures of famous scientists, who are the subjects of "legends", such as those concerning other historical figures. In the children's imagery emerging from our research, the great scientists are indeed confused and mixed with the great figures from history, as they stand aside Beethoven, Napoleon, Magellan, Mozart and even Stalin.

References to the present time appear here and there in the list, especially with people appearing on TV, such as meteorologists presenting the weather forecast.

## Working on science

After the analysis of the reference figures respondents have for a scientist, question n. 3 required the students to classify in four degrees (from very important to not important at all), some activities that altogether make up the job of a scientist, from "making forecasts" to "making discoveries".

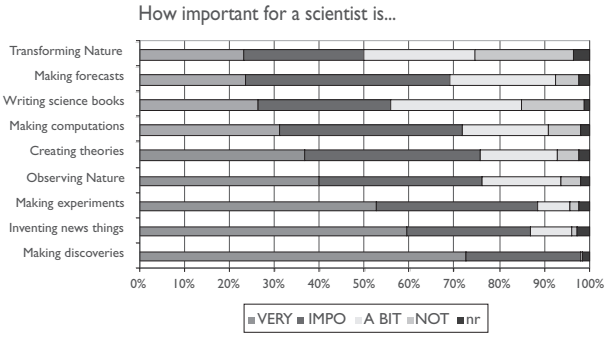


**Figure 1.** *The answers to the questions n.3*

The answers clearly reveal that, according to children, the most important trait of a scientist is that of making discoveries, inventing new things and making experiments (fig. 1). It is an experimental and applied science that appears to be closer to technology rather than to theoretical reflection, without any significant difference between children and adolescents.

"Making forecasts" is not seen by our respondents as such an important activity for a scientist, in contrast to responses given by teachers (see Gouthier). A simple explanation may be the fact that children and adolescents do not have a clear idea of what "making forecasts" means and are not able to associate it with scientific activities (e.g. those mentioned above) that are widely known and have a general interest.

Likewise, "writing books" is not seen as a crucial point, as it is also part of a vision of the production process of the scientific knowledge, which is probably too sophisticated. Children and teenagers apparently confine scientific writing among scarcely important activities and therefore, at the end of the day, they see them as quite irrelevant for the development of science.

At the opposite end of the scale, right after "making discoveries" – the scientific activity par excellence – "making experiments" and "inventing new things" interestingly are substantially equal. Indeed, both of them are important to science, but they somehow reveal two visions of research. The experiment is the traditional epistemological instrument, with deep historical roots, well-established in the ground of the past science. On the other hand, invention is also a modern aspect of a science that becomes business and follows the new paths of patenting and marketing. This is not to say that inventions have never existed – Archimedes and Leonardo were supreme scientists and inventors, only to mention a couple of them. Nevertheless, the hypothesis we want to suggest is that the contemporary imagery may refer both to a traditional view of a scientist and his/her new position in a society where science and technology are closely linked to the market of products and innovation.

Even so, in the children's imagery, inventing is also related to another ingenious and creative activity: wizardry, still a very frequent paradigm, as mentioned when discussing the drawings. The most modern vision and one with ancient roots are found to merge in the drawings, as previously reported.

## Science in everyday life

After an attempt to analyse the image of a scientist's job and the "legendary" figures that spring to children's minds, question n. 4 was aimed at detecting whether children and adolescents can realise to what extent science is pervasive in their everyday life. Therefore, their task was to mention three objects related to science they can see in their homes.

The vast majority of the children were able to mention three objects and, on average, children and the teenagers mentioned 2.6 instruments (table 2).

| Object | Occ | % | Occ/Pup | Object | Occ | % | Occ/Pup |
|---|---|---|---|---|---|---|---|
| Computer | 476 | 16,49% | 41,11% | Radio | 26 | 0,90% | 2,25% |
| TV | 301 | 10,43% | 25,99% | Calculator | 26 | 0,90% | 2,25% |
| Books | 180 | 6,24% | 15,54% | Electric bulbs | 25 | 0,87% | 2,16% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Microscope | 158 | 5,48% | 13,64% | Telephone | 24 | 0,83% | 2,07% |
| Telescope | 75 | 2,60% | 6,48% | Flowers | 24 | 0,83% | 2,07% |
| Magnifying glasses | 60 | 2,08% | 5,18% | Atlas | 24 | 0,83% | 2,07% |
| Microwave oven | 51 | 1,77% | 4,40% | Phone | 22 | 0,76% | 1,90% |
| Washing machine | 50 | 1,73% | 4,32% | Lamps | 20 | 0,69% | 1,73% |
| Electricity | 42 | 1,46% | 3,63% | Clock | 17 | 0,59% | 1,47% |
| Binoculars | 42 | 1,46% | 3,63% | Plants | 16 | 0,55% | 1,38% |
| Plants | 41 | 1,42% | 3,54% | Encyclopedia | 15 | 0,52% | 1,30% |
| Globe | 34 | 1,18% | 2,94% | Cooker | 15 | 0,52% | 1,30% |
| Thermometer | 31 | 1,07% | 2,68% | Stove | 14 | 0,49% | 1,21% |
| Mobile phone | 30 | 1,04% | 2,59% | Medicine | 13 | 0,45% | 1,12% |
| Bulb | 30 | 1,04% | 2,59% | Science books | 12 | 0,42% | 1,04% |
| Water | 29 | 1,01% | 2,50% | Maps | 12 | 0,42% | 1,04% |
| Refrigerator | 29 | 1,01% | 2,50% | Scientific books | 11 | 0,38% | 0,95% |
| Fridge | 27 | 0,94% | 2,33% | Playstation | 11 | 0,38% | 0,95% |
| Test tube | 26 | 0,90% | 2,25% | Light | 11 | 0,38% | 0,95% |

**Table 2.** *The objects mentioned by the pupils for question n. 5*
*The list includes only the objects that have recorded more than ten mentions*

Quite remarkably, the first three objects – the computer, the television and books – are instruments for communication and learning. Rather than products obtained thanks to scientific principles and technological innovations (which is true for computers and TV-sets, but not for books), apparently they are associated to science as they are concentrates of information. Strikingly, the subsequent group consists of microscope, telescope and magnifying lenses. None of them is strictly an object for everyday use; they are not communication instruments, they are real scientific instruments. But their frequency as educational games can be quite high, and this role of theirs may be the reason why they were mentioned so often. Or presumably, when answering, children thought about the school environment rather than their homes.

In any case, pupils proved to be able to identify the contribution of science also in a familiar and everyday environment such as their home: from the washing machine to electricity, from the mobile phone to plants, from bulbs to water, they can realise that science is related to everything.

What emerges is that their homes are full of objects that can be used to learn about science, as well as objects that technologically result from it, and both intrigue the children.

## Science for sustainable progress

Question n. 5 prompted children and adolescents to mention the issues science should contribute to for a better Europe ("What do you think scientists should study for a better future for Europe? Name three things").

Despite their young age, both children aged 9 and adolescents aged 14 within our sample have

very adult concerns, as this question was answered by many of them (2,399 themes were gathered, over 2 for each respondent) and not by mentioning super-technologies featured in science fiction, but rather expressing a concern that is completely rational, for instance the environment they live in. Once again, their descriptions are rich and interesting. They were grouped by similar themes; in table 3 the keywords referring to the themes and their frequencies.

| Thematic groups | Occ | % | Occ/Pup | Grouped theme | Occ | % | Occ/Pup |
|---|---|---|---|---|---|---|---|
| pollution | 208 | 9,90% | 17,96% | oil | 6 | 0,29% | 0,52% |
| nature | 94 | 4,47% | 8,12% | inventing sun engine cars | 6 | 0,29% | 0,52% |
| environment | 73 | 3,47% | 6,30% | hydrogen | 6 | 0,29% | 0,52% |
| technologies | 61 | 2,90% | 5,27% | flying cars | 6 | 0,29% | 0,52% |
| improving our lifestyle | 45 | 2,14% | 3,89% | creating new theories | 6 | 0,29% | 0,52% |
| transportation | 40 | 1,90% | 3,45% | perpetum mobile | 5 | 0,24% | 0,43% |
| space | 37 | 1,76% | 3,20% | people needs | 5 | 0,24% | 0,43% |
| diseases | 32 | 1,52% | 2,76% | new theories | 5 | 0,24% | 0,43% |
| observing nature | 31 | 1,48% | 2,68% | nature | 5 | 0,24% | 0,43% |
| medicines | 25 | 1,19% | 2,16% | education | 5 | 0,24% | 0,43% |
| computer | 25 | 1,19% | 2,16% | cloning | 5 | 0,24% | 0,43% |
| plants | 24 | 1,14% | 2,07% | trash | 4 | 0,19% | 0,35% |
| climate | 24 | 1,14% | 2,07% | machines | 4 | 0,19% | 0,35% |
| inventions | 23 | 1,09% | 1,99% | inventing vaccines | 4 | 0,19% | 0,35% |
| energy | 22 | 1,05% | 1,90% | human body | 4 | 0,19% | 0,35% |
| robots | 19 | 0,90% | 1,64% | galaxies | 4 | 0,19% | 0,35% |
| factories | 19 | 0,90% | 1,64% | foreign languages | 4 | 0,19% | 0,35% |
| mathematics | 16 | 0,76% | 1,38% | foods | 4 | 0,19% | 0,35% |
| chemistry | 16 | 0,76% | 1,38% | flowers | 4 | 0,19% | 0,35% |
| ecology | 15 | 0,71% | 1,30% | electric cars | 4 | 0,19% | 0,35% |
| physics | 13 | 0,62% | 1,12% | weather | 3 | 0,14% | 0,26% |
| experiments | 13 | 0,62% | 1,12% | warm water | 3 | 0,14% | 0,26% |
| working on better future for Europe | 12 | 0,57% | 1,04% | volcanoes | 3 | 0,14% | 0,26% |
| water | 12 | 0,57% | 1,04% | tobacco | 3 | 0,14% | 0,26% |
| recycling | 12 | 0,57% | 1,04% | to limit pollution | 3 | 0,14% | 0,26% |
| discoveries | 12 | 0,57% | 1,04% | to be polite | 3 | 0,14% | 0,26% |
| health | 11 | 0,52% | 0,95% | study nature | 3 | 0,14% | 0,26% |
| ecological cars | 11 | 0,52% | 0,95% | solar energy cars | 3 | 0,14% | 0,26% |
| vaccines | 10 | 0,48% | 0,86% | solar cars | 3 | 0,14% | 0,26% |
| writing science books | 9 | 0,43% | 0,78% | planets | 3 | 0,14% | 0,26% |
| geography | 9 | 0,43% | 0,78% | new fuels | 3 | 0,14% | 0,26% |
| economy | 9 | 0,43% | 0,78% | nanotechnology | 3 | 0,14% | 0,26% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| waste | 8 | 0,38% | 0,69% | increasing human communication | 3 | 0,14% | 0,26% |
| trees | 8 | 0,38% | 0,69% | heat in schools | 3 | 0,14% | 0,26% |
| electricity | 8 | 0,38% | 0,69% | eraser on which you can write (by pen) | 3 | 0,14% | 0,26% |
| history | 7 | 0,33% | 0,60% | economy | 3 | 0,14% | 0,26% |
| energy | 7 | 0,33% | 0,60% | discovering life in the Universe | 3 | 0,14% | 0,26% |
| earth | 7 | 0,33% | 0,60% | dinosaurs | 3 | 0,14% | 0,26% |
| technologies | 6 | 0,29% | 0,52% | conservation species | 3 | 0,14% | 0,26% |
| science | 6 | 0,29% | 0,52% | communications | 3 | 0,14% | 0,26% |

**Table 3.** *The keywords referring to the themes emerging from the answers to question n. 5, and their frequencies*

There is a serious concern for the environment (pollution, nature, transportation, climate), as previously shown by the drawings. Subsequently, there is an interest in technology (technologies, computer) and for health (diseases, medicine). The first strictly scientific themes are: space, observing nature and plants.

Children and adolescents seem to have great expectations on the role played by science in the improvement of their everyday life.

The themes regarding the environment, pollution, the relation between development and nature and, in general, quality of life comes forth in the conceptual maps. It shows that the science-Europe pair is highly oriented towards the need for sustainable development.

## Interests and curiosity

Two questions (n. 6 and n. 7) were conceived as two long lists of topics: in this case students had to select "Yes" only if they were interested in further information about the topics.

Question n. 6 was about the "pure" scientific themes: from stars to the functioning of the human body, from evolution to technology. The aim was to understand what are the most interesting themes for our sample, and if there are any relevant differences between the youngest and the eldest and between boys and girls in the sample. This question drew partially on the questionnaire used by Sjoberg[1], also to improve comparison possibilities with data gathered in several countries of the world.

Question n. 7 introduced the European dimension and required the students to show their possible interest in the issues linked to Europe itself or to scientific research in Europe or to the impact of science on the European social and economic context. The answers to question n. 6 are summarised in figure 2.

Looking at the results as a whole, without sorting them by age group, the interest shown is mainly about life: "how animals live and communicate" ranks first as a theme, whereas "the evolution of life on earth" ranks second. Except for stars, planets and galaxies, one of the most popular scientific themes ever, not only among children, the first half of the list still sees themes that concern life and health: how science and technology can help to defeat diseases or to protect the environment, the functioning of our brain, and the food needed to remain healthy.


**Figure 2.** *The answers to question n. 6*

On the other hand, the bottom of the list sees the group of the so-called "hard" sciences (physics with the elementary components of matter, mathematics represented by numbers and formulas), whereas technology comes last ("how things work").

A further explanation is required at this point. The question was designed to make the respondents select the topics they were most curious about, and not those believed to be the most interesting ones. Owing to its massive presence in our lives, technology is maybe seen as something familiar and consequently it may not be able to arouse a special curiosity, although this may not imply an absolute lack of interest in children.

The research by Sjoberg actually revealed that technological issues were the subject of a special interest especially in children from developing countries, who could be more attracted to this kind of novelty, whereas Japanese children, whose everyday life is now pervaded by technology to the maximum extent, were most uninterested in it.

In any case, the choices made by children should be separated from those by adolescents, as at times they are completely different. Indeed, reading the data collected after having sorted them by

level of education, what emerges is that children are much more curious about the human body (and the functioning of the brain) than teenagers are (fig. 3).

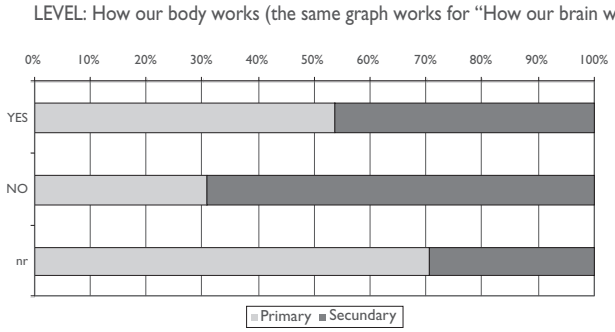


**Figure 3.** *Age differences in answering question n. 6*

The same applies for "the origin and evolution of the human being" (fig. 4).

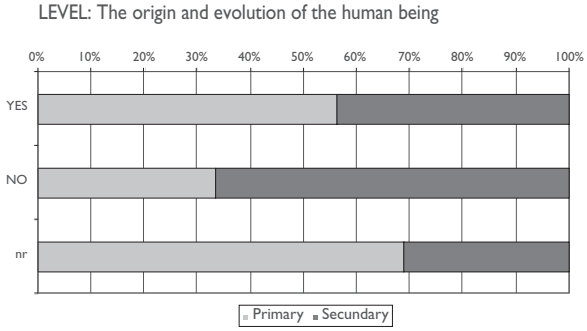


**Figure 4.** *Age differences in answering question n. 6*

The youngest children are probably more interested in a theme like evolution, as this is usually explained according to a narrative paradigm that is easier to understand and closer to the imaginative dimension of childhood. Or perhaps teenagers have already heard much about this issue and do not believe they need further information.

Another case, still different from the two above, is the imbalance in the theme "plants and flowers". Whereas children still have a special interest for plant life (expressed also in the drawings), as age increases this theme appears to be too simple, "childish", to the eyes of adolescents, as also confirmed by other research projects (fig. 5).

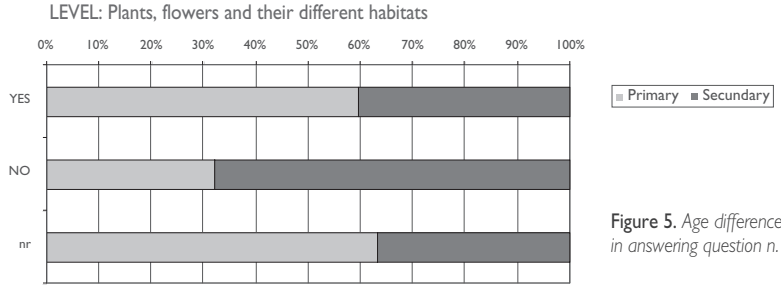


**Figure 5.** *Age differences in answering question n. 6.*

Our data do not highlight a significant gender influence. Only one question is marked by a certain gender gap (fig. 6).

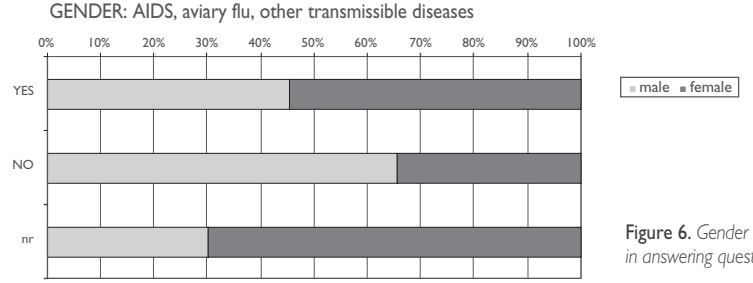


**Figure 6.** *Gender differences in answering question n. 6.*

When asked to state whether they are interested in transmittable diseases, such as AIDS and the avian flu, boys tend to say no, whereas girls tend to say yes. In all the other cases, the deviations from the average in the answers of the two genders are irrelevant in every respect.

Answers to question n. 7 are summarised in figure 7.

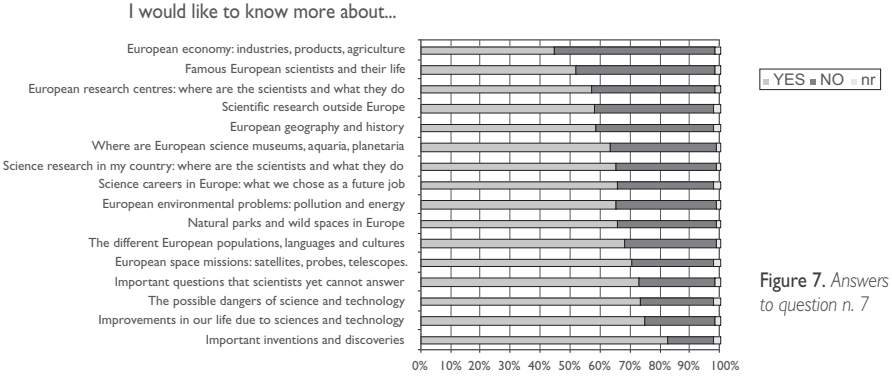


**Figure 7.** *Answers to question n. 7*

The preferences in our sample are very clear: in first place there are the impacts of science on society, arising from the inventions, the discoveries and, in particular, the improvements that science and technology may contribute to our life, and the possible risks connected to scientific activity – they are the first three themes chosen from the list. The fourth position is occupied by the limitations of science, including the popular issues scientists have not been able to tackle as yet. On the other hand, the themes that concern Europe are all to be found at the bottom of the list.

The European theme that arises the greatest interest is space missions. Next, come European populations, languages and cultures that, even though not strictly linked to science, bear witness to a desire to improve one's understanding of what the European Union is. The strong association between Europe and the linguistic and cultural variety is confirmed also in the conceptual maps, as the most recurrent words concern precisely languages and European peoples, sometimes even food, poets, songs and other aspects of the local and national cultures.

Let's consider now if we can find country-based differences in the answers to questions 6 and 7.

As previously mentioned, environmental protection is the "hot" issue children and adolescents believe science should work on. The protection of air, water and nature in general originates a divide between Italian, Portuguese, Romanian and Czech students on the one hand, and French and Polish students on the other (fig. 8).

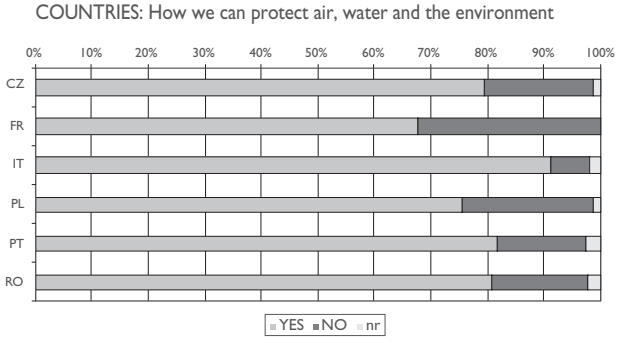


**Figure 8.** *Country-based differences in answering question n. 7.*

In Italy, the interest in this subject is extremely high, and perhaps this is because in this country environmental culture is limited or totally inexistent. Facing the environmental and urban disasters occurring in their country, Italian young people can be nothing but alarmed and in need of better information and actions. Apparently, in France the situation is completely the opposite, at least in the area represented in the survey.

The gap in the interest in the environment is confirmed by the opinions collected on alternative energy sources, once again showing the highest interest level in Italy, Romania and Portugal (fig. 9).

As regards the issue of natural protection, the level of interest in the specific issue of the energy sources decreases by over ten per cent in all cases.

The famous European scientists (as shown in the general list), are of little interest as is demon-

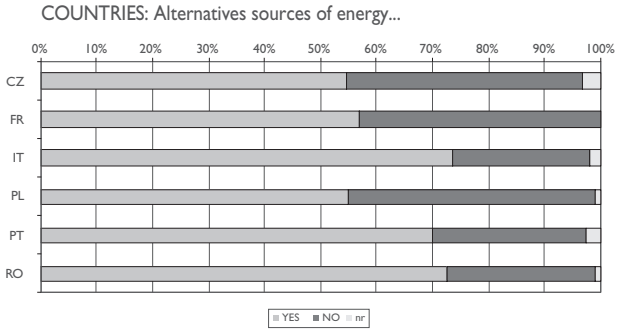


**Figure 9.** *Country-based differences in answering question n. 7*

strated by the fact that less than 50% of the respondents express their interests in this subject. Positive exceptions can be found in Italy and, most of all, in Romania, which shows a very high interest (fig. 10).

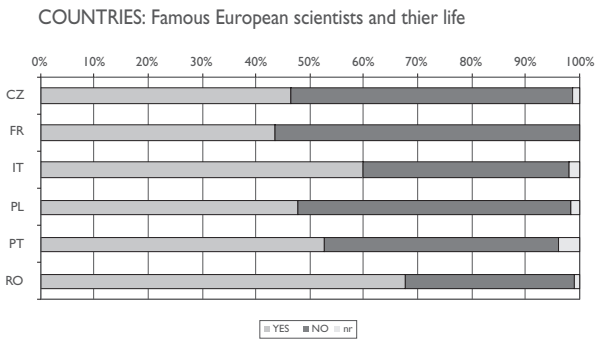


**Figure 10.** *Country-based differences in answering question n. 7*

The interpretation is not easy. Maybe the biography of scientists is not appealing in general, or the adjective "European" sounds bureaucratic and not really evocative.

The last comparison between countries regards the interest in "science research in my country" (fig. 11).

In this respect, countries are divided in three groups. The children from the Czech Republic and Poland are not very interested in the national dimension; on the other hand, they are very good at expressing it when asked to mention famous scientists or to portray them in the drawings; probably they are less interested as they believe they are sufficiently informed on these issues. In contrast, the Italian and Romanian children tend to be very interested.

The history of science is not a common subject in Italy, neither in general history classes, nor as a component of scientific education. Such an evident interest demonstrated by pupils is quite interesting and it should be an inspiration for teachers.

The figures recorded in France and Portugal fall within the average, yet this interest exceeds by far 50%.

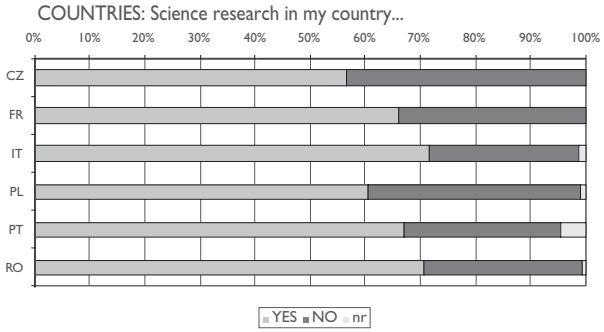


**Figure 11.** *Country-based differences in answering question n. 7*

The interest in the national dimension of science is clearly higher than the one in research at a European level. Maybe this is so because the European identity is still weak in many respects, and therefore a child does not feel emotionally pushed to know what happens in a supranational dimension. Certainly, "European" science does not have a strong or successful image, nor are laboratories and institutions working in this sector widely known. Maybe pupils simply bear witness to the lack of a communication policy. On the other hand, if we refer to the conceptual maps, the more Europe is associated to the dimension of cultural variety, the less it is associated to research.

## Would you like to be a scientist? Why?

When asked "Would you like to be a scientist?", children are split in two nearly equal groups between yes and no (fig. 12).

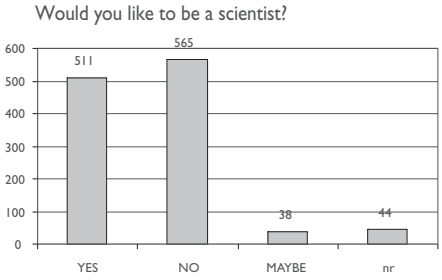


**Figure 12.** *Answers to question n. 8*

However, the most interesting aspect is to read the reasons they wrote for their positive answers, even though they are not always consistent with the content of other sections of the questionnaire: indeed, some who said they are not interested in science actually show a very great interest when explaining their rejection; otherwise, some respondents gave a positive answer, but their statements have a worried, perplexed or even negative tone.
Some crucial themes emerge when the respondents support their answers.

Regarding the positive answers, children want to become scientists because science can help the world:

*"Yes, scientists help the world and care about the future" (PL)*

*"Yes, I want to do something good for society and the environment" (PL)*

*"Yes, because I could invent things to improve people's lives and reduce pollution" (IT)*

*"Yes, I'd like to be a female scientist because I could discover new things that would benefit mankind" (IT)*

Because science can treat diseases (a popular theme also in drawings):

*"Yes. I would like to be a scientist. I would study diseases to help persons with diabetes, handicap, obesity, coeliac disease" (IT)*

*"Yes. Because I could help people and cure the most dangerous diseases" (RO)*

Another reason is because a scientist leads an exciting life:

*"Yes. Scientist can travel a lot and learn a new things" (PL)*

Because scientists are well-known and well-paid:

*"Yes. I will make some inventions and I'll be famous in the whole of Europe" (PL)*

*"Yes. I need a well paid job and social recognition" (PL)*

*"Yes. I will become a celebrity, I will be smart …" (RO)*

*"Yes. Because as scientist you have access to a large amount of information and you may discover amazing new things, that were not yet discovered. You will be famous, not only in your country, but throughout the world." (RO)*

*"I am not sure. It can give you money and fame but it is boring" (PL)*

*"Yes, I would like to be a scientist but only in a specific domain. Science is an interesting and complex domain, but it offers a lot of very well paid jobs all over the Europe" (RO)*

Working in a laboratory is fun (as is travelling into space!):

*"Yes. I want to be a mad scientist and spend time in laboratory" (PL)*

*"Yes. If I will become a scientist I will experiment and I will find forms of life in space" (RO)*

*"Yes. I would like to visit space and to see asteroids." (FR)*

*"Yes, the job of scientist is appealing to me. I will go into space and on the Moon. I also love biology." (FR)*

*"Yes, because I wish (I have a dream) to travel on Mars, and to find out if other intelligent creatures live in the Universe" (RO)*

Children want to become scientists because they are seen as smart people, even though it may make them feel inadequate:

*"Yes, to have an intelligent mind, to know more than others, to discover new formulas and new theories to write books" (IT)*

*"No because scientists are wise but not in a normal way, super wise. I'd like to be a biologist" (PT)*

Some have a problem with mathematics:
*"No because I don't like mathematic and it's difficult for me" (FR)*

*"I am not sure. I am not good in math and phys" (PL)*

*"No because I'm unable to formulate alone a hypothesis and I don't like to do it, but I like to hear it made by other people" (IT)*

*"No because there is no place with imagination in sciences. It is necessary to prove by calculations" (FR)*

Also the danger implied is an issue (the same applies to liquids!):
*"No, because it is very dangerous and there are many risks, and I would never put my life in danger for discovering some new idea." (RO)*

*"Yes, I could go to space and work with chemical reagents but I know it's dangerous" (PT)*

*"I don't know, because it may be dangerous, but it could be nice" (FR)*

*"I am not sure. You can help but M. Curie died because of radiation" (PL)*

*"It depends. Because I don't want to travel in space and if there was an explosion or things that destroy my lungs" (FR)*

*"No, because I don't like liquids" (PT)*

In any case, a common belief is that scientists have to work hard – and probably on their own:
*"I don't know. On one hand yes because I would like to find solutions, on the other hand no because it's too much work" (PT)*

*"No, I am not interested in this field. Nowadays, children can find no satisfaction in spending 7 days out of 7 in a room, in front of mathematics and formulas. We should study more arts, and especially every kind of design" (RO)*

*"No. It is interesting but I need a contact with people in my future work" (PL)*

The past few years have seen an increase in the awareness of little girls that science may be part of their professional future, that one day they too could be scientists. It can be seen through their drawings, and in the texts of their answers.

Their attention is focussed on sciences studying life rather than technological applications, and on observation, rather than experiment. They spontaneously consider science as one of their possible professional paths and it is a trend worth noticing.

They have removed all kinds of estrangement and exceptionality. In a normal context, a girl may imagine to be a future scientist. The gender issue is almost totally missing in the answers given by children.

1. Sjoberg S., Science and scientists: The SAS-study Cross-cultural evidence and perspectives on pupils' interests, experiences and perception, Acta Didactica 1, University of Oslo, Revised and enlarged version, 2002, http://folk.uio.no/sveinsj/