



10 years with planet Earth: the essence of primary school children's drawings

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Abstract. “10 years with planet Earth” is the title of the calendar created for primary schools, realized in 2016 by the Istituto Nazionale di Geofisica e Vulcanologia (INGV), the Italian Institute of Geophysical Research. The calendar is the outcome of a project created to support and complement 15 years of dissemination activities with schools. Each year for 10 years, we have printed calendars that represented different subjects related to a world in constant evolution. Each year we have launched a calendar competition among schools, asking children to send in drawings related to the chosen theme. The aim was to stimulate interest in learning about Earth sciences and the dynamics of planet Earth, as well as to raise awareness of water resources availability, the prevention of natural disasters and planet sustainability. We have received about 10 000 drawings from students of more than 400 schools. For each yearly competition, we have chosen the most significant drawings and we have included them in the calendar. The creators of the drawings were awarded by scientists, journalists, artists, science communicators and even by a government minister. In addition to the competition, the drawings reflect impressions and thoughts and illustrate the children's point of view. From the images, one can feel great sensitivity, consideration, responsiveness and respect for the planet as well as positive feelings towards science.

1 Introduction

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) is one of the most important international research institutes in the field of geophysics. As part of the Italian Civil Protection Service, INGV provides vital support for seismic and volcanic risk mitigation programmes on a global scale and

emergency management. INGV is in charge of monitoring seismicity of the national territory, the activity of Italian volcanoes and early warning for tsunamis in the Mediterranean area, through instruments with cutting-edge technology. Particular attention is given to the dissemination of scientific culture, aiming to develop awareness of risks and prevention. INGV manages the museums dedicated to Geophysics and Volcanology – the Geophysical Museum of Rocca di Papa, the Vesuvian Observatory and the Aeolian Information Centres – and collaborates in the scientific management of the Laboratory Museum of Earth sciences of Ustica and the Volcanological Museum of Nicolosi. In these museums, INGV has organized permanent and temporary scientific exhibitions and installations (Pagliuca et al., 2007; Avvisati et al., 2015; D'Addezio et al., 2015). Furthermore, during national and international events and festivals, as well as in projects with schools, INGV researchers and technicians offer educational and outreach initiatives on Earth sciences (Pessina and Camassi, 2012; D'Addezio et al., 2014; Lanza et al., 2013; Musacchio et al., 2015a, b; 2019; Amici and D'Addezio, 2018; Di Nezza et al., 2018). The goal is to meet the needs and demands of the community on issues regarding our planet and to engage society in correct, straightforward and efficient communication about scientific research and technological innovations. In a world that needs citizens to be more informed, aware and able to make important decisions about their own health and safety, knowledge is crucial to handle doubts and take conscious decisions. Educational activities are designed to raise awareness of Earth sciences and research, as well as to generate interest in scientific culture.

This work is a summary of the first 10 years of INGV's calendar competitions and describes the experience of Earth

science education through drawings. The project on the artistic representation of scientific subjects through drawings was presented at the EGU session “Earth sciences and art”. The paper describes this project and discusses the impact and efficiency of our approach.

The calendar projects

One of the most successful INGV initiatives is the creation of calendars, designed for schools and realized with drawings from a contest for primary school children. The aim is to introduce the opportunity of discussion among scientists, teachers and students. The initiative has achieved great participation and appreciation, as every year schools have joined in with enthusiasm by sending pupils' drawings on specific themes that keep changing every year and are chosen within Earth science subjects. Earthquakes, volcanic eruptions, tsunamis, magnetic storms and other phenomena are manifestations of the complexity and the changing dynamics of our planet, which began more than 4 billion years ago and has never stopped. In the past decades, we have recognized that global warming is part of the Earth's dynamism. Although we are already facing the crises of climate change, an even stronger impact will be felt by future generations.

By involving primary school children in this project, we have the chance to bring them closer to science and to investigate their point of view on the Earth, science, environment and sustainable behaviour. Indeed, children's artwork may provide insights into their feelings and thoughts about the world and the way it works. Drawing is an important activity for children since it not only encourages their imagination, but it also represents an amazing way of displaying emotions. Many authors in the field of education have been focusing on children's drawings (Farokhi and Hashemi, 2011; Cherney et al., 2007), which can be useful to understand their fears, joys, dreams, hopes and nightmares. The use of art as a tool for teaching and learning science is described and discussed in the literature (Phyllis, 2017). For example, artwork has been used to investigate learning strategies (Van der Veen, 2012) and to analyse children's volcanic risk awareness (Brasini et al., 2020) and their perceptions of the environment (Günind, 2012). In our project, the drawings may provide valuable information to understand children's environmental perceptions and their major expectations and concerns about the future.

The first calendar was the result of an educational project with a school (see the description of the 2004–2005 calendar in Sect. 2.1.). After the success of the first calendar, the experience was repeated and extended: all Italian primary schools were invited to participate. Launch calls were prepared for each competition. The calls included a brochure illustrating the importance of the chosen theme and some starting points for discussion. Information on the competition was spread via institutional websites and via social media. The initiative has been advertised in all INGV venues

and in all dissemination activities. As a result, we collected drawings from schools throughout the whole Italian territory. The first four calendar editions were organized by the INGV Settore Formazione e Divulgazione Scientifica (Training and Educational Office). Starting from the 2009 calendar, I have coordinated the competitions together with the INGV Laboratorio Didattica e Divulgazione Scientifica (Educational and Outreach Laboratory).

For each calendar, a working team, composed of researchers, graphic experts and occasionally science communicators and/or psychologists, took care of the selection. The collected drawings were selected on the basis of their relevance to the theme, their originality and attractiveness and their inherent message. For some calendars, texts have also been chosen among the ones sent by the children, together with the drawings. In the final selection we have considered gender, age balance and uniformity in the geographic distribution of the winners.

The graphic designs of the calendars were developed and realized by the INGV Laboratorio Grafica e Immagini (Graphics and Images Laboratory) (Riposati et al., 2020). Each graphic project was inspired by the theme of the competition and realized by considering the heterogeneity of drawings, using different techniques, colours and subjects but always keeping the focus on the children's work. The participating schools received educational materials produced by INGV, in addition to copies of the calendars. The latter have also been distributed to the schools participating in INGV projects and events but not directly to the contest.

Award ceremonies were organized at the INGV venue in Rome to reward the winners, in the presence of classmates, teachers and often relatives. They received certificates of attendance, medals, scientific games, and T-shirts with the logo of the competition. We invited scientists, journalists, artists, and science communicators, to the award ceremonies. Remarkably, the Italian Minister of Public Education came to the INGV headquarter in Rome to support the event on 20 October 2005, personally rewarding the winners.

2 The 2016 calendar

For the 2016 calendar we chose the drawings used in the past calendars, dedicated to the Earth (Fig. 1). This initiative allowed us to reflect, evaluate and sum up the message that this 10 year-long project has conveyed to the scientific community regarding the relationship between children and our planet. A description of the calendars, whose images contributed to the one released in 2016, follows below.

2.1 2004–2005 calendar: “A natural phenomenon called earthquake”

The first calendar was inspired by the project “When the Earth has a stomach ache” (Burrato et al., 2004). In 2000 a small earthquake (M 4.1) hit the Aniene valley, near



Figure 1. The cover page of the 2016 calendar made with a collage of all previous calendar covers (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

Rome. This event was strongly felt in the town of Subiaco (RM), shocking teachers and students of a local primary school. This led to the idea of developing a dissemination project focused on earthquakes. Children, who have been taught about earthquakes, can be engaged to use their artistic expression and demonstrate their awareness of this phenomenon through drawings (Izadkhah and Gibbs, 2015). The aim of the project was for the children to learn about the causes of earthquakes and to become familiar with a phenomenon often considered random and unpredictable. Moreover, an important aim of the project was to train students and teachers to behave properly during the occurrence of an earthquake. At the end of the project, the researcher team realized a calendar that displays earthquakes using the children's original drawings and texts, presenting their own impressions and experiences of earthquakes and shaking effects. According to the researchers' efforts, most students have focused on what they have learned about the simple behaviours that can help reduce damage.

2.2 2005–2006 calendar: "Once upon a time there was a volcano"

Drawings of this calendar were chosen among 853 works dedicated to volcanoes. The drawings show the fascination and fear that the "mountains of fire" evoke in children. Month after month, children told us about the legends of the past regarding volcanoes, for example Hephaestus, the god of fire in Greek mythology, that had his nether forge inside Etna and worked alongside the one-eyed giant Cyclops. Many draw-

ings represented the volcano as an island, such as the island of Vulcano in the Aeolian archipelago, the dwelling of the homonymous god of fire of the ancient Roman people. At the end of the Middle Ages, in fact, the name "volcanoes" was given to the mountains of fire because of Vulcano Island. Children also represented active volcanoes, the damage caused by eruptions, fire and flames, houses in danger and frightened people; however, the role of volcanoes in the life of the planet, with the springing up of flowers and fish from craters and the slopes of the volcano covered with vegetation, is also a subject of the children's drawings.

2.3 2006–2007 calendar: "Telling the story of the Earth"

In this calendar, children drew the Earth's history and the different living beings that have dwelled on it, showing Mother Earth's diversity and greatness. We received 2200 drawings, illustrating the children's point of view of the history of the planet, from the origins of the universe and of the solar system and the first forms of life to the differentiation of species in the waters and then on land, with dinosaurs, mammals and humans. Through the children's sketches one can follow the story of an extraordinary adventure, a universe full of energy, seas and oceans crowded with forms of life, with giant dinosaurs among luxuriant vegetation, grappling with smoking volcanoes, then the birth of the human race, with human ancestors and other hominids engaged in hunting, and finally the incoming of civilization.



Figure 2. The back cover of the 2007–2008 calendar dedicated to the Sun and realized, through a partnership of European countries in the COST269 project, in eight languages (edited by INGV Settore Formazione e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

2.4 2007–2008 calendar: “Living with a Star”

On the occasion of the International Heliophysical Year (IHY), the 2007 competition was dedicated to the Sun, “our star” (Fig. 2). Thanks to the European Cooperation in Science and Technology (COST269 project), schools from eight European countries – Czech Republic, Cyprus, Finland, France, Italy, Poland, Spain and the United Kingdom – participated in the competition. The winning drawings were chosen among about 1300 works. Realized in all the languages of the participating countries, this calendar collected the drawings inspired by our star. Fantastic images were drawn of the Sun, sitting in space with other celestial bodies, rockets and satellites and spreading out colourful rays. Some drawings recall life on Earth, the Sun, the rainbow and the warm sunshine on the beach in summer. There are images related primarily to the energy and life brought by the Sun and, finally, the Sun’s interaction with the Earth at different latitudes: eclipses, auroras and the Sun in summer and

lack of sunshine in winter, in some cases probably inspired by personal experience.

2.5 2009 calendar: “The Earth of tomorrow is in my hands today”

For the UNESCO International Year of Planet Earth, we focused on the issue of human responsibility for the sustainability of the planet, trying to stimulate young students in becoming active citizens of tomorrow. Children’s relationships with nature for environmental education have been explored using the “draw and write” methodology (Kalvaitis and Monhardt, 2012). Climate change will have multiple effects on human health, and it is an important challenge for the development of young humans in the 21st century. We suggested topics on climate, oceans, and seas and continental waters to raise awareness in the younger generation of the beauty of Earth and natural resources, of natural hazards and of the relation between humans and Earth’s health. Children responded by sending drawings of rainbows, waterfalls, vol-



Figure 3. The back cover of the 2009 calendar dedicated to the Earth and to the present responsibility to protect the environment (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

canoes and fields of flowers but also images showing concern for the environmental degradation and the indiscriminate use of the planet's resources. Disrespectful behaviour is sometimes represented as being fought by superheroes or protectors. Moreover, drawings of the natural environment and everyday life highlight virtuous and environmentally friendly behaviour, respect for the environment and the importance of taking care of it (Fig. 3).

2.6 2010 calendar: "Precious Earth"

The 2010 calendar still focused on children's view of the planet Earth and the effect of human activity on it. We asked children to create a message by drawing an image to promote planet Earth. The title "Precious Earth", was chosen to underline how our existence completely depends on planet Earth. We are and will continue to be part of it if we manage to maintain a dynamic balance between a sustainable life and the Earth's ecosystem. The alteration of the planet's natural

climate cycle calls for a more responsible and efficient use of natural resources in the future and the promotion and development of alternative energy sources. From the collected drawings and texts, a sense of respect for the planet and consciousness of its beauty and uniqueness emerge, as well as sadness about activities that are seen as damaging for the planet. The texts suggest the same sensitivity; i.e. "Va bene cercare un altro mondo ma se ti trattiamo bene sarà sempre bello chiamarti casa". ["It's okay to look for another world but if we treat you well it will always be nice to call you home."] "Chiudo gli occhi e sogno un mondo pulito e nessuno alza un dito. Sogno le persone rispettose dell'ambiente e la natura tornare vincente". ["I close my eyes and dream of a clean world and nobody lifts a finger. I dream of people who respect the environment and nature becoming the winner again."]

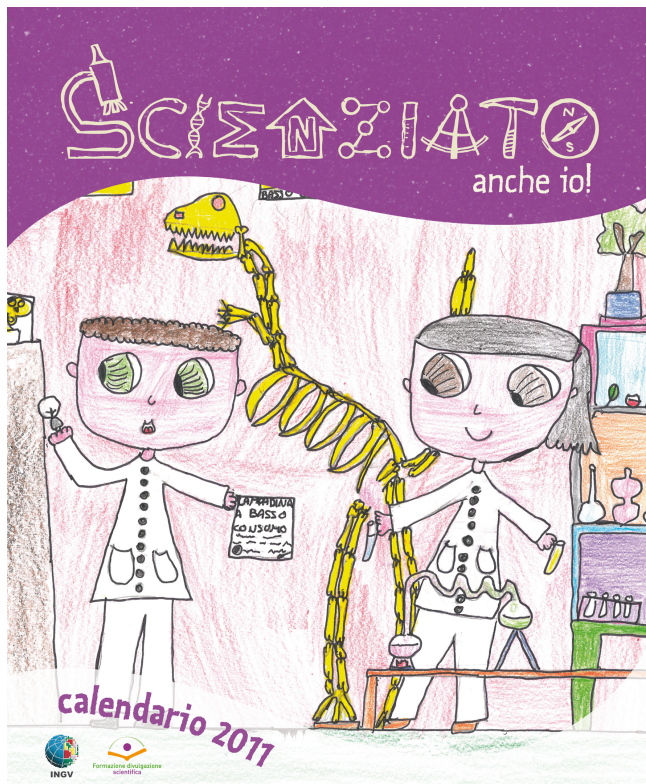


Figure 4. The design chosen for the 2011 calendar cover summarizes the main themes presented in the drawings sent by the children. Smiling scientists, confident of the potential of science, engaged in enthusiastic discoveries to improve life on the planet (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

2.7 2011 calendar: "I'm a scientist too! Science and scientists from the children's point of view"

In the International Year of Youth, established by the United Nations General Assembly, the theme was selected to find out what the children's point of view on science, scientists and research, and its potential and future perspective, is. Children were asked to answer the following questions through a drawing: (1) How do you imagine a scientist? How do you imagine the daily activities of a researcher? (2) What is the invention you consider the most important among all those you know? (3) What would you invent?

During the competition, 986 drawings were collected. What we got is a colourful and busy world, full of young scientists confident in the power of science and technology, engaged in inventing devices to make us happy, to travel in space and time and to solve the Earth's problems (Fig. 4).

A sample of 200 drawings has been analysed in order to test and tune a classification scheme and to infer some considerations of the perceived image of science, scientists and inventions from a child's point of view (Rubbia et al., 2015). The analysis reveals a persistent gender stereotype related

to scientists, since 70 % of the depicted persons were male and 45 % of girls draw male scientists. The image of a "mad scientist", mainly related to male scientists, is still present (15 %). Female scientists are drawn by girls, and they are represented as being young, not crazy and usually good-looking. Scientists of both genders are young, and this is positive: scientists may be perceived as being closer to everyday life (Rubbia et al., 2015).

2.8 2012 calendar: "Mission possible: let's save the world"

The theme was inspired by the International Year of Sustainable Energy for All, designated by the United Nations General Assembly to promote research on new green technologies and to focus on environmental problems and the future of the Earth. Our planet provides all the resources that allow life to flourish. Many of these resources depend on delicate balances and are not unlimited. We consume more resources than the Earth can generate. Almost all of the energy and raw materials we use to produce or build what surrounds us and what we need to live come from the Earth, a land that feeds, warms and offers us beauty.

In the brochure of the call we suggested some priorities for the mission.

1. Counteract the pollution of air, water and soil.
2. Stop global warming and the destruction of ecosystems.
3. Develop new green technologies.

Children's fantasies offered us images of a planet with rainbows, trees, clean rivers and lakes, school buses powered by pedals, eco-volcanoes and machines that convert waste into flowers. The real challenge for children was to draw inventions. We can see green ideas and technologies based on solar energy for high-speed trains or pizza ovens and energy that comes from the destruction of weapons or by harnessing volcanoes (Fig. 5) – in other words, sustainable development that is able to meet the needs of the present without compromising those of future generations.

2.9 2013 calendar: "In the heart of the Earth"

What do primary school students imagine inside the Earth? Scientists agree on a common representation of the interior of the Earth, but so far no one has been to check it. Inside the Earth, temperature and pressure increase progressively until they reach very high values that challenge any technology known to date. We went to the moon, but we have not been able to go for more than a few kilometres into the Earth. From the 1034 drawings, we can say that the interior of the Earth is definitely very colourful and sometimes animated by turtles, butterflies and fire-breathing dragons. In some cases it consists of candies, cream and chocolate, precious stones and fire-feeding volcanoes. Some drawings were inspired by



Figure 5. One of the drawings selected for the 2012 calendar. The drawing shows a very complex project of an eco-volcano, with very detailed instructions and precise statements on the low cost of the project and on the absence of pollution (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

legends and myths, alluding to the existence of underground, hidden and mysterious worlds, also inhabited by people and fantastic creatures.

2.10 2014 calendar: “The magic of water”

Water is an essential part of the Earth making it a rare planet. Precious and indispensable to life, water is a fundamental necessity that we need to protect. By raising awareness, we can avoid the waste and pollution of water. We received 1195 children’s drawings, in which water is represented in its plentiful manifestations, in the atmosphere and on the Earth’s surface (Fig. 6). There are placid waters of lakes and lagoons and pouring waterfalls reflecting the Sun as well as more troubled waters that give rise to glaciers and other features of ice and polluting boats. There are also suggestive images that reminded us of extreme weather events such as floods or very powerful rain, which represent a sign of awareness. The understanding of water’s varied and sometimes powerful manifestations in the atmosphere and on the Earth’s surface promotes a correct attitude towards and respectful behaviour towards nature.

3 Final considerations

The 10 years of INGV’s calendar competitions directly involved more than 400 schools. In addition, at least 500 other schools have been part of the initiative each year by receiving copies of the calendar. We have collected about 10 000 drawings. These data indicate a high level of impact of the calendar-drawing competition approach. Except for the first calendar, resulting from a specific educational activity, the scientific messages were conveyed without direct interaction between children and researchers. The launch call brochures represented only a starting input. The teachers organized special lessons to raise awareness in pupils on the competition topics and to better develop the calendar theme subject.

After 4 years of interruption due to other demanding outreach activities, the calendar project has been restored in 2020. Thanks to the cooperation with the Science Together NET project (a European Researchers’ Night project, financed by the European Commission under the Marie Skłodowska-Curie actions) we expect the competition to take place again in the next years. The interaction with researchers can be enhanced in future competitions by organizing lectures and workshops for the participating schools using distance learning technologies. This could more effectively con-



Figure 6. The back page of the 2014 calendar dedicated to water (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

vey the scientific messages to teachers and students. Moreover, a direct interaction, even if at distance, can offer the possibility of feedback on the efficiency of the initiative in raising knowledge and awareness.

This work, summarizing 10 years of the INGV's calendar competition, represents a contribution to a more general investigation into the effectiveness of the INGV training activities. The organization of training and outreach activities can benefit from the knowledge of the cognitive and emotional outcomes of the beneficiaries. Projects with schools and in public have been analysed to determine the effects of the training activities and the motivations of participants. These studies provided information on the amount of popularity and effectiveness of training in various contexts (D'Addezio, 2019; D'Addezio et al., 2014; Lanza et al., 2013; Musacchio et al., 2015a, b). Moreover, we can perform a more general analysis of how the scientific message has been received and of the ability of scientists to transfer concepts, ideas and in-

formation in a correct and captivating way. Besides the competition, the drawings we received in 10 years of continuous activity with schools depicted children's impressions and reflections and provided an opportunity to understand their point of view. Children's drawings can provide valuable information on the development of their environment perceptions (Farokhi and Hashemi, 2011). How do young people deal with global problems such as climate change and other potential sources of worries and distress? Generally, children cope with worries about, for example, climate change by having less problem-focused behaviour, taking distance and placing trust in researchers and technological development to a higher degree than adults (Ojala, 2012). Our analysis shows that this attitude can be observed in the children's drawings. In fact, from the drawings and texts we have collected a great consideration, a deep environmental concern and respect for the planet arise. As shown in other experiences (Kalvaitis and Monhardt, 2012), children showed a positive relationship

with nature. A similar positive relationship between children, science and scientists also emerges from the calendar drawings. Science and technology are perceived as powerful tools that are capable of handling the continuous challenges humanity is facing. Moreover, children represent themselves as users of these tools to solve problems and improve the world. In this light, the outcome of the calendar project gives us hope that similar initiatives can contribute to increasing the knowledge of the Earth and the fragile human ecosystem in the hearts and minds of future active citizens.

Data availability. Data can be accessed at <http://istituto.ingv.it/it/calendari-scolastici.html> (last access: 7 December 2020, Rocchetti, 2020) and <https://doi.org/10.5281/zenodo.4302205> (D'Addezio, 2020).

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