10 years with Planet Earth essence in the primary school children drawings

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Abstract

"10 years with Planet Earth" is the title of the calendar addressed to primary schools, realized in 2016 by the Istituto Nazionale di Geofisica e Vulcanologia - 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 Planet Earth dynamics, as well as to raise awareness on water resources availability, 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 authors of the drawings have been awarded by scientists, journalists, artists, science communicators and even by a 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 programs 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 tsunami 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, 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 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 et al., 2012, D'Addezio et al., 2014; Lanza et al., 2013; Musacchio et al., 2015a; 2015b; 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 a 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 has been presented at the EGU session Earth sciences and Art. The paper describes this project and discusses the impact and efficiency of our approach.

1.1 The calendar projects

One of the most successful INGV initiatives is the creation of calendars, designed for schools and realized with drawings from the contest for primary school children. The aim is to introduce the opportunity of discussion among scientists, teachers, and students. The initiative achieved great participation and appreciation, as every year schools 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 four billion years ago and never stopped. In the past decades, we 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 artworks 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, Eds, 2017). For example, artworks have been used to investigate learning strategies (Van der Veen, 2012), to analyse children 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). 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 the 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 by 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, also texts have been chosen among the ones sent by the children, together with the drawings. In the final selection we have considered gender and 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., this Volume). Each graphic project was inspired by the theme of the competition and realized by considering the heterogeneity of drawings, using different techniques, colors and subjects, but always keeping the focus on the children's work. The attendee 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 October 20, 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 was conveying 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.

*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 Rome. This event was strongly felt in the town of Subiaco (RM), shocking teachers and students of a local primary school. This lead 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 expressions, and demonstrate their awareness on 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 kids' original drawings and texts, presenting their own impressions and experiences on earthquakes and on shaking effects. According to the researchers' efforts, most students have focused on what they have learned about the simple behaviours that can help reduce the damage.

*Calendar 2005 – 2006 **"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" arise in children. Month after month, children told us about the legends of the past regarding volcanoes. Hephaestus, the god of fire in the Greek mythology, that had his nether forge inside the Etna and worked alongside the cyclopes, giants with a single eye. Many drawings represented the volcano as an island, such as the island of Vulcano in the Eolian archipelago, the dwelling of the homonymous god of fire of the ancient Roman people. At the end of the Middle-age in fact, the name 'volcanoes' was given to the mountains of fire, because of Vulcano Island. Children also represented active volcanoes and the damage caused by eruptions, fire and flames, houses in danger and frightened people; but the role of volcanoes for the life of the

planet, with the emissions of flowers and fishes from craters, and the slopes of the volcano covered with vegetation are also a subject of the children's drawings.

Calendar 2006 – 2007 ***"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 on the history of the planet, from the origins of the Universe and of the solar system, the first forms of life, 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.

Calendar 2007 – 2008 ***"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 8 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. Finally, the sun interaction with the Earth at different latitudes: eclipses, auroras, the sun in summer and non-sun in winter, in some cases probably inspired by personal experiences.

2009 Calendar ***"The Earth of tomorrow is today in my hands"***
For the UNESCO International Year of Planet Earth, we focused on the issue of human responsibility on 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 on the beauty of Earth and natural resources, as well as on natural hazards and on the relation between humans and Earth's health. Children responded by sending drawings of rainbows, waterfalls, volcanoes and flower fields, but also with images showing concern for the environmental degradation and the indiscriminate use of the planet's resources. Disrespectful behaviour is sometimes represented as fought by "Superheroes" or protectors. Moreover, drawings on the natural environments and everyday life highlight virtuous and environmentally friendly behaviour, respect for the environment and the importance of taking care of it (Fig. 3).

2010 calendar ***"Precious Earth"***
The 2010 calendar still focused on children's attention on 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, consciousness of its beauty and uniqueness emerges, as well as sadness for 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.

2011 Calendar ***"I'm a Scientist too! Science and scientists from the children point of view"***
In the International Year of Youth, established by the United Nations General Assembly, the theme was selected to find out how 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 colorful 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 problems (Fig. 4).

A sample of 200 drawings has been analyzed in order to test and tune a classification scheme and to infer some considerations of the perceived image of science, scientists and inventions from the 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 young, not crazy and are usually good-looking. Scientists of both genders are young, and this is positive: scientists may be perceived as closer to everyday life (Rubbia et al., 2015).

*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 comes from the Earth. A land that feeds warms and offers us beauty.

In the brochure of the call we have suggested some priority 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 fantasy offered us images of a planet with rainbows, trees, clean rivers and lakes, school buses powered by pedals, eco-volcanoes, 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, an 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.

*2013 Calendar **"In the heart of the Earth"***

What do primary schools students imagine inside the Earth? Scientists agree on a common representation of the interior of the Earth, but so far no one went 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 legends and myths alluding to the existence of underground, hidden and mysterious worlds, also inhabited by people and fantastic creatures.

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, where water is represented in its plentiful manifestations, in the atmosphere and on the Earth's surface (Fig. 6). Placid waters of lakes and lagoons, pouring waterfalls reflecting the sun, more troubled water that gives rise to glaciers and ice figures, 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 approach with the territory and respectful behaviour towards nature.

3. Final considerations

The 10 years of INGV's calendar competitions directly involved more than 400 schools. Besides, 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 a 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 Sklodowska-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, for the participating schools,

lectures and workshops using distance learning technologies. This could more effectively convey 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 on raising knowledge and awareness.

This work, summarising 10 years of the INGV's calendar competition, represents a contribution to a more general investigation on the INGV training activities imprint. 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 over 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; Musacchio *et al.*, 2015b). Moreover, we can perform a more general analysis on how the scientific message has been received, on the ability of scientists in transferring concepts, ideas, information in a correct and captivating way. Besides the competition, the drawings we received in ten 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, potential sources of worries and distress? Generally, children cope with worries on i.e. 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 planetarise. 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 emerge from the calendar drawings. Science and technology are perceived as powerful tools that are capable to handle 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 in increasing the knowledge of the Earth and the fragile human ecosystem in the hearts and minds of future active citizens.

The author declares that she has no conflict of interest. Figures are from INGV publications.

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Codice campo modificato

Figures and captions

Fig. 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).

Fig. 2. The back cover of the 2007-2008 calendar dedicated the to the Sun and realized, through a partnership of European countries in the COST269 project, in 8 languages (edited by INGV Settore Formazione e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

Fig. 3. The back cover of the 2009 calendar dedicated the 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).
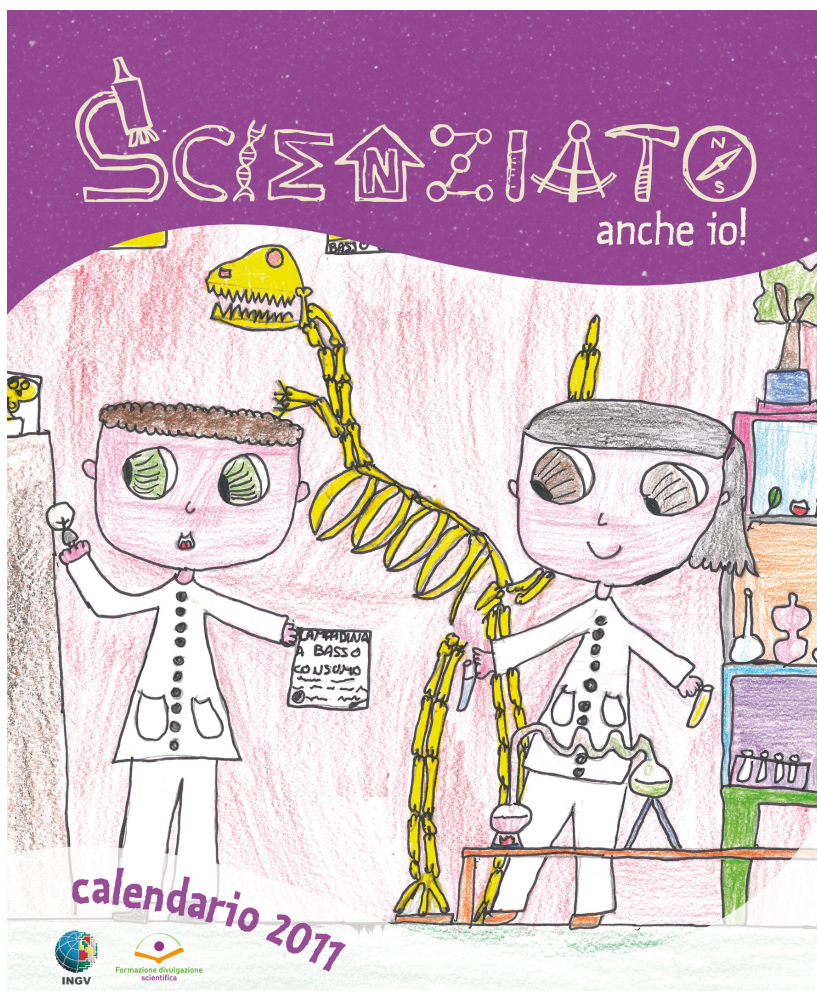
Fig. 4. The design chosen for the 2011 calendar cover summarizes the main themes presented in the drawings sent by the children. Smiling scientists, confident of the potential of science, engaged in enthusiastic discoveries to improve planet life (edited by INGV Laboratorio Didattica e Divulgazione Scientifica and INGV Laboratorio Grafica e Immagini).

Fig. 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).

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