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## Final Report

# AGORA – CRAGP3\_171682 PSC Creative Camps for Youth

**01.04.2017 to 31.07.2020**

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## 1. Executive summary

In collaboration with art educators from the Zurich University of the Arts (ZHdK), the PSC developed creative and inquiry-based workshop activities for young people aged 8–14. The workshops were offered during holiday camps but also at Treffpunkt Science City, Scientifica, spring festival at the Botanical Garden of University of Zurich and the Fascination of Plants Day.

The *Creative Camps* Project has been designed around a core group of about 10 research groups reflecting frontiers research on topics like biocommunication, plant development and evolution, adaptation on climate change, modelling of future landscapes and ecosystem services.

From 2017–2020 the PSC carried out 8 camps with 184 participants, 14 workshops and elements of the workshops adapting the hands-on activities of workshop contents for: International Fascination of Plant Day (2017, 2019), Pro Juventute Ferienplausch (2017), Scientifica (2019), Bugnplay.ch (2017, 2018, 2019), Frühlingfest, Botanische Garten Zürich (2018) 100 Ways of Thinking, Kunsthalle Zürich, 2018, Forschungswoche Bern 2019, Olma 2019. Total participants for all our activities was 3079.

The project emphasizes our aim to increase the capacity of the Plant Science Center's many researchers to engage a broad cross-section of young people in Switzerland with **hands-on learning experiences**, open dialogue formats and tinkering activities. An essential step in maximizing their long-term community impact is that scientists, science educators and communicators worked together to translate frontier innovation in plant sciences into a fascinating learning experience for young people. The **collaboration with bachelor students of Art Education at the Zurich Universities of the Arts** allowed us new ways of investigating creationship. We evolved new learning materials by bringing creative methods from the arts into a scientific context and compiled a DIY-book with easy to follow guidelines. The combination of **creative and inquiry-based approaches** to learning and teaching allowed us to expand young people's capacity of understanding of science by foster children's own interests and explorations and to encourage a range of inquiry skills in particular observing and exploring, asking questions, reasoning and making connections. An aesthetic experience enables emotion and empathy and thereby inquiry-based learning. By communicating science from a position of building empathy with an audience — rather than simply telling an audience what it needs to know — we can create more compelling, memorable experiences that invite participants to arrive at their own understanding.

## 2. Overview of outputs

Table 1: Overview of outputs

Activity	Description of Activity	Outputs	When
<b>Workshops</b>	12 interactive workshop concepts	14 Workshop elements carried out multiple times with a total of over 3000 participants	2 in 2017 9 in 2018 6 in 2019
<b>Camps</b>	7 residential camps were held and one multi-day day camp	184 participants	1 in 2017 5 in 2018 2 in 2019
<b>Book</b>	Detailed and illustrated guide to the camps and workshops	Juanita Schläpfer-Miller und Manuela Dahinden, Hrsg. (2020). Creative Camps – Verknüpfung von Kunst- und Wissenschaftsvermittlung. Zürich-Basel Plant Science Center. ISBN: 978-3-907234-04-4 <a href="https://doi.org/10.3929/ethz-b-000421727">https://doi.org/10.3929/ethz-b-000421727</a>	2020
<b>Online Magazine</b>	Detailed descriptions for parents and teachers to do the experiments and activities	Juanita Schläpfer-Miller and Manuela Dahinden, Hrsg. (2020). MINT-rich TINKERING. Ausgabe 01: Circuits. Zürich-Basel Plant Science Center. <a href="https://doi.org/10.3929/ethz-b-000428641">https://doi.org/10.3929/ethz-b-000428641</a>	2020
<b>Peer-reviewed journal article</b>	Summary of results and experiences in combining art and science education for youth	<i>The interplay of art education and science communication engage adolescents in creative experimentation and environmental sciences</i> Juanita Schläpfer-Miller, Renate Lerch and Manuela Dahinden, Manuscript in preparation. Will be submitted to Science Communication <a href="https://journals.sagepub.com/home/scx">https://journals.sagepub.com/home/scx</a>	2020
<b>Further education for teachers and camp leaders</b>	One day hands on course for teachers and youth leaders	<i>Teaching creativity through MINT-rich Tinkering</i>	2020
<b>Scientifica</b> Science Fact or Science Fiction	Science-Art Workshop: Plants on the moon	60 participants	2019

<b>Fascination of Plants day</b>	Plant chromatography, Hapazome, Plant color extraction	600 participants beim Frühlingsfest im Botanischen Garten der Universität Zürich	2018
<b>Festspiel Zurich, Munsterhof</b>	Workshop element Plant Aesthetics - Hapazome	25 participants	2018
<b>100 Ways of Thinking -</b>	Workshop element Zoom in Zoom Out	60 participants	2018
<b>100 Ways of Thinking -</b>	3D- Cells, Celia Baroux	150 participants	2018
<b>Forschungswoche Bern</b>	Space kids workshop: Plant Space Capsules for the moon	25 participants	2019
<b>Olma, St Gallen</b>	Soft circuits activity for young children	400 participants	2019
<b>Zoologisches Museum der UZH</b>	Workshop for children: Bionics and electronics	32 participants, 1 Video	2018, 2019
<b>Lab Visits</b>	Lab visits and lectures, brainstorming and co-design of activities	19 Lab visits 90 Art Education students 31 Scientists	2017-2020
<b>Social media</b>	Blog and facebook site	<a href="https://www.facebook.com/plantsciencecenter/">www.facebook.com/plantsciencecenter/</a> Twitter: @plantscicenter	Since 2017 Since 2018
<b>Webpages</b>	Archiv of all events	<a href="http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html">www.plantsciences.uzh.ch/de/outreach/ferienlager.html</a> <a href="http://www.creativelabz.ch">www.creativelabz.ch</a>	Since 2017
<b>Videos</b>	Creative Camps: Die Natur ist die Allerbeste Erfinderin	<a href="http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html">www.plantsciences.uzh.ch/de/outreach/ferienlager.html</a>	2019
	Creative Camps: Ferienlager mit Kunst und Wissenschaft		2020
	Science et Cite video	<a href="https://www.youtube.com/watch?v=AgHsnQM62yU">www.youtube.com/watch?v=AgHsnQM62yU</a>	2019

<b>PSC Newsletter</b>	The results and experiences of the project were shared with the members of the PSC network	7 articles, 700 subscribers	2017-2020
<b>Presentation at ScienceComm, ECSITE</b>	The concept of creative science learning workshops was discussed with other science educators	One poster presentation, 250 participants One oral presentation, 50 participants One speed talk, 200 participants	2017-2019
<b>Press &amp; Media</b>		<a href="https://www.srf.ch/news/regional/zentralschweiz/zugang-zu-wissenschaft-foerdern-forschungsreise-fuer-kinder-auf-hoher-see">https://www.srf.ch/news/regional/zentralschweiz/zugang-zu-wissenschaft-foerdern-forschungsreise-fuer-kinder-auf-hoher-see</a>	2018

### 3. Achievements

#### 3.1 Facilitation of transdisciplinary process, structure of program

Based on regular meetings of the program leaders (Schläpfer, Dahinden, Lerch, Truniger) and feedback of program participants (art education students), we are able to describe the key elements and formats or mechanisms that facilitate the transdisciplinary process:

- I. *Incubate*: Key elements for success in the lab visits were to have hands on tactile and visual experiences for the art education students. The first year we preceded the lab visits with four short lectures from the professors but these were too overwhelming for students who had not studied biology for several years. In subsequent years we only had theoretical input during the lab tour.
- II. *Understand and ideate*: The art education students were tasked with using their sense of wonder as a starting point to ask questions that connect to their own aesthetic experiences. They were fascinated for example by color qualities or color changes, or by plants under different conditions. They were amazed by pattern perforations and their consequences when cutting into DNA chains, or they considered the diversity of growth in a plant, considerations which generated broad associations and narrative developments. Out of these questions came the teaching exercises for the target groups.

In the mediation laboratories, the students showed how access to rather complex scientific phenomena can be opened with basic, aesthetic experiences. They have learned that when preparing simple design exercises, even complex issues became clearer and more conscious and that sharing their own fascination with the phenomena arouses curiosity among target groups, which in turn is the starting point for joint, intrinsically motivated learning.

It proved critical that the science communicator attended as many of the sessions as possible in order to clarify scientific questions which arose and also to provide input to the creative spiral (Input -> imagine-> ideas-> create ->) to remind and continue the process of making connections between the science they had experienced and the aesthetic experience they were generating. This was time intensive and involved attending at least 3 full mornings at the art school.

- III. *Design, develop:* The internship at the Plant Science Center consisted of one day a week for 11 weeks and two days of working in their studio for the students. It proved necessary for the science communicator to also join the visits and discussions with researchers so that connections could be made and stories could be teased out of the wealth of scientific information. One lab (Prof. Consuelo de Moraes) was very generous with their time and organized a different researcher each week for six weeks to present their work to us. Brainstorming immediately after the scientific encounters proved invaluable for recording reactions. Research at the macro-level such as plant-insect interactions proved easier for the art educators to find entry points, rather than micro biology research. This was more tangible when the researchers used interesting metaphors and the students could then find metaphors of their own.
- IV. *Execute and apply:* The Workshops and camps are usually structured with an initial input from scientists and art educators, both communicate their sense of wonder and introduce the questions that interest them. Materials and processes may also be introduced. The goal is to facilitate in experimental mindset, and then to observe and intervene only when necessary to nudge the process.

### 3.2 Achievements in creative art and science workshop development

#### Lab visits

Firstly the Bachelor Art Education students (BAE) visit the science labs, and based on this input they create interactive activities for their peer group. These actions are incubated in the mediation labor

(Vermittlungslabor). This is a complete unit in itself but also creates a pool of ideas which can be used in the next phase.

The students had to create an exercise for their fellow students, inspired by their lab visits. Many chose to examine the processes of observing and discovering. What information is needed about an object in order to make a verbal description or a drawing? What is the difference between the information available from being able to observe in real life an object (say a fruit or flower) compared to a photo of the same object. Many of the exercises were concerned with the visual representation of things and the communication of this information. Or they were concerned with experimental methods: for example, the «Banana Lab» where participants were allowed to first look at a banana but not touch it and then in a second-round use dissection tools to examine it.

The students were also interested in the scale at which an object was looked at and the information available at different dimensions.

### **Internships**

The second phase is that two or more of the BAE students undertake an 11-week internship at the Plant Science Center (PSC), where in collaboration with a science communicator they create hands on activities for the public. This internship includes many more lab visits and exchanges with researchers followed by ideating immediately afterwards, to document and discuss the images and metaphors which arose. Two Art Education students decided to come to the PSC for their internship in spring 2018. This involves them being with us for 3 days a week and working on activities for the *Creative Camps* in the spring, summer and autumn holidays.

### **Actors**

The *Creative Camps* project has been designed around a core group of about 10 research groups from the PSC, reflecting cutting edge research on topics such as biocommunication, plant development and adaptive evolution, interdependencies in environmental networks, land use and conservation of ecosystems.

Researchers invite the art education students into their labs. They present research facilities and instruments, and explain research processes and experiment results. The students of the BAE are commissioned to engage with the topics, phenomena and questions presented in an art-analogous manner. They are tasked with engaging in aspects of the research projects that they base on their own artistic exploration and are therefore relevant to them. They can relate to a familiar vulnerability in dealing with the unknown and the unforeseen and encounter the complex matter in a balance between intuitive understanding and experience-based recognition. The didactics begin with amazement and design experiences serve as a resource to proactively counteract the excessive



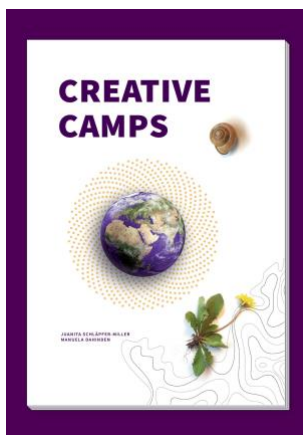
demands on the content and to ask design questions that result in creative implementation (development of creative activities)

In the specialization in Aesthetic Education and Socioculture within the Bachelor's degree in Art Education at the Zurich University of the Arts, training is given to specialists in a range of teaching and instructional activities relating to art, design and culture. The vocational training offered prepares participants for work with children, young people and adults within a diverse and culturally rich teaching environment. As part of the project work, the art students are asked to carry out a situation and needs analysis and to analyze the social space or sociocultural context.

Our guiding ethos is that through creative activity and involvement with the products of creative work, people of all backgrounds can develop the sensitivity and competence needed for appreciation, aesthetic discernment and self-expression. This learning and developmental process requires specialists with a solid foundation in training. Creative and artistic educational options with a high standard of quality are essential for the development of an enduring interest in the created environment.

### 3.3 Publications

#### BOOKS



Juanita Schläpfer-Miller und Manuela Dahinden, Hrsg. (2020).

Creative Camps – Verknüpfung von Kunst- und Wissenschaftsvermittlung. Mit Beiträgen von Gianna Brühwiler, Giulia Donati, Christian Ginzler, Oskar Hagen,

Sabrina Flütsch, Joyce Kalumba, Mina Karrer, Renate Lerch, Alexandra Rosakis.

Zürich-Basel Plant Science Center.

ISBN: 978-3-907234-04-4

<https://doi.org/10.3929/ethz-b-000421727>

*In preparation:*

Juanita Schläpfer-Miller and Manuela Dahinden, Hrsg. (2020). MINT-rich TINKERING. Ausgabe 01: Circuits. Zurich: Zurich-Basel Plant Science Center. <https://doi.org/10.3929/ethz-b-000428641>

#### PEER-REVIEWED JOURNALS

Juanita Schläpfer-Miller, Renate Lerch and Manuela Dahinden (2020). *The interplay of art education and science communication engage adolescents in creative experimentation and environmental sciences. Manuscript in preparation*

#### **WEBSITES / SOCIAL MEDIA**

[www.plantsciences.uzh.ch/de/outreach/ferienlager.html](http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html)

[www.creativelabz.ch](http://www.creativelabz.ch)

Facebook: @plantsciencecenter / @creativelabzurich

Twitter: @plantsciencenter

Vimeo: <https://vimeo.com/user96081540>

#### **PSC NEWSLETTER**

The results and experiences of the project were shared with the members of the PSC network (+600 plant scientists & 100+ external subscribers)

Available at: <http://www.plantsciences.uzh.ch/en/publications.html>

#### **PRESS & MEDIA**

2019 [Abenteuer auf dem gelben Zuger Schiff](#), Luzerner Zeitung

2018 <https://www.srf.ch/news/regional/zentralschweiz/zugang-zu-wissenschaft-foerdern-forschungsreise-fuer-kinder-auf-hoher-see>

#### **VIDEOS**

Creative Camps: Die Natur ist die allerbeste Erfinderin

Creative Camps: Ferienlager mit Kunst und Wissenschaft

[www.plantsciences.uzh.ch/de/outreach/ferienlager.html](http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html)

Video produced by Science et Cité: <https://www.youtube.com/watch?v=AgHsnQM62yU>

## **4. Delays and deviations**

In the original grant application 15 scientists were named – of these 8 participated in the project and 7 did not. An additional 16 scientists not named in the grant application did participate, bringing the total of participating scientists to 31. This occurred for reasons of availability of the researchers at the required time or an unavoidable change in circumstances.

#### **Table 2: Overview on output goals and their achievement**

<b>Activity</b>	<b>Output in qualitative terms</b>	<b>Output in quantitative terms</b>	<b>Output goals achieved</b>
<i>Creative Workshops</i>	<i>Hands-on experiments combining creative and inquiry-based activities</i>	<i>Development of 12 workshops at minimum, each workshop will be performed twice with 10-15 participants on average (250+ in total)</i>	<i>Yes with over 3000 participants</i>
<i>Holiday Camps</i>	<i>Creative and social outdoor learning environments</i>	<i>One camp last 5 days, with one workshop activities of 3 to 4 hours per day, ca 20 participants per camp, 8 camps in minimum</i>	<i>Yes (one residential camp was replaced by a series of day camps)</i>
<i>Documentation</i>	<i>Protocols, guidelines, teaching (video) materials and best-of examples</i>	<i>1 Do it yourself Manual online available and 1000 printed issues</i>	<i>Yes – Open Access Book (only 70 prints because of high print costs) 3 Videos 1 Scientific paper 1 Activity magazine</i>
<i>Facilitation</i>	<i>Camp leaders and educators will be introduced to the use of the workshop modules and give feedback</i>	<i>4 x half day day workshops. 10- 15 participants per workshop (60+ in total)</i>	<i>Yes with delay: All workshop leaders received in person training (5 participants) 2 Workshop were carried out with workshop leaders (45 participants). A one-day teacher training course has been developed and was postponed due to Corona but has been rescheduled for 7.9.20 with 35 teachers.</i>

## 5. Schedule and milestones

**Table 3: Milestones reached within the program duration**

### *Project management*

2017-2020	<i>Financial &amp; HR administration, SNSF reporting (MD)</i>
2017-2020	<i>Integration into PSC initiatives, additional fundraising, sustainability (MD, board)</i>
2017-2020	<i>Program monitoring and evaluation (MD, JS, board)</i>

### *Workshop development, performance and evaluation*

2017-2020	<i>Workshop development (Scientists, JS, artists in residence, pedagogical expert)</i>
Continuous	<i>Organisation of camps (JS, Science et Cité, Zürcher Schülerferienstiftung, others)</i>
Continuous	<i>Workshop performance in camps as well as at the Fascination of Plant Day, Scientifica, Treffpunkt Science City (JS, student helpers, artist in residence)</i>
Continuous	<i>Workshop evaluation (JS, bachelor students of Art Education, board)</i>

### *Project advertisement & documentation*

May 2017	<i>Establish corporate identity, incl. website (MD)</i>
Continuous	<i>Program advertisement (MD, JS, camp organizers)</i>
2018-2020	<i>Facilitation (JS, camp organizers)</i>

Aug 2020	<i>Do-it-yourself Manual printed and distributed</i>
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MD: Manuela Dahinden, RK: Romy Kohlmann, JS: Juanita Schläpfer

## 6. Sustainability of the program after Aug 2020

We developed learning materials for informal science education that facilitate creativity, scientific literacy and critical-thinking. We have disseminated the learning materials among educators and practitioners of holiday camp organizers and providers of out of school programs at universities, and also science centers and museums. The content was developed so that there is a clear guideline of how to do the workshops, so that they can be easily reproduced.

### *Ongoing activities:*

- We will offer the developed workshop elements in holiday camps and public events such as the science festivals organized by ETH /UZH as well as part of the newly established [www.creativelabz.ch](http://www.creativelabz.ch). Financed by the Drosos Foundation, the CreativeLabZ aims towards socially disadvantaged teenagers. Running from January 2018-2022 one of the goals is to establish a physical space where workshops and day camps can be held.
- The facilitation courses will continue – thus, encouraging the community of informal science educators to provide and further develop educational content and assessment criteria for creative and inquiry-based activities.
- The collaboration with the ZHdK will continue as in autumn 2020, 35 BAE students will come for a lab visit at the PSC. This is financed by the ZHdK. If BAE students wish to come to the PSC for an internship this will be in future subsidized jointly by the ZHdK and the PSC.
- With Science et Cité and Kovive we founded a national platform Netzwerk - Pop up Science, that aims to promote and implement science engagement opportunities for youth. We are currently seeking to attract sponsors.

## Achievements of members of the project team

The program was jointly managed by Dr. Manuela Dahinden (Managing director research and communications) and Dr. Juanita Schläpfer (Outreach Manager) of the Zurich-Basel Plant Science Center and Prof. Consuelo de Moraes from ETH Zurich. Dr. Juanita Schläpfer developed the workshops and carried them out embedding the research activities of the PSC scientists. She accompanied the mediation lab of the ZHdK (Vermittlungs Labor) and the internship of the art education students, coaching them in the development of activities for children. The program was supported by the effort

of PSC staff members: Romy Kohlmann (PSC finances and HR), Ulrike von Groll (Outreach Assistant). Dr. Alexandra Rosakis worked on the activity instruction manuals and publications. Central to the project was collaborations with researchers, listed in table 4 and further activities are listed in table 5.

**Table 4: Participating researchers**

Date	Description Activity	Scientists / Science Communicator	Location	Nr. Participants	ZHdK Students
<b>Lab Visits - Incubator for Mediation Lab</b>					
22.09.17	Lab visit	Prof. Consuelo de Moraes, PD Dr. Diana Santelia, Prof. Loïc Pelissier, Prof. Joop Vermeer, Prof. Clara Sanchez,	UZH & ETH Zurich	28	BAE Class
21.09.18	Lab visit	Group of Prof. Kentaro Shimizu: Lucas Mohn, Group of Johan Six: Dr. Anette Hoffmann	UZH & ETH Zurich	30	BAE Class
20.09.19	Lab visit	Group of Prof. Antia Rodrigriez, Dr. Alexandra Rosakis, Group of Prof. Samuel Zeeman: Dr. Barbara Pfisterer, Florian Galbier	ETH Zurich	32	BAE Class
<b>Lab visits and input meetings with scientists for ZHdK students internship</b>					
29.01.18	Meeting to discuss Internship and content of workshops	J. Schläpfer, Mina Karrer, Joyce Kalubma, Diana Santalia and Sabrina Flütsch	UZH		Mina Karrer, Joyce Kalumba
29.01.18	Meeting to discuss Internship and content of workshops	J. Schläpfer, Mina Karrer, Joyce Kalubma, Joop Vemeer and Vinay Shekhar	UZH		Mina Karrer, Joyce Kalumba
08.02.18	Meeting to discuss Zug Schiff Lager	J. Schlaepfer, Jenny Flück, Kovive	Zug		Mina Karrer, Joyce Kalumba
12.02.18	Meeting to discuss Internship and content of workshops	J. Schläpfer, Mina Karrer, Joyce Kalubma, Consuelo De Moraes	ETHZ		Mina Karrer, Joyce Kalumba

Achievements of members of the project team

12.02.18	Meeting to discuss Internship and content of workshops	J. Schläpfer, Mina Karrer, Joyce Kalubma, Loic Pelliesser group Gulia & Oskar	ETHZ		Mina Karrer, Joyce Kalumba
15.03.18	Organising Lab visits	J. Schläpfer, Mina Karrer, Joyce Kalubma, Corrine Hertaeg & Fotieni Paschalidou	ETHZ		Mina Karrer, Joyce Kalumba
22.03.18	Lab visit with Fotieni	J. Schläpfer, Mina Karrer, Joyce Kalubma, Consuelo Lab & Harriert Lambert & Nina Stanczyk	ETHZ		Mina Karrer, Joyce Kalumba
29.03.18	Lab Visit & Insect Collection of the ETH	J. Schläpfer, Mina Karrer & James Sims, Michael Greeff	ETHZ		Mina Karrer, Joyce Kalumba
12.04.18	Lab visit	J. Schläpfer, Mina Karrer, Joyce Kalubma, Conseulo Lab Tobias Löser & Hannier Pulido	ETHZ		Mina Karrer, Joyce Kalumba
17.04.18	Testing flower chromatography in lab	J. Schläpfer, James Simms	ETHZ		Mina Karrer, Joyce Kalumba
23.04.18	Testing flower chromatography in lab	J. Schläpfer, James Simms	ETHZ		Mina Karrer, Joyce Kalumba
17.05.18	Lab visit	J. Schläpfer, Mina Karrer, Joyce Katubma, Jichang Zhang	ETHZ		Mina Karrer, Joyce Kalumba
24.05.18	Lab visit Botanical Institute	J. Schläpfer, Mina Karrer, Joyce Kalubma, Vinay Shekhar, Sabrina Fluetsch	UZH		Mina Karrer, Joyce Kalumba
31.05.18	Lab visit Botanical Institute	J. Schläpfer, Vinay Shekhar,	UZH		
13.06.18	Meeting to discuss Festspiel event	J. Schläpfer, Prof. Christoph Küffer, Kevin Vega (FHS Rapperswil)	ETHZ		
14.06.18	Lab visit Botanical Institute	J. Schläpfer, Milica	UZH		

## 7. Impact analysis and evaluation

In order to evaluate art-science hands-on activities and experiments with children and adolescents, observation criteria have been compiled from the "Learning Dimensions Framework" from The Exploratorium (2013) and "Beurteilen und Bewertung im Kunstunterricht" Georg Peez (2008) and "Didaktische Reflexion eine Ästhetische Analyse" Renate Lerch, ZHdK (2017, unpublished). The observation criteria use the analysis levels of process, social scaffolding, product, development of understanding, and experience. The observation matrix is filled out by the facilitator or an observer by participant observation, during, or shortly after an art-science activity with youngsters. (see Appendix 2)

This project requires reflection on a number of levels. Firstly on the methods of collaboration between the art educators and the scientists/science communicators. This has been partly addressed in the results, section 3 above. There are clearly goals shared by the disciplines. These may be phrased differently but amount to the desire to engage people in a sense of wonder in the natural world which will lead to further lines of inquiry.

The two phases of the collaboration can be reflected upon separately as the target group for each phase is different. In the first phase the art students are the target group (mediation laboratory) and in the second phase they become the facilitators for the next target group – children in summer camps or adults in exhibitions.

### 7.1 Reflections on the mediation laboratory

The art education lecturer reflected that for her it was a success that the scientific input had provoked a phenomenologically genuine mediation approach in aesthetic education. Phenomenologically genuine communication is a creative process. It is based on a "real-time experience", a participation in phenomena that occur immediately, are colored according to the situation and can amaze learners. It starts with a search for elements that can be linked to previous experiences and elements that are new. This requires those involved to engage with phenomena with all their senses and to explore the matter in an exploratory and reflective manner. Finally, it awakens questions and ideas.

### 7.2 Effects on the target groups: Building relations between teachers and learners

- Brings learners and teachers to where things are happening, e.g. into nature, into the research laboratory, into the museum.
- Involves teachers and learners equally as learners and teachers.

- Builds on a shared experience and shares aesthetic experiences.
- Conveys people with different requirements (laypersons / experts, young / old, teachers / learners), phenomena that fascinate them and arouse their curiosity.
- Lets teachers and learners develop concepts to follow up these questions and concerns.
- Pursues these concepts thinking and acting - practical discussions alternate with scientific studies.
- Establishes everyday theoretical and cultural references.

### **7.3 Elements that facilitate the learning process**

- Considers processes and results in a reflexive language-finding process.
- Clarifies questions with a high sense of meaning for the learners by means of in-depth investigations and substantive research
- Enables the further development of interim results and knowledge.
- Supports the exchange of decision-making steps with learners and teachers and their linguistic and creative formulations.

*We held the hypothesis that the combination of art and science education facilitates inquiry and creativity among young people and impacts students' learning and problem solving.*

### **7.4 Observations Case study I**

Plant colour extraction and Hapazome (Japanese printing technique) was carried out in the Botanical Garden, Zurich (BG) spring festival with a mixed audience of families, and at the Guggachbrache (GW) a day camp with children aged 8-14 and summer camp "Research Expedition on the yellow ship" (RE) with children from disadvantaged backgrounds aged 8-13 and as part of a Monoprints workshop at the FHS Rapperswil (FHS) with children and students.

Participants were able to make connections to previous knowledge: for example, children had done paper chromatography with felt pens so they recognized the plant chromatography (BG). Children had an astounding previous knowledge of edible plants and wanted to share this knowledge with others (GW). The observation matrix has so far encouraged reflection on the part of the facilitators for example under the criteria "connecting to prior knowledge including MINT concepts" the facilitator noted, "I was fascinated that many of the children had a large previous knowledge of plants including edibles, which they encouraged other children to help them search for".

This in contrast with the children from the summer camp who indicated no signs of previous knowledge or concepts (RE).



The hapazome process had potential for self-reflection and trying new methods “The colours on the paper were not always the same as in the flowers, this inspired thinking about plant dyes” (BG) or combining the two printing techniques (HSR). One facilitator noted that children often just tried out things for themselves without asking whereas adults asked more questions (BG). Interestingly self-reflection occurred in the children from the camp during the hands-on phase as the facilitator interpreted as they then had direct feedback from the materials. Regarding materials, it was always fascinating to see that with just a few materials or simple instruments the children would make up their own research projects – such as putting a snail on a measuring tape to see how far it moved in a minute and then recording this in their self-made research books (GW). The researcher notebook which the children bound themselves provided a space for notes and drawings, and reflection on the materials and processes.

### **7.5 Observations Case Study II**

The «one to one» activity in the Kunsthalle Zürich was held within the context of an exhibition “100 ways of seeing”, contrasting observation processes in art and science. Participants were mostly adults, and it was indeed sometimes challenging for children to have the verbal skills to make the interaction “work”. (but a good exercise to develop these skills). Adult participants appreciated the “ah-ha” effect when they realized their partner had the same object, and reported that it did make them think about how heavily they relied on visual information in their lives. And how quickly they made a judgement from a photo about an object’s properties even if the information was incomplete – they were extrapolating from previous knowledge. As observers we noticed that the activity worked better when the objects were unfamiliar, such as an exotic fruit they had not seen before.

### **7.6 Observations Case Study III**

Camp: Superhero Plants. This week-long camp enabled an exploration of plant biology using simple experiments with familiar materials. A focus on individual characteristics such as water transportation, photosynthesis, and interaction with insects allowed a conceptual disassembly of the plants, which in turn led to an artistic mechanical sculptural installation. For example, plants can communicate with each other and with other species via messenger substances (volatile aerosols). If a cucumber is attacked by a pest, such as a spider mite, it releases a substance that attracts an enemy of the pest, a predatory mite. The rescuer summoned by the plant eliminates the pest. With this so-called tritrophic interaction in mind the children created a microcontroller (microbit) alarm system for their mechanical plant using a programmable Thymio robot as the savior of the plant.

Concepts of scientific methods and plant biology were introduced through the plant experiments and then the children built their own Superhero plant sculptures using microcontrollers and recycled and found objects. It was observed that participants were engaged in reflective language, asked in-depth scientific questions about photosynthesis, for example and co-created complex constructions with facilitators and the other children.

### **7.7 Impact analysis**

Through working with the foundation Kovive, and the Sport and Education Department of the City of Zurich, we were able to engage with children and youth from socially and economically disadvantaged backgrounds. We observed a high level of engagement with the activities we designed as whilst providing a structure and input, the facilitators enabled room for creative exploration and questioning. Simply the act of inquiry by itself was important to children who saw themselves as researchers, aided by the performative structure of lab coats and real scientific instruments.

The activities developed were supported by guiding key questions from the course leaders to the participants (such as *How do we tell the difference between natural and artificial?* Addressed in the Zoom-in Zoom-out exercise two. Or *What information do we obtain from different research and data recording methods?* Such as fish morphology or DNA extraction.) questions that foster discovering in small groups and include cognitively activating forms of learning such as metacognitive questions and space for self-explanation, followed by peer-discussion. Art and science educators and scientists shared the supervising of young people during the camp activities. We experienced that the presence of scientists facilitates a deeper engagement of young people with science and the potential for the development of new dispositions, understandings, and directions. For example, on the last day of the nature adventure camp the children had many follow up questions about photosynthesis after spending the previous day with two plant biologists.

The reaction of the workshop participants was assessed by means of the observation framework which we developed by combining methods from hands-on science activity evaluation and from art education evaluation processes. We were able to show that the participants did have a high degree of engagement with the activities – working on a project for an extended period, trying their own methods, inventing their own scientific projects. The limitation of this evaluation method is that it is very much in the moment and does not compare pre- and post-activity knowledge, nor does it allow for a control group.

## 7.8 Lessons learnt

We propose the integration of informal science with art education for children and adolescents. We recommend a focus on practice in spaces of transdisciplinary learning that have a broad appeal to young people. It is important to ensure art-science activities are collaborative and involve diverse student groups. This can help to nurture open and inclusive behaviors in students. An example of activity could be organizing an exhibition centered around the results of a recent research project, inviting school staff and students, parents, representatives of the local community and even experts on the topic.

However, productive collaborations between science communicators and art educators requires time and resources. Time is required to build up trust and relationships with the lecturers and the internship and supporting the art education students to develop activities.

We consider out-of-school programs, such as summer camps or afterschool programs, as highly important to provide the described learning frameworks. These programs generally have lower student-to-teacher ratios and the potential ability to spend more extended time on one activity or set of activities, because of the lack of pressure to cover a broader curriculum. In the Swiss informal learning system we have the additional advantage that city run holiday activities include children from all social backgrounds.

The Durham report on Creativity in Education recommended a network of Creativity Collaboratives to support schools, but this should be 'complemented by diverse routes to take part in creative activities outside of school hours.' (James et al. 2019 p 25).

In summary we recommend an improvement of quality and choices of informal science education programs, by developing inquiry and creativity-based learning material for young people. We recommend evaluating the impact of art in informal science education and facilitating the use of new learning materials among providers of out of school activities. We also suggest the establishment of networks to promote the long-term establishment of creative learning environments (e.g. Wissenschaftsferien Schweiz).

Improving scientific education and making scientific careers more attractive for young people will nurture the researchers of the future. It will also create informed citizens equipped with the skills, knowledge and creativity to engage with culture and science, and to make informed decisions about the environment they live in.

## 8. Detailed description of activities

Table 5. Activities coordinated and carried out by the program

Date	Description Activity	Scientists / Science Communicator	Location	Nr. Participants	ZHdK Students	Collaborators
<b>Creative Camps</b>						
7-12.8.17	Science Adventure Camp	Olivia Wassmer	Beatenberg	26		Stiftung Zürcher Schulferien
05.05.18	Day camp: Bio communication	J. Schläpfer	Brache Guggach	15	Mina Karra und Joyce Kalumba	Verein Guggach Brache
12.05.18	Day camp: Bio communication	J. Schläpfer	Brache Guggach	12	Mina Karra und Joyce Kalumba	Verein Guggach Brache
19.05.18	Day camp: Bio communication	J. Schläpfer	Brache Guggach	12	Mina Karra und Joyce Kalumba	Verein Guggach Brache
16-19.07.18	Holiday camp: Forscherreise auf dem Yellow	J. Schläpfer	Zugersee	25	Mina Karra und Joyce Kalumba	Science et Cite, Kovive
8-12.8.18	Holiday camp: Science Adventure Camp, Zoom- in, zoom-out	J. Schläpfer, Edi Bruderer, Sabrina Fluetsch, Olivia Wassmer	Beatenberg	25		Stiftung Zürcher Schulferien
8-13.10.18	Holiday camp: Cyberkids	Sandra Unterschütz	Magliaso	20		Stiftung Zürcher Schulferien
14-19.7.19	Holiday camp: Forscherreise auf dem Yellow	J. Schläpfer	Zugersee	24		Science et Cite, Kovive
12-17.8.19	Holiday camp: Science	J. Schläpfer, Olivia Wassmer	Beatenberg	abgesagt		Stiftung Zürcher Schulferien

	Adventure Camp,					
7-12.10.19	Holiday camp: Cyberkids	Moritz Rövencamp, Sandra Unterschütz	Magliaso	25		Stiftung Zurcher Schulferien
<b>Bugnplay</b>						
09.05.18	Jury Sitzung Bugnplay - Vergabe Greenbug	Dr. Juanita Schläpfer	Migros Kulturprozent	200		Migros Kulturprozent
09.06.18	Tinkering Workshop anlässlich der Bugnplay Preisverleihung	Sandra Unterschütz	Migros Kulturprozent	50		Migros Kulturprozent
13.05.19	Jury Sitzung Bugnplay - Vergabe Greenbug	Dr. Juanita Schläpfer	Migros Kulturprozent	150		Migros Kulturprozent
<b>Treffpunkt Science City</b>						
19.11.17	Workshop: Big Data	Dr. Juanita Schläpfer, Dr. Christoph Küffer, Kevin Vega	ETH Hönggerberg	500		ETH Zurich
18.11.18	Workshop: Big Data	Kevin Vega	ETH Hönggerberg	600		ETH Zurich
<b>Science Fairs</b>						
1-3.9.2017	Scientifica: was Daten verraten	Dr. Juanita Schläpfer, Dr.	ETH Zentrum	3000		ETH Zurich / UZH

		Christoph Küffer, Kevin Vega				
29.04.18	Frühlingsfest Botanische Garten	Dr. Juanita Schläpfer	Botanische Garten, Zürich	600	Mina Karra und Joyce Kalumba	Botanical Garden / UZH
20.06.18	Festspiel Zurich, Münsterhof	Dr. Juanita Schläpfer, Dr. Christoph Küffer, Kevin Vega	Zurich, Munsterhof	25		City of Zurich
23.09.18	100 Ways of Thinking - Zoom in Zoom Out	Dr. Juanita Schläpfer	Kunsthalle Zürich	60	Mina Karrer	UZH, Kunsthalle Zürich
23.09.18	100 Ways of Thinking – 3D Cells	Dr. Celia Baroux	Kunsthalle Zürich	150		UZH, Kunsthalle Zürich
01.09.19	Scientifica: Science Fact or Science Fiction	Dr. Juanita Schläpfer, G. Bruhweiler, S. Unterschütz, E. McDonald	ETH Zentrum	60		UZH/ETH
<b>Tinkering Workshops</b>						
13.02.18	Bionik Bugs Workshop	Dr. Juanita Schläpfer, Natascha und Sandra		16		Zoological Museum
09.06.18	How to design tinkering workshops	Dr. Juanita Schläpfer, Ryan Jenkins (CA) and Rannei		30		ECSITE Conference, Geneva

		Simonsen (Norway)			
13.02.19	Bionik Bugs Workshop	Dr. Juanita Schlöpfer, Natascha und Sandra Unterschütz		15	Zoological Museum, UZH
08.04.19	Space Kids Workshop	Dr. Juanita Schlöpfer, Giana Brühweiler, S. Unterschütz		25	Uni Bern, mit Science et Cite
08.06.19	Tinkering with natural materials	Dr. Juanita Schlöpfer		15	ECSITE Conference, Copenhagen

Table 6. Detailed description of contents and scientific themes

Title	Content	Link to research or scientific and artistic concept
<b>Biocommunication</b>		
Learning objectives: <b>Observing</b> and learning from nature / <b>Exploring</b> how plants to interact with their environment / <b>Get an insight</b> how and why plant scientists study cell-cell, plant-plant and plant-insect interactions / <b>Understanding</b> the relation between plant morphogenesis and function / <b>Increase senses</b> with body extensions / <b>Reflect</b> on daily life activities and develop ideas for responsible actions		
Zoom-in-zoom out	Looking at plants from the micro to the macro level. <ol style="list-style-type: none"> <li>1. Leaf peels and starch production in plant cells – some elements of basic plant biology linking to plant research at the micro level.</li> <li>2. Self-made drone to survey the mountain landscape, using weather balloons and old digital</li> </ol>	Role of Stomata opening in adaptation to drought and heat – linking climate change to research on plant productivity (Diana Santelia, molecular biologist at ETH Zurich).  Drones are increasingly used in scientific research from ecology to agriculture. E. g. ecologists can measure plant range shift resulting from climate change (Loic Pelissier, professor for landscape ecology at ETH Zurich) or biodiversity hot spots, important for land use decision making (Jaboury

	cameras. Encourage design-thinking and recycling/repurposing materials.	Ghazoul, professor for ecosystem management at ETH Zurich). Drones are also used in citizen science to survey environmental degradation and pollution events such as oil spills.
Zoom-in-zoom-out Exercise Two	Macro and micro images of plants and insects. One exercise was to guess what image was from micro-image, other activity was to finish partial image and imagine what it could be – either “real” or an imaginary plant.	Images and imaging processes are central to plant science research. Inspired by confocal microscopy images from Joop Vermeer (UZH). Art and design is also inherently concerned with imaging and various types of information gained from differ.
Flower power through colour	<p>The link between flower colour and defence against insect predators. Different colour flowers of <i>Solanum eleagnifolium</i> emit different volatiles and have different chemical compounds. We did colour chromatography of these plants to tell this story.</p> <p>Extracting pigment from plants: We developed a method for simple colour extraction from plants. These pigments were then used in the next activity.</p> <p>Plant Colour mixing: On specially designed postcards participants painted pigments of their choice. They then took these colour samples and went out into the garden and found leaves or flowers that matched their colour sample. They then drew the plant on the postcard. There was a space on the postcard and a poster for naming the colour that they had mixed.</p>	<p>Plant colours play an important role in research on pollination (Florian Schiestl, professor for evolutionary ecology and Philipp Schlüter, University of Zurich) but also evolutionary research (Kentaro Shimizu, professor for evolutionary genomics at University of Zurich) and the development of new species.</p> <p>Research lab of Consuelo de Moraes, professor for biocommunications and entomology at ETH Zurich studies the effect of volatiles on plant-insect interactions. James Sims, plant biochemist at ETH Zurich extracts volatiles by GC/MS:</p>
A sense of smell	Using plastic water bottles, we created mosquito traps using a dirty sock from	Plants emit perfume that insects can perceive and mosquitos can also “smell humans”. In the lab of



	each child to see who was the most attractive to mosquitos. The traps were left for a week outside at the research station.	Consuelo de Moraes, professor of biocommunications and entomology at ETH Zurich they use human feet scent in the wind tunnel to evaluate which scent molecules the mosquitos are attracted to.
Binding own researcher notebook	Book binding activity with good quality sketch paper. We discussed artist/naturalists such as Maria Sibylla Merian and looked at her images. Children created their own illustrations of plants and insects from observation in the field.	Both artists and scientists keep sketch and note books, binding your own gives a different sense of attachment for children to fill their own book. We looked at diagrams of plant-insect interactions from the group of Consuelo de Moraes (ETH Zurich).
Hapazome	This is an old Japanese plant printing technique, new repurposed. Grasses and flowers can be hammered onto cloth or heavy cardboard creating beautiful patterns and prints.	Inspired by the colour extraction work of James Sims, group of Consuelo de Moraes (ETH Zurich).
Bionic-Bugs	Combining input on plant and animal Bionics from the Zoological Museum we created a multidisciplinary workshop including electronics. Participants could solder their own solar jitterbug.	Inspired by insect collection at ETH Zurich, curated by Consuelo de Moraes (ETH Zurich) – plant insect interactions.
<p><b>Ecological Networks</b></p> <p>Learning objectives: <b>Observing</b> and learning from nature / <b>Get an insight</b> how plant scientists investigate ecological networks from gene to landscape level / <b>Understanding</b> ecosystems as a complex and vulnerable system / <b>System thinking</b>: what happens in a system if one component radically changes? / <b>Tipping Point</b>: Introducing ecosystems as systems that are so highly complex that they cannot be controlled at a certain point, if one element reaches a critical status, then there is no return and an entire system may collapse / <b>Develop</b> an understanding on how to keep the balance? / <b>Reflect</b> on daily life activities and develop ideas for responsible actions</p>		
DNA Pairs card game	Fish pairs card game, idea is to match pairs by morphology, DNA or shape.	Game developed with the research group of Loïc Pelissier, professor of landscape ecology at ETH

	Comparing fish relatives is not always easy and there are some genetic surprises.	Zurich. His research involves looking at the evolutionary genetic links between diverse fish populations.
Nature treasure hunt	Part one - Participants had to find natural objects in the landscape. Part two – groups hid different treasure boxes for each other and created a treasure map using compass directions or a GPS device.	Hidden learning was orientation in the landscape, directions, how to use a compass and GPS device. How to create a map and instructions for another group to follow. All necessary skills for budding field scientists.
One-to-one	Participants sit back to back and describe an object or photo before them for 1 minute without saying the name of the object. We used various familiar and unfamiliar fruits, tools etc. At the end it was revealed that each pair had the same object or a photo of that object.	This activity was inspired by the research of Loïc Pellisier (ETH Zurich) who images fish rather than take samples, and necessarily killing them. The art students were fascinated by the concept of information available from a photo versus the actual object.
<b>Design of Nature</b> Learning objectives: <b>Understanding</b> the interconnection of form and function / <b>Distinguish</b> between natural and artificial / <b>Shifting perspectives</b> from learning about nature to learning from nature: <b>How would nature solve this?</b> / <b>Get an insight</b> how plant scientists investigate plant structures and how engineers get inspired by nature / <b>Design</b> your own prototype		
Plant capsules for the moon	What could we eat on the moon? What could we grow first? We created capsules for plants to grow on the moon.	Plants in micro gravity research from Lorenzo Borghi, plant and microbial biologist at University of Zurich.
Chain-reactions in nature	Beans planted in plaster to show the power of plants, Plants in glass containers producing O <sub>2</sub> which was then collected Cola-Mentos Rocket (sugar and acid) Corn starch and water Mix (Non-Newtonian fluid) Sugar and salt dough showing electrical conductivity.	A fun science and art chain reaction using biological and mechanical phenomena to create a Fischli-Weiss inspired event. (Swiss artist duo who made famous film <i>The way things go</i> ) Inspired by research on starch metabolism of Diana Santelia's group at ETH Zurich.

	Copper tape circuits with voice chip recordings.	
Superheroes	Build your own plant – recycling of waste packaging (e.g. Mimose)	Inspired by research on Phloem development of Antia Rodriguez, professor for plant development at ETH Zurich.
Faltungen & phyllotaxis	The Miura fold is a special form of Origami, where a flat structure is folded into a small space.	This folding technology is important in nature for example in ladybugs, who stow their skin wings under the cover wings. The principle of miura folding also comes in plant leaves albeit in a simplified form. Most plant species have leaves in the bud folded or rolled to save space.

## 9. Promotional measures

A logo used on websites, letterheads and all printed materials established cooperate identity and visibility. We advertised the program, camps and DIY- Book at the websites of all project partners. The camps were advertised in established channels of the camp organizers as well as by direct advertising to the schools and community centers.

**Table 7. Overview on promotion of PSC Creative Camps**

Date	What	Copies	Collaborator
<b>Newsletters</b>			
2017	PSC Newsletter (spring and fall)	500 each	
2018	PSC Newsletter (spring and fall)	500 each	
2019	PSC Newsletter (spring and fall)	500 each	
2020	PSC Newsletter (spring and fall)	300 each	
<b>Websites</b>			
Since 2017	<a href="http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html">www.plantsciences.uzh.ch/de/outreach/ferienlager.html</a>		
Since 2018	<a href="http://www.creativelabz.ch">www.creativelabz.ch</a>	10'000 visitors with 50'000 visits so far	

Mar 18/ 19/ 20	Ausschreibung Workshop auf Website des Schul- und Sportdepartements der Stadt Zürich (SSD Stadt Zürich)	ca. 50,000 Familien	SSD Stadt Zürich
<b>Social Media</b>			
Mar 18	Facebook event on PSC page		
Mar 18	Facebook event on ETHZ page		HK ETHZ
Mar 18	Facebook event on UZH Graduate Campus		UZH
<b>Versand von PR Material</b>			
Jan 18	Ausschreibung Workshop im "Fit und Ferien" Broschüre des Schul- und Sportdepartements der Stadt Zürich	30,000	SSD Stadt Zürich
Mar 18	Flyers verteilt an Treffpunkt Science City	200	TPSC ETHZ
Mar 18	Versand an Teilnehmer Bionic Bugs Workshop	16	
Mar 18	Flyers Verteilt an Partnern:		
Mar 18	Bugnpay – elektronischer Versand Newsletter und Website	2000	
Mar 18	Life Science Learning Center (LSLC)	50	UZH/ETHZ
Mar 18	Science Lab	50	UZH
Mar 18	Science et Cite	50	
Mar 18	Schul – und Sozialarbeit Stadt Zürich	50	SSD Stadt Zürich
Mar 18	ZHdK	150	
Mar 18	Gemeinde Zentren (GZs) der Stadt Zürich	150	
Mar 18	ETH KIDZ E-Versand an Eltern	200	
Mar 18	Versand PSC Lehrer Kontakts	100	
Mar 18	Kinder Universität	30	UZH
	Lola Brause?	1300	
May 18	Creative Camp Flyers verteilt	250	
Jun 18	Creative Camp Flyers verteilt - Museums und GZs	150	
Sep 18	Creative Camp Flyers verteilt - Museums und GZs	80	
Apr 18	neue Flyer für den Workshops erstellt		
Mar 19	Flyers verteilt an Treffpunkt Science City	200	
Mar 19	Bugnpay - elektronischer Versand Newsletter und Website	2000	
Mar 19	LSLC	50	UZH/ ETHZ
Mar 19	Science Lab	50	UZH
Mar 19	Science et Cite	50	

Mar 19	Schul. und Sozialarbeit Stadt Zürich	50	SSD Stadt Zürich
Mar 19	ZHdK	150	
Mar 19	GZs der Stadt Zürich	150	
Mar 19	ETH KIDZ E-Versand an Eltern	200	
Mar 19	Versand PSC Lehrer Kontakts	100	
Apr 19	Kinder Universität	30	
May 19	Creative Camp Flyers verteilt	250	
Jun 19	Creative Camp Flyers verteilt - Museums und GZs	150	
Jul 19	Creative Camp Flyers verteilt - Museums und GZs	80	
Jan 20	neue Flyer für den Workshops erstellt	200	
Feb 20	Creative Camp Flyers verteilt - Museums und GZs	200	
July 20	Open Access Creative Camps Book	70	
<b>Presentations</b>			
10.Apr 17	Minisymposium: Public engagement with science - relevance and methods	20 PhD students	
04.Jun 18	ECSA Citizen Science: Speedtalk Wo Samen Fallen	200 Participants	
11. Jun 2019	Ecsite International Science Communication Conference, Speed talk - Creative science communication	1000+ participants	
<b>Print Media</b>			
Juni 2018	ETH Globe article about Camps	25,000	
Sep.18	ETH Globe article advertising Cyberkids Camp	25,000	
<b>Videos</b>			
Feb.19	Creative Camps: Die Natur ist die allerbeste Erfinderin <a href="http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html">www.plantsciences.uzh.ch/de/outreach/ferienlager.html</a>		
17.07.18	<a href="http://www.srf.ch/news/regional/zentralschweiz/zugang-zu-wissenschaft-foerdern-forschungsreise-fuer-kinder-auf-hoher-see">www.srf.ch/news/regional/zentralschweiz/zugang-zu-wissenschaft-foerdern-forschungsreise-fuer-kinder-auf-hoher-see</a>		
19.07.19	<a href="http://www.zeitung.ch/2019/0719/Abenteuer-auf-dem-gelben-Zuger-Schiff-Luzerner-Zeitung">2019/0719, Abenteuer auf dem gelben Zuger Schiff, Luzerner Zeitung</a>		
May.20	Creative Camps: Ferienlager mit Kunst und Wissenschaft <a href="http://www.plantsciences.uzh.ch/de/outreach/ferienlager.html">www.plantsciences.uzh.ch/de/outreach/ferienlager.html</a>		

## 10. References

*Barron, Brigid, and Linda Darling-Hammond (2008): "Teaching for Meaningful Learning: A Review of Research on Inquiry-Based and Cooperative Learning. Book Excerpt." George Lucas Educational Foundation*

SNSF Research projects that we did address:

<http://p3.snf.ch/project-163145> – Prof. Consuelo de Moraes, ETH Zürich

<http://p3.snf.ch/project-159767> – Prof. Kentaro Shimizu, Universität Zürich

<http://p3.snf.ch/project-172988> – Prof. Florian Schiestl, Universität Zürich

<http://p3.snf.ch/project-155943> – PD Dr. Philipp Schlüter, ehemals Universität Zürich, jetzt Universität Hohenheim

<http://p3.snf.ch/project-160004> – Ass. Prof. Péter Szövényi, Universität Zürich

<http://p3.snf.ch/project-163145> – Prof. Consuelo de Moraes, ETH Zürich

<http://p3.snf.ch/project-166539> – PD Dr. Diana Santelia, ETH Zürich

<http://p3.snf.ch/project-185241> – PD Dr. Diana Santelia, ETH Zürich

<http://p3.snf.ch/project-162604> – Ass. Prof. Loïc Pellisier, ETH Zürich

<http://p3.snf.ch/project-184118> – Ass. Prof. Loïc Pellisier, ETH Zürich

<http://p3.snf.ch/project-177587> – Prof. Jaboury Ghazoul, ETH Zürich

<http://p3.snf.ch/project-184118> – Ass. Prof. Loïc Pellisier, ETH Zürich

<http://p3.snf.ch/project-169671> – Prof. Jordi Bascompte, Universität Zürich

<http://p3.snf.ch/project-179551> – Prof. Antia Rodriguez-Villalon, ETH Zürich

<http://p3.snf.ch/project-163065> – Prof. Clara Sánchez-Rodríguez, ETH Zürich

<http://3.snf.ch/project-157524> – Prof. Joop Vermeer, Universität Neuchatel

<http://p3.snf.ch/project-169546> – Prof. em. Enrico Martinoia, Universität Zürich

<http://p3.snf.ch/project-160326> – Prof. Christian Fankhauser, Universität Lausanne

<http://p3.snf.ch/project-169542> – Prof. Achim Walter, ETH Zürich

<http://p3.snf.ch/Project-160336> – Prof. Ueli Grossniklaus, Universität Zürich

<http://p3.snf.ch/project-182570> – Prof. Samuel Zeeman, ETH Zürich

## 11. Appendix I: Announcements of Creative Camps and Workshops

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### **Forscherreise auf der Yellow: So, 12. – Sa, 18. Juli 2020, Zug**

Kindercamp auf der MS Yellow / Zug

Eine Woche lang wohnen wir im schwimmenden Haus MS Yellow auf dem Zugersee. Zusammen mit dem Kapitän unternehmen wir spannende Schifffahrten auf hoher See und erkunden mit einem Forscherteam die Natur. So werden wir selber zu kleinen Forschenden! Wir geniessen die freie Zeit mit Spiel und Spass, bräteln am Feuer, bewegen uns viel und schwimmen im See.

Wann: So, 12. – Sa, 28. Juli 2020

Wo: auf der MS Yellow / Zug

Wer: Kinder von 8 bis 11 Jahre

Kosten: CHF 180.-

Anmeldung: Dieses Angebot richtet sich ausschliesslich an Familien mit einem niedrigen Netto-Jahreseinkommen. Anmeldung über [www.kovive.ch](http://www.kovive.ch)

Veranstaltungspartner: [Science et Cité](#), Kovive

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### **Forscherreise auf der Yellow: So, 14. – Sa, 20. Juli 2019, Zug**

Kindercamp auf der MS Yellow / Zug

Eine Woche lang wohnen wir im schwimmenden Haus MS Yellow auf dem Zugersee. Zusammen mit dem Kapitän unternehmen wir spannende Schifffahrten auf hoher See und erkunden mit einem Forscherteam die Natur. So werden wir selber zu kleinen Forschenden! Wir geniessen die freie Zeit mit Spiel und Spass, bräteln am Feuer, bewegen uns viel und schwimmen im See.

Wann: So, 14. – Sa, 20. Juli 2019

Wo: auf der MS Yellow / Zug

Wer: Kinder von 8 bis 11 Jahre

Kosten: CHF 180.-

Anmeldung: Dieses Angebot können nur Familien mit einem niedrigen Netto-Jahreseinkommen buchen. [www.kovive.ch](http://www.kovive.ch)

Veranstaltungspartner: Science et Cite, Kovive

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### **Adventure Camp: 12-17.8.2019, Beatenberg**

Das ist ein Lager für neugierige Entdeckerinnen und Entdecker, die sich gerne unter freiem Himmel bewegen. Wir erforschen die Natur, beobachten wilde Tiere und zahme Pflanzen, erkunden den Wald,

bauen Hütten und sammeln Beeren. Viel Spiel und Spass mit neuen Freunden ist garantiert.

Wann: **12-17.8.2019**

Wo: ZSF Lagerhaus Beatenberg

Wer: Klassen 3-6

Kosten: Nach Einkommen

Anmeldung: [www.zsf.ch](http://www.zsf.ch)

Veranstaltungspartner: Stiftung Zürcher Schulferien, Science et Cite

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### **Cyberkids – Tüftlerwoche, Intelligente Pflanzen (Lager): 07.10.-12.10.2019, Magliaso/TI**

In dieser Tüftler-Woche kannst du vieles selber ausprobieren. Wir bauen einfache elektronische Schaltungen, lernen dabei zu löten und lassen unserer Kreativität freien Lauf.

Ausserdem erforschen wir die Natur und deren Geheimnisse. Wir nutzen unsere Entdeckungen und Erkenntnisse für verschiedene Experimente, Spiele und Basteleien. Wir bauen gemeinsam ein grosses Spektakel, inspiriert von Technik und Natur.

Nebenbei bleibt genügend Zeit für Spiele mit neu gewonnenen Freunden und Ausflüge in der Umgebung.

Wann: 07.10.-12.10.2019

Wo: ZSF Lagerhaus, Magliaso/TI

Wer: Klassen 3-6

Kosten: Nach Einkommen

Anmeldung: [www.zsf.ch](http://www.zsf.ch)

Veranstaltungspartner: Stiftung Zürcher Schulferien, Science et Cite

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### **Space Kids, workshop: 8. - 10. April 2019, Bern**

Forschertage für Kinder und Jugendliche in Bern

Wir richten unseren Blick für drei spannende Tage ins Weltall. Dabei treffen wir Berner Weltraumexpertinnen und -experten des Center for Space and Habitability der Universität Bern und erfahren mehr über ihre aktuellen Weltraummissionen. Wir erforschen wie und was wir auf dem Mars anbauen könnten, um dort zu überleben. Welche Pflanzen wachsen auf dem Mars? Oder müssen wir uns von Sternenstaub und Mondkäse ernähren?

Wann: Mo, 8. – Mi, 10. April 2019, jeweils von 10:00 bis 16:30 Uhr

Wo: Universität Bern

Wer: Kinder und Jugendliche von 11 bis 14 Jahre



Kosten: CHF 30.-

Anmeldung: durch Kovive [www.kovive.ch](http://www.kovive.ch)

Veranstaltungspartner: Center for Space and Habitability der Universität Bern, Science et Cite, Kovive

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### **Bionic Bugs, workshop – 12 Feb 2019, Zürich**

Entdecke im Zoologischen Museum die tierischen Vorbilder der Technik und staune über den Erfindungsreichtum und die Raffinesse der Natur. In der Sonderausstellung «Insekten - lebenswichtig!» lernst du die Vielfalt der Insekten und ihren Nutzen für uns Menschen und die Umwelt kennen. Danach hast du Zeit zum Tüfteln und Experimentieren! Unter Anleitung baust du dir einen, mit einer Solarzelle betriebenen, elektronischen Käfer, den du natürlich mit nach Hause nehmen darfst.

Wann: Sportferien 2019, 1. Woche, Dienstag 12.2.2019 9.00–17.00 Uhr

Wo: Zoologisches Museum der Universität Zürich, Karl-Schmid-Str. 4, 8006 Zürich

Wer: Mädchen und Knaben, Jahrgänge 2006–2009

Kosten: CHF 50.–

Mitbringen: Mittagessen, Zwischenverpflegung

**Anmeldung:** vorbei. <https://www.stadt-zuerich.ch/sport-portal/angebot/ferienkurse>

Veranstaltungspartner: Zoologisches Museum der Universität Zürich und Stadt Zürich Schul- und Sport Department

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### **Creative Camp: Cyberkids, 8. - 13. Oktober 2018**

Dieses Lagerangebot ist ein Aufruf an alle die gerne tüfteln.

**Wann:** 8-13 Oktober 2018

**Webseite und Anmeldung:** über die Stiftung Zürcher Schülerferien [www.zsf.ch](http://www.zsf.ch)

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### **Forscherreise auf der MS Yello, 15. - 21. Juli 2018, Zugersee**

Eine Woche lang wohnst du im schwimmenden Haus «MS Yellow» auf dem Zugersee. In diesem Lager sind wir unterwegs auf dem See und an Land. Dabei experimentieren und tüfteln wir und untersuchen die Umgebung und ihre Lebewesen.

Kovive Camp Anmeldung, **Kontakt** Beatrice Trinklee

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### **Adventure Camp: Die Berge aus einer Drohnen Perspektive, 6. - 11. August 2018**

In diesem Ferienlager erforschen wir die Natur von nah und fern.

**Webseite und Anmeldung:** über die Stiftung Zürcher Schülerferien [www.zsf.ch](http://www.zsf.ch)

**Wann:** 6-11 August 2018

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### **Creative Camp: Feel the vibes – so reden Tiere mit Pflanzen**

**5., 12. und 19. Mai 2018 von 10 bis 15 Uhr, Guggach Brache Zürich**

Familien Aktivitäten für alle ab 7 Jahre.

Tiere und Pflanzen können nicht reden oder ein WhatsApp versenden, aber trotzdem können sie untereinander kommunizieren. Du möchtest wissen wie? Wir basteln und tüfteln, forschen und entdecken, um dies herauszufinden. Die Natur inspiriert uns kreativ zu sein.

An drei Samstag-Vormittagen werden wir auf der Guggach-Brache (Hofwiesenstrasse 187, 8057 Zürich) sein und auch zusammen Mittagessen.

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### **Bionik Bugs, 12. März 2018**

Baue dir einen fantastischen elektronischen Käfer und entdecke Innovation in der Natur. Du lötest einen mit Solarzellen angetriebenen Käfer, und natürlich kannst du ihn nach Hause mitnehmen.

In diesem ganztags Workshop hast du Zeit zum Tüfteln und Experimentieren und die Welt von Bionik im Zoologischen Museum zu entdecken.

**Wann:** 12. März 2018, 9-17 Uhr

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### **Cyberkids: zwischen Mensch, Maschinen und Natur. 9.–14. Oktober 2017**

Herbstlager im Tessin: Hören, sehen und spüren Pflanzen etwas? Wolltest du schon immer wissen, wie es sich anfühlt, ein anderes Lebewesen zu sein? Als junge Forschende gehen wir mit unseren selber gebauten Sinneserweiterungen auf die Suche nach den Geheimnissen der Pflanzenwelt. Wir üben jeden Tag Aikido mit einer Sensei und wir erfahren die Grenzen unserer eigenen Körperwahrnehmung. Wir bauen einfache elektronische Schaltungen, lernen dabei zu löten und erweitern mit ihnen unsere Sinne. Mit grösseren Ohren, farbigen Brillen, leuchtenden Fingern und selbengenähten elektronisch-leitenden Kostümen entwickeln wir zusammen ein Bakterien- und Pflanzentheater.

Inspiriert von [Hackteria and Swiss Mechatronic Art Society](#) und [Hackteria.org](#)

#### **Leitung:**

- Juanita Schläpfer, Zurich-Basel Plant Science Center
- Felix Banteli
- Andrea Pfisterer, Sensei, Kokoro Dojo

**Zielpublikum:** Junge EntdeckerInnen (3. - 7. Klasse).

**Wann:** 9. - 14. Oktober 2017

**Ort:** Ferienhaus der Stiftung Zürcher Schulferien in Maligiaso, Tessin

**Informationen:** psc-expeditionen@usys.ethz.ch

**Website und Anmeldung:** [Stiftung Zürcher Schulferien](#)

## 12. Appendix II: Evaluation matrix

Analysis levels	Indicators	Descriptions of learners' interactions	Observations of group and individuals
<b>Process and intention</b>	Spending time with activity	Play, envision, make, explore materials	
	Shows motivation	by trying new methods, by persisting despite difficulties	
	Self-reflecting	Describes and reflects on the process of making	
<b>Social Structures</b>	Connecting to the work of others	Notice and comment on work of others' Innovate by remixing others' ideas or strategies Physically connecting to others' work	
	Requesting/offering help	From facilitators or other participants	
<b>Product</b>	Realization of the input idea	To what extent is the suggestion completed or has the learner taken the idea further	
	Colour, form, composition, function	Possibly one or two of these criteria applicable	
	Manual competence	Ability to master technique and materials	
<b>Participants understanding and experience</b>	Expressing a realization	Showing excitement when realizing something	
	Offering explanations	Offering explanations for a strategy, tool or outcome	
	Applying previous knowledge	Connecting to prior knowledge, including MINT concepts	

	Striving to understand	Indicate not knowing, but remaining to work through confusion and build an understanding.	
	Asking questions	About content or form	