



# Can the Public Contribute to Plastic Pollution Policy-Making through Community Science? A vision for Participatory Legislation

Information Science Public Lecture, 19<sup>th</sup> of November 2024

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Photo by Débora Boratto

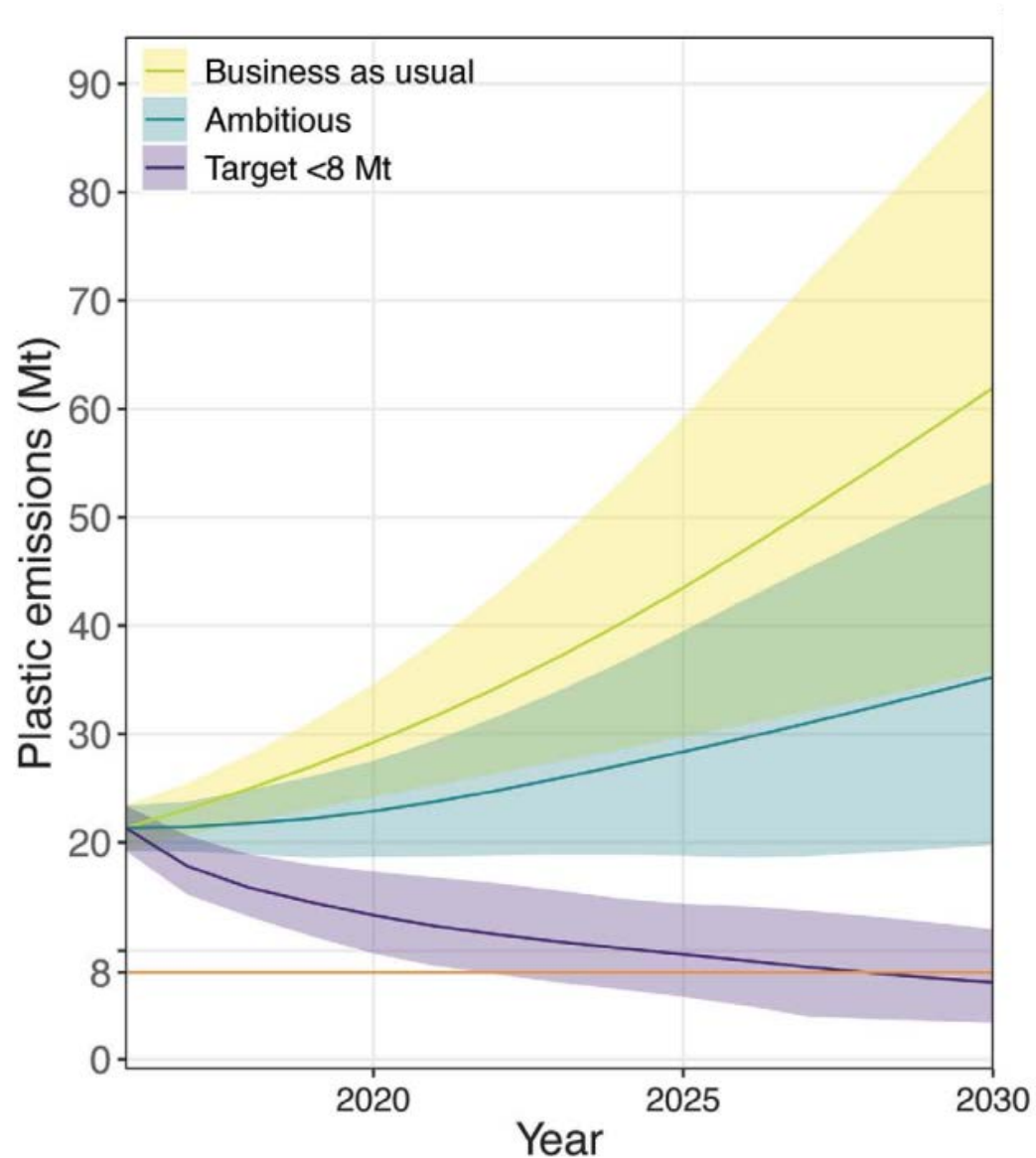


Kiel Science Factory, the school lab of Kiel University and the Leibniz Institute for Science and Mathematics Education, photos by © Heike Groth/Kieler Forschungswerkstatt





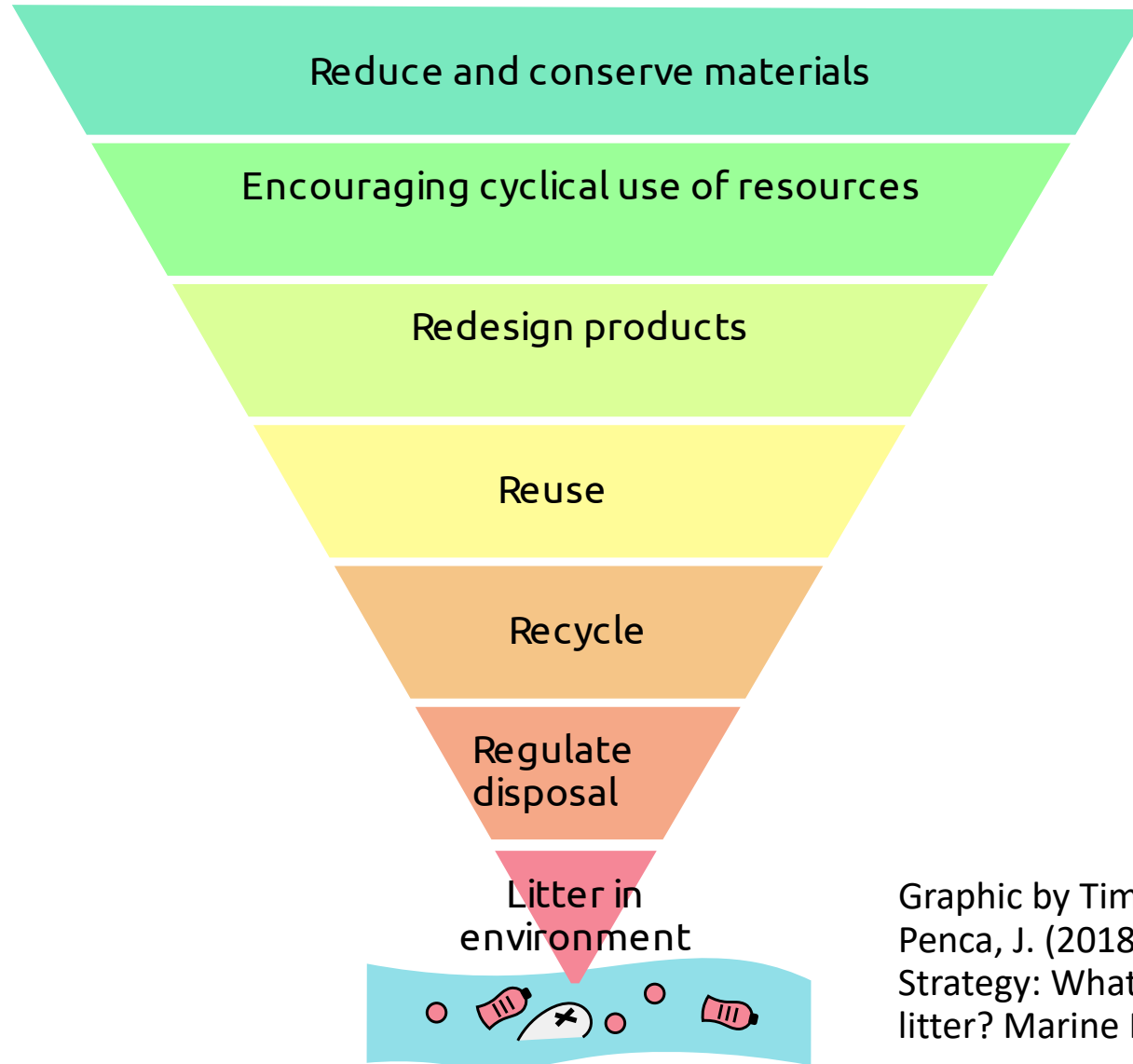
# PLASTIC POLLUTION PROBLEM



Borrelle et al. (2020): “Under the ambitious scenario, we predict between 20 and 53 Mt [million metric tons]/year of plastic emissions to aquatic ecosystems by 2030, remaining at or exceeding 2016 levels despite tremendous reduction efforts by the global community”

Graphic from Borrelle et al. 2020 „Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution.” *Science* 369(6510), 1515-1518, <https://doi.org/10.1126/science.aba3656>

# PLASTIC POLLUTION SOLUTIONS



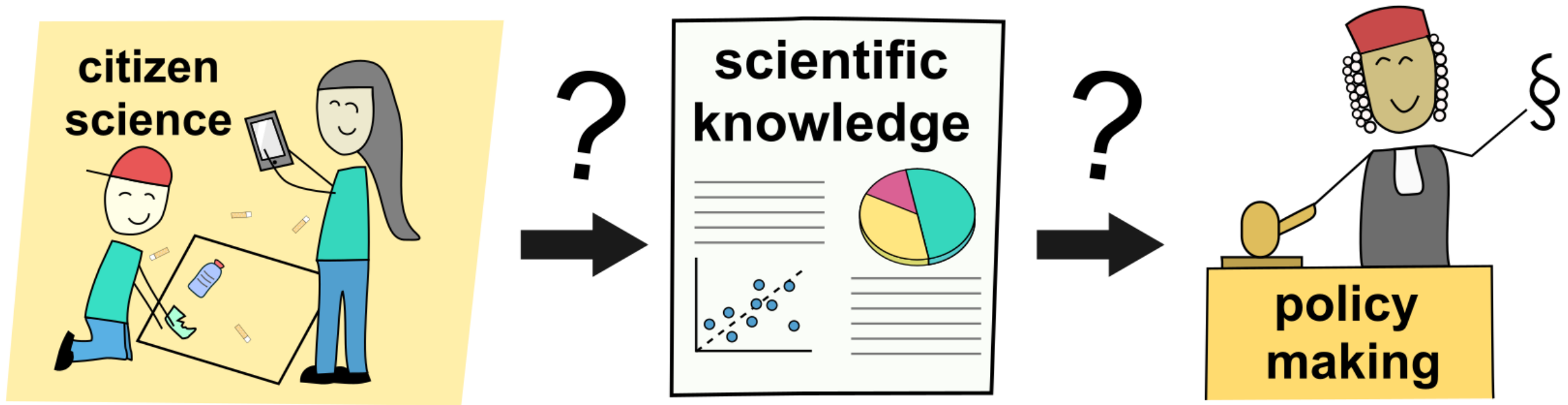
Graphic by Tim Kiessling, published by Penca, J. (2018). European Plastics Strategy: What promise for global marine litter? *Marine Policy*, 97, 197-201.



# PLASTIC POLLUTION SOLUTIONS



Photo by Tim Kiessling  
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Question 1: Can schoolchildren do research?

Question 2: Can the contribution of citizen scientists be used for policy-making?

# WHAT IS SCIENCE, WHAT IS RESEARCH?

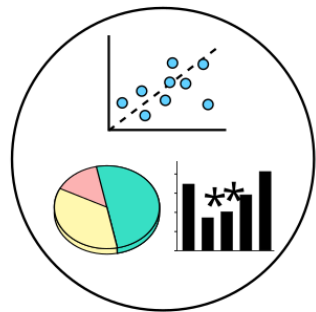
What do you imagine scientists do, when they claim to do research?

What do you do, when conducting research?

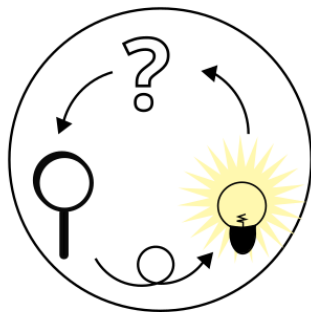
Write down two processes related to „doing research“.



# WHY DO WE WANT TO INVOLVE SCHOOLKIDS IN RESEARCH?



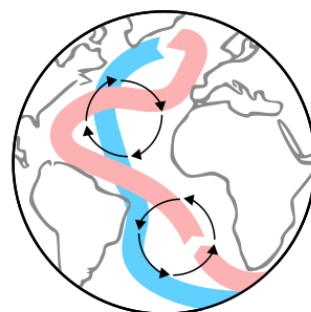
collect  
data



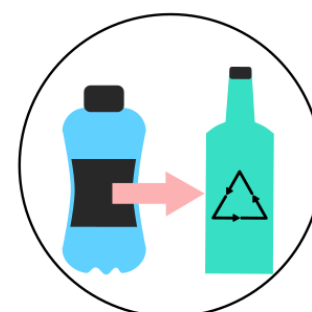
employ scientific  
method



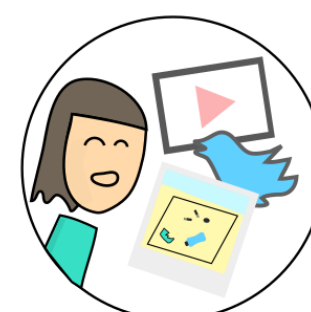
familiarize with  
scientific careers



get expert  
knowledge



reflect own  
behaviour



spread the  
word



initiate political  
processes

by Tim Kiessling, published in Kruse et al. (2020) Dem Plastikmüll auf der Spur – Ein internationales Citizen Science-Projekt zur Förderung der naturwissenschaftlichen Grundbildung von Schülerinnen und Schülern. CHEMKON, <https://doi.org/10.1002/ckon.201800093>. Creative Commons License BY 4.0





Cunard Junior High school at Williams Lake, October 10<sup>th</sup> 2024



# SOME RESULTS

Participants: 221 schoolchildren (grade 4, 5 and 6), volunteers from Let's Talk Science and St. Margarets Bay Stewardship Association

About 630 hours of field sampling effort



Leslie Thomas Junior High school, photo by © Nicole Saulnier (left). Data recording with Crichton Park school, photo by Tim Kiessling (CC BY 4.0 license; right)



# SOME RESULTS

- On average 0.8 litter items found per 1 m<sup>2</sup>
- More litter found higher up at lakes and beaches



Photo by Tim Kiessling

# SOME RESULTS

- A total of 2882 litter items collected and classified
- 50% of litter items were single-use plastics
- Plastic wrappers for snacks and sweets were found most commonly (20% of all litter items)
- About 107 kg of litter collected



# PLASTIC PIRATES PROGRAM IN GERMANY



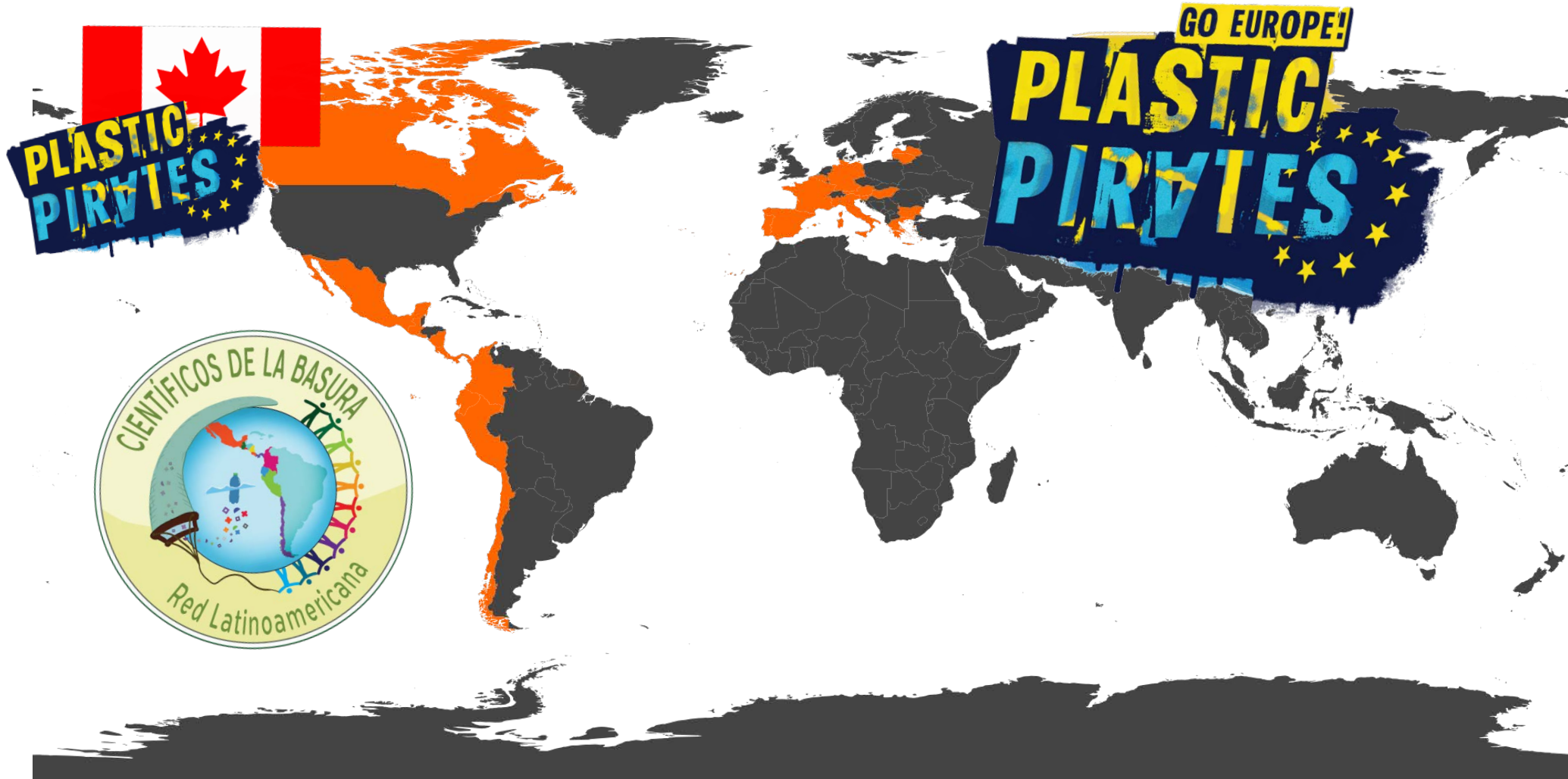
<https://www.plastic-pirates.eu/>



© Gesine Born/Federal Ministry of Education and Research of Germany



# PLASTIC PIRATES AND CIENTÍFICOS DE LA BASURA



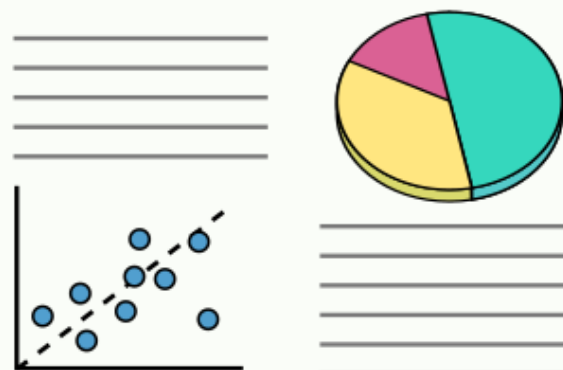
Plastic Pirates countries in Europe = 13, Científicos de la Basura countries in Latin America = 9, plus Canada = 23 countries

<https://www.plastic-pirates.eu/> and <https://cientificosdelabasura.ucn.cl/proyectos-e-investigaciones/>

**citizen  
science**



**scientific  
knowledge**



# FEEDBACK FROM REVIEWERS

“I appreciated authors' great effort to collect on a large scale basis data on plastic litter in riverine ecosystems. I also appreciate very much the scientific approach applied by the authors also into a not scientific context such as Citizen Science is. [...] In spite of the fact that I really appreciated the work performed and the paper produced by authors, scientific papers should be, in my opinion, clearly different by didactic and/or divulgative ones. I'm also persuaded that, not all citizen science experiences have the same scientific rigor and less rigorous activities should not have (in my opinion) the chance to present collected data for the publication on a scientific journal of high impact on the scientific communities.”

(Excerpt from Reviewer 2 of the manuscript Kiessling et al. 2019: “Plastic Pirates sample litter at rivers in Germany—Riverside litter and litter sources estimated by schoolchildren” Environmental Pollution 245, 545-557, <https://doi.org/10.1016/j.envpol.2018.11.025>)





Contents lists available at [ScienceDirect](#)

## Environmental Pollution

journal homepage: [www.elsevier.com/locate/envpol](http://www.elsevier.com/locate/envpol)



Plastic Pirates sample litter at rivers in Germany – Riverside litter and litter sources estimated by schoolchildren<sup>☆</sup>

Tim Kiessling<sup>a,b,\*</sup>, Katrin Knickmeier<sup>b</sup>, Katrin Kruse<sup>b</sup>, Dennis Brennecke<sup>b</sup>, Alice Nauendorf<sup>b</sup>, Martin Thiel<sup>a,c,d</sup>





Contents lists available at [ScienceDirect](#)

## Science of the Total Environment

journal homepage: [www.elsevier.com/locate/scitotenv](http://www.elsevier.com/locate/scitotenv)



Schoolchildren discover hotspots of floating plastic litter in rivers using a large-scale collaborative approach<sup>☆</sup>

Tim Kiessling<sup>a,b,\*</sup>, Katrin Knickmeier<sup>a</sup>, Katrin Kruse<sup>a</sup>, Magdalena Gatta-Rosemary<sup>a</sup>, Alice Nauendorf<sup>a</sup>, Dennis Brennecke<sup>a</sup>, Laura Thiel<sup>c</sup>, Antje Wichels<sup>c</sup>, Ilka Parchmann<sup>a</sup>, Arne Körtzinger<sup>d,e</sup>, Martin Thiel<sup>b,f,g</sup>





Contents lists available at [ScienceDirect](#)

## Waste Management


journal homepage: [www.elsevier.com/locate/wasman](http://www.elsevier.com/locate/wasman)



What potential does the EU Single-Use Plastics Directive have for reducing plastic pollution at coastlines and riversides? An evaluation based on citizen science data

Tim Kiessling<sup>a,\*</sup>, Mandy Hinzmann<sup>b</sup>, Linda Mederake<sup>b</sup>, Sinja Dittmann<sup>a</sup>, Dennis Brennecke<sup>a</sup>, Marianne Böhm-Beck<sup>a</sup>, Katrin Knickmeier<sup>a</sup>, Martin Thiel<sup>c,d,e</sup>





Contents lists available at [ScienceDirect](#)

## Marine Pollution Bulletin

journal homepage: [www.elsevier.com/locate/marpolbul](http://www.elsevier.com/locate/marpolbul)



Temporal variability of litter pollution of rivers in Germany – A long-term assessment by schoolchildren as citizen scientists

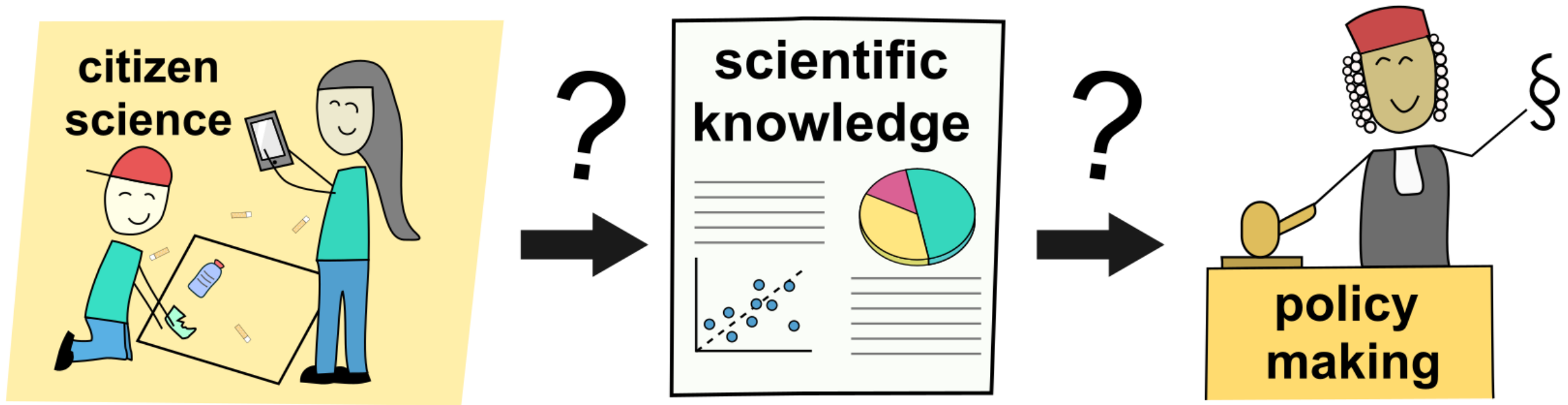
Sinja Dittmann<sup>a,b,\*</sup>, Tim Kiessling<sup>a</sup>, Katrin Knickmeier<sup>a</sup>, Janto Schönberg<sup>a</sup>, Dennis Brennecke<sup>a</sup>, Mandy Hinzmann<sup>f</sup>, Doris Knoblauch<sup>f</sup>, Martin Thiel<sup>c,d,e</sup>

## How to get citizen science data accepted by the scientific community? Insights from the Plastic Pirates project

Sinja Dittmann,<sup>a,\*</sup> Tim Kiessling,<sup>a,\*</sup> Katrin Kruse,<sup>a</sup> Dennis Brennecke,<sup>a</sup> Katrin Knickmeier,<sup>a</sup> Ilka Parchmann,<sup>a</sup> and Martin Thiel<sup>b, c, d</sup>

## Sharing communication insights of the citizen science program *Plastic Pirates*—best practices from 7 years of engaging schoolchildren and teachers in plastic pollution research

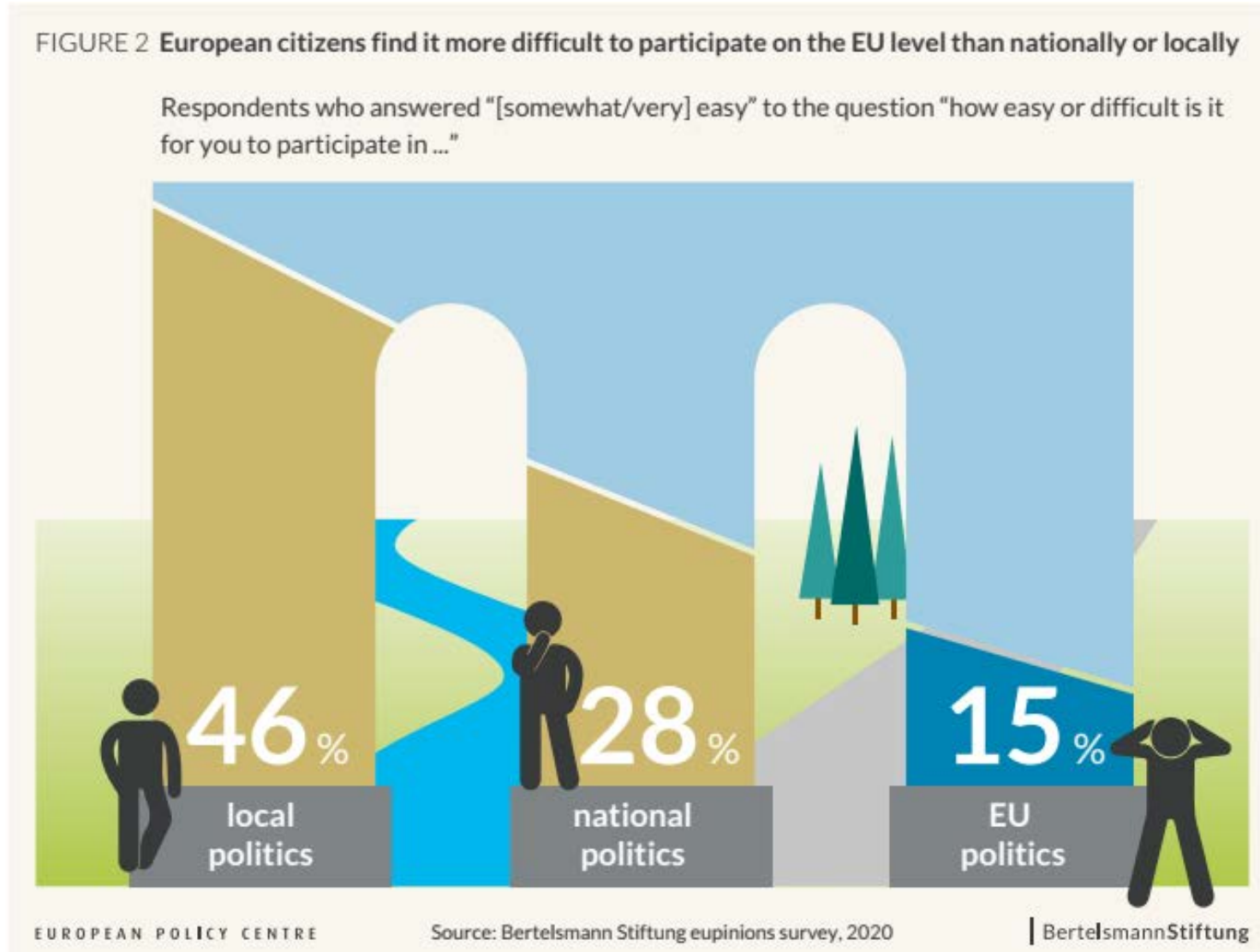
Sinja Dittmann<sup>1,\*†</sup>, Tim Kiessling<sup>1†</sup>, Linda Mederake<sup>2</sup>, Mandy Hinzmann<sup>2</sup>, Doris Knoblauch<sup>2</sup>, Marianne Böhm-Beck<sup>1</sup>, Katrin Knickmeier<sup>1</sup> and Martin Thiel<sup>3,4,5</sup>



Question 1: Can schoolchildren do research? YES!

Question 2: Can the contribution of citizen scientists be used for policy-making?

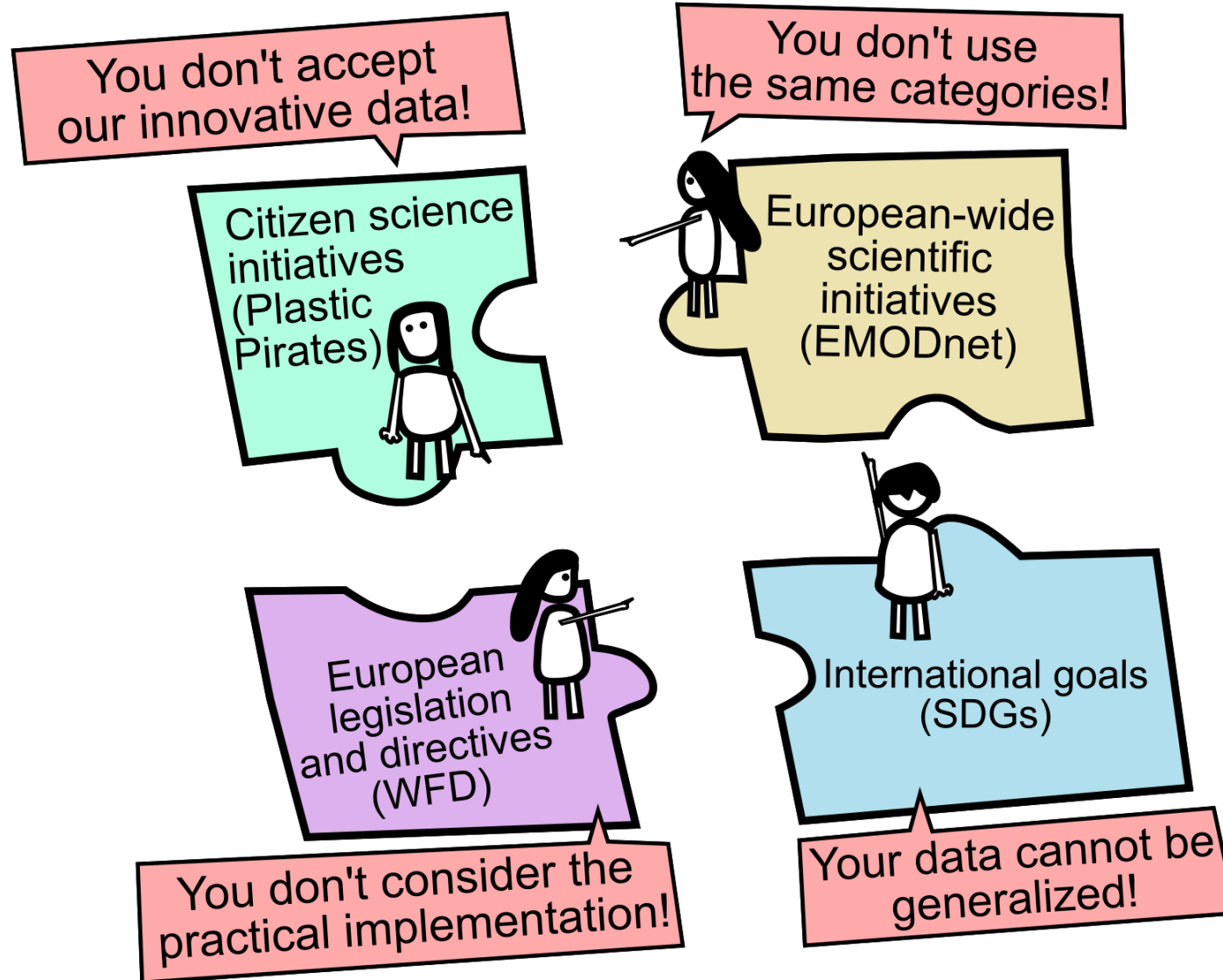
# WHY DO WE WANT TO INVOLVE PEOPLE IN POLICY-MAKING?



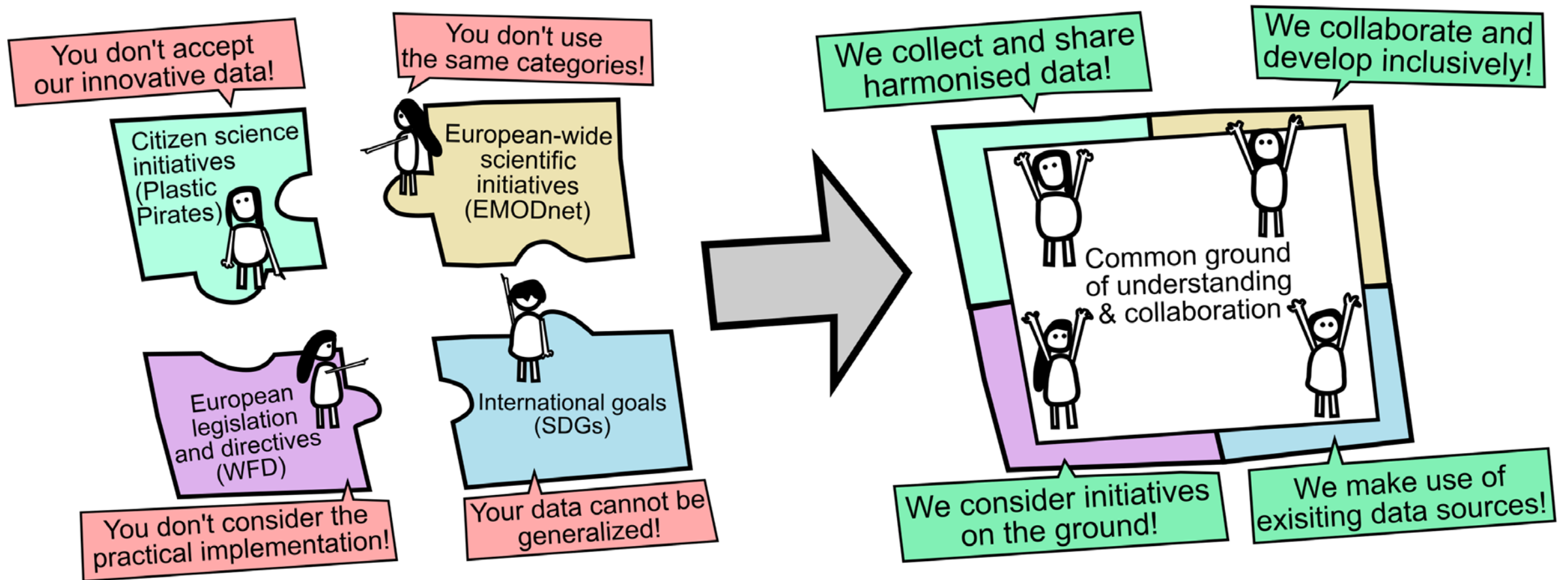
From Hierlemann, D., Roch, S., Butcher, P., Emmanouilidis, J.A., Stratulat, C., de Groot, M., 2022. Under construction: citizen participation in the European Union. Verlag Bertelsmann Stiftung, Gütersloh.  
<https://www.epc.eu/en/publications/Under-Construction--Citizen-Participation-in-the-European-Union~483460>



# MAKING CITIZEN SCIENCE DATA IMPACTFUL



# MAKING CITIZEN SCIENCE DATA IMPACTFUL



From Schönberg et al. (to be submitted) „Public participation in EU legislation? Recommendations for involving citizen scientists in anthropogenic litter research within the Water Framework Directive”



# WATER FRAMEWORK DIRECTIVE IN EUROPEAN UNION

- Seeks to transform all freshwater bodies and coastal waters into a „good status“ (Water Framework Directive 2000)
- “The success of this Directive relies on close cooperation and coherent action at Community, Member State, and local level, as well as on information, consultation and involvement of the public [...]” (Water Framework Directive 2000, p.2)

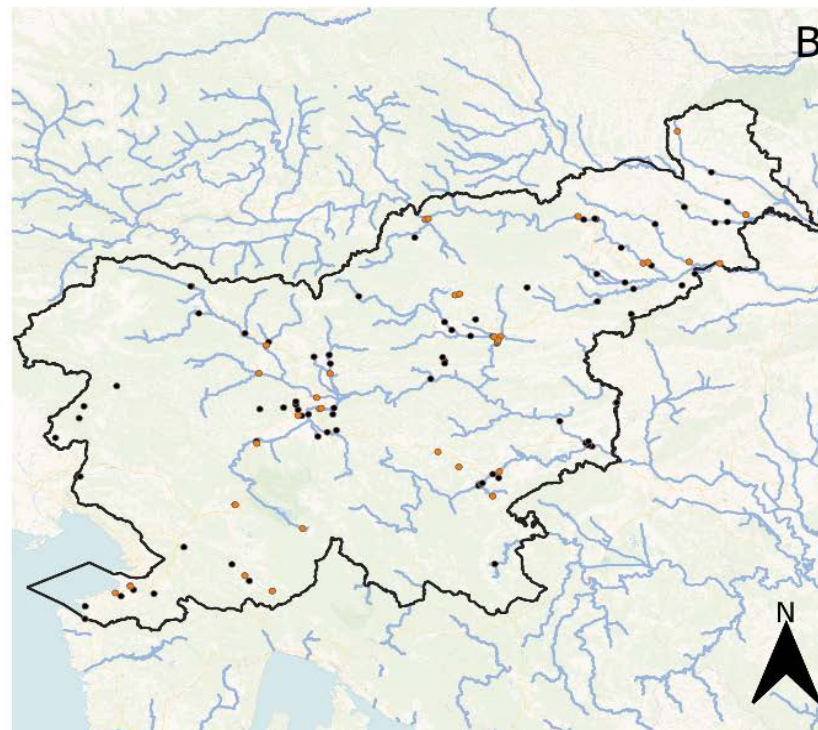
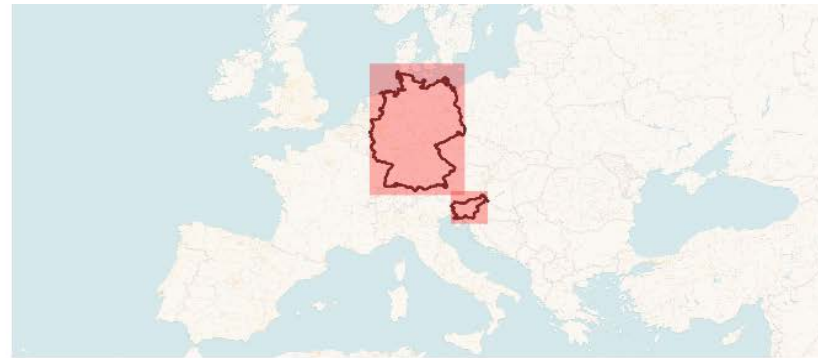
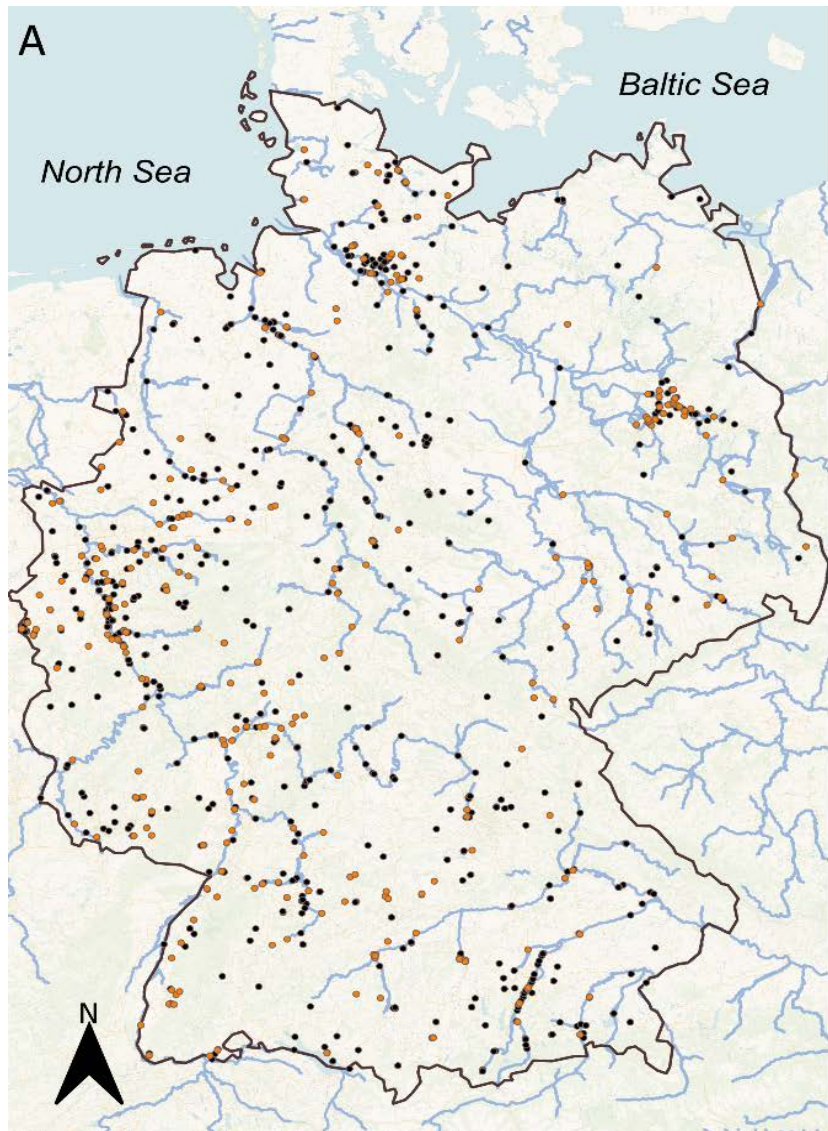
Water Framework Directive (2000): Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, <https://eur-lex.europa.eu/eli/dir/2000/60/oj>

# PARTICIPATION IN THE WATER FRAMEWORK DIRECTIVE?

Suggestion 1: Use existing data as a baseline for plastic pollution



# USE EXISTING DATA AS A BASELINE OF PLASTIC POLLUTION



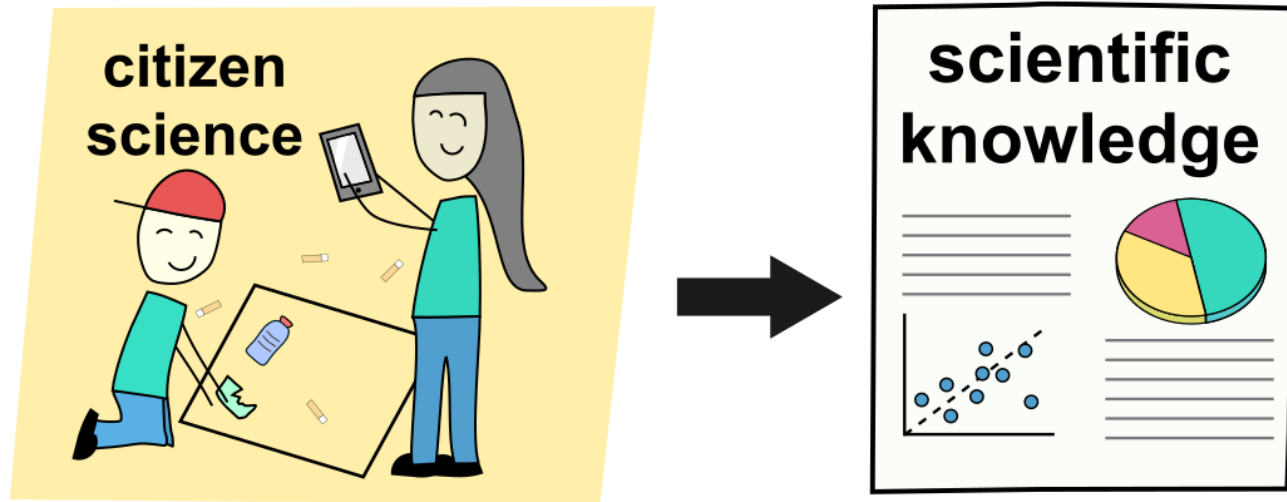
Plastic Pirates sampling sites in (A) Germany ( $n = 1327$ ) and (B) Slovenia ( $n = 122$ ) from 2016 to 2023. Orange dots are sites located within a 1 km radius of established monitoring stations of the Water Framework Directive (31% of sampling sites).

From Schönberg et al. (to be submitted) „Public participation in EU legislation? Recommendations for involving citizen scientists in anthropogenic litter research within the Water Framework Directive”

# PARTICIPATION IN THE WATER FRAMEWORK DIRECTIVE?

Suggestion 1: Use existing data as a baseline for plastic pollution

This requires: data harmonisation, development of indicators relevant for the Directive

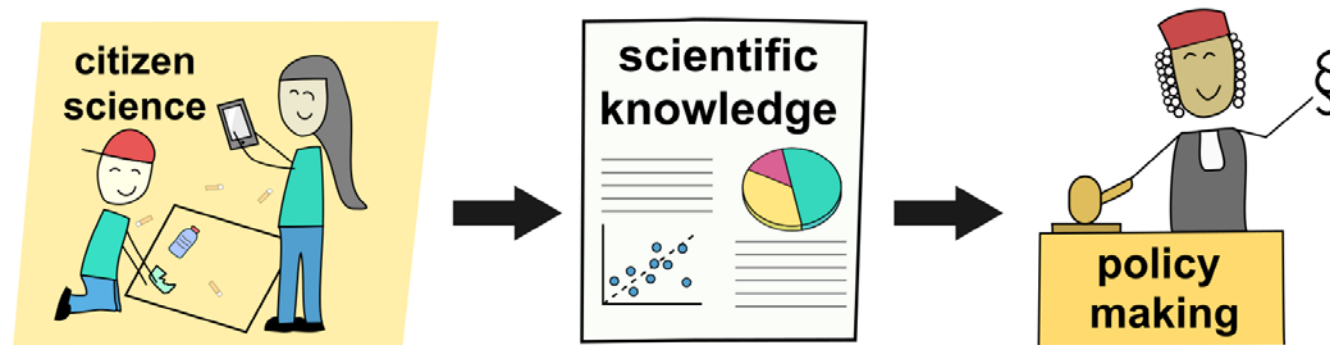


# PARTICIPATION IN THE WATER FRAMEWORK DIRECTIVE?

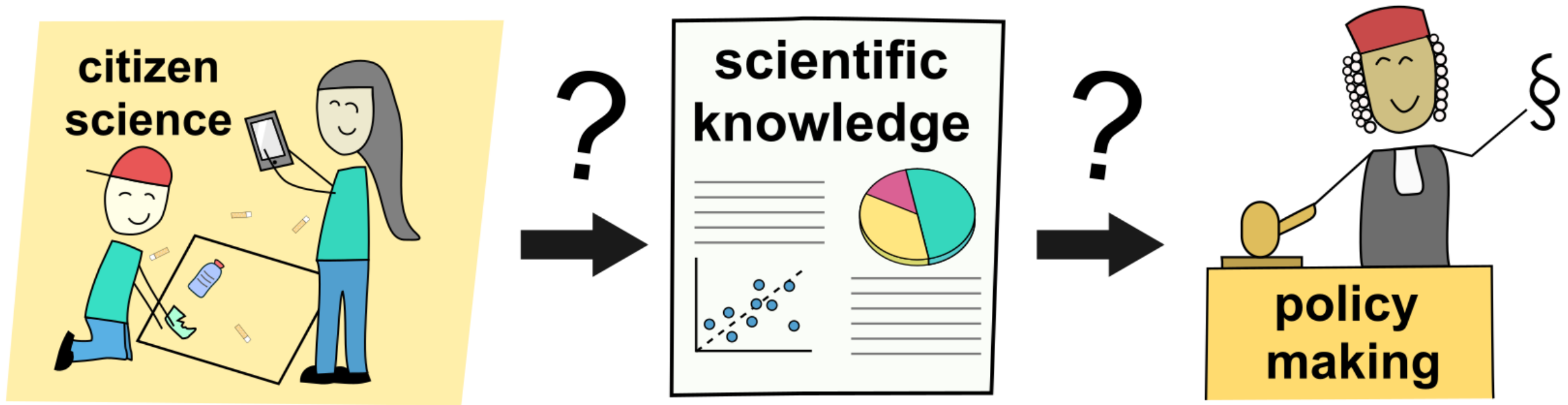
Suggestion 2: Complementary citizen science activities, for example to detect plastic pollution hotspots and use local knowledge

This requires for example:

- establishment of communication pathways and involvement of citizen science and science communication experts,
- a willingness to accept to re-negotiate power balances,
- yet maintaining clear governmental responsibilities







Question 1: Can schoolchildren do research? YES!

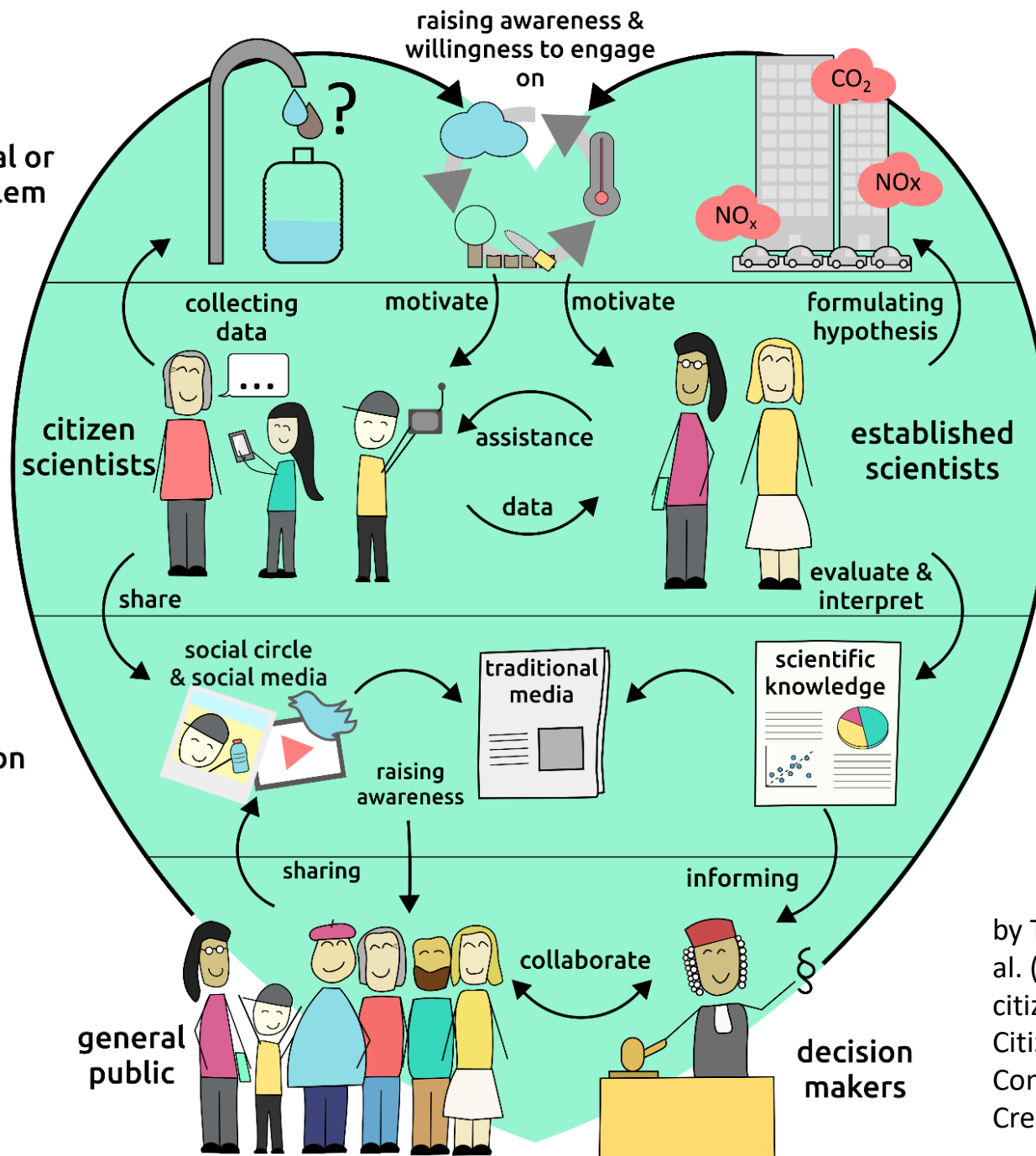
Question 2: Can the contribution of citizen scientists be used for policy-making?

environmental or societal problem

science actors

communication

policy actors



by Tim Kiessling, first published in Thiel et al. (2017) Marine litter – bringing together citizen scientists from around the world. In *Citizen Science for Coastal and Marine Conservation* (pp. 104-131). Routledge. Creative Commons license BY NC 4.0.

# TRULY A COLLABORATION? A DISCLAIMER

- Many citizen science activities are coordinated by researchers and participation for the public is limited to specific activities
- Citizen science involving schoolchildren happens at the interface of two highly institutionalized systems (academia and school education)
- Acknowledgments of research work of citizen science participants is important and good practises still need to be developed



# THANK YOU

The presented insights are based on the participation of thousands of schoolchildren, their teachers and volunteers in research processes – I greatly admire their dedication and the effort of school teachers to go the extra mile to offer citizen science and out-of-school learning experiences to their schoolchildren.

The implementation of the Plastic Pirates program in Canada is supported by Let's Talk Science and the School for Resource and Environmental Studies at Dalhousie University, Kiel Science Factory located at Kiel University and the Leibniz Institute for Science and Mathematics Education (IPN), funding ID: „Zukunftsvertrag Lehre stärken – Entwicklungslabor Citizen Science“ in Germany, and the Ocean Frontier Institute's Visiting Fellowship Program 2024, through an award to Tim Kiessling from the Canada First Research Excellence Fund.

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# PLASTIC PIRATES EDUCATIONAL MATERIAL

- Co-developed between teachers and researchers
- Educational material about the ocean, anthropogenic use of the ocean, plastic pollution on how to get active on the environmental issue,  
<https://www.plastic-pirates.eu/en/material/download>



Eine gemeinsame Initiative von:



MINISTRSTVO ZA IZOBRAŽEVANJE,  
ZNANOST IN ŠPORT



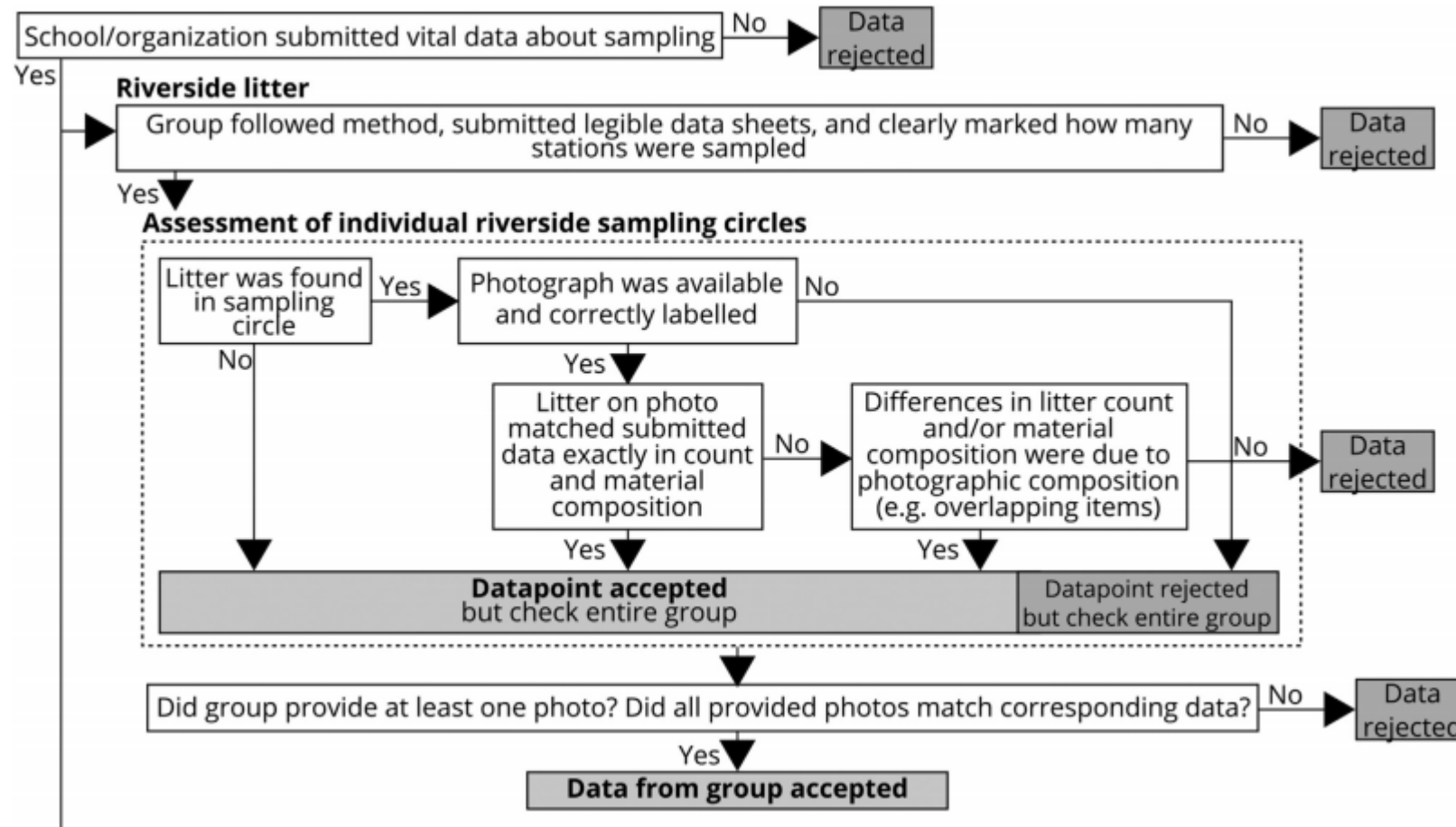
Eine gemeinsame Initiative von:



MINISTRSTVO ZA IZOBRAŽEVANJE,  
ZNANOST IN ŠPORT

# DATA QUALITY: DECISION MAKING FLOWCHARTS

Systematizing our data quality review approach





# DATA QUALITY: BE TRANSPARENT AND HONEST

Transparently communicating why and how many datasets were excluded

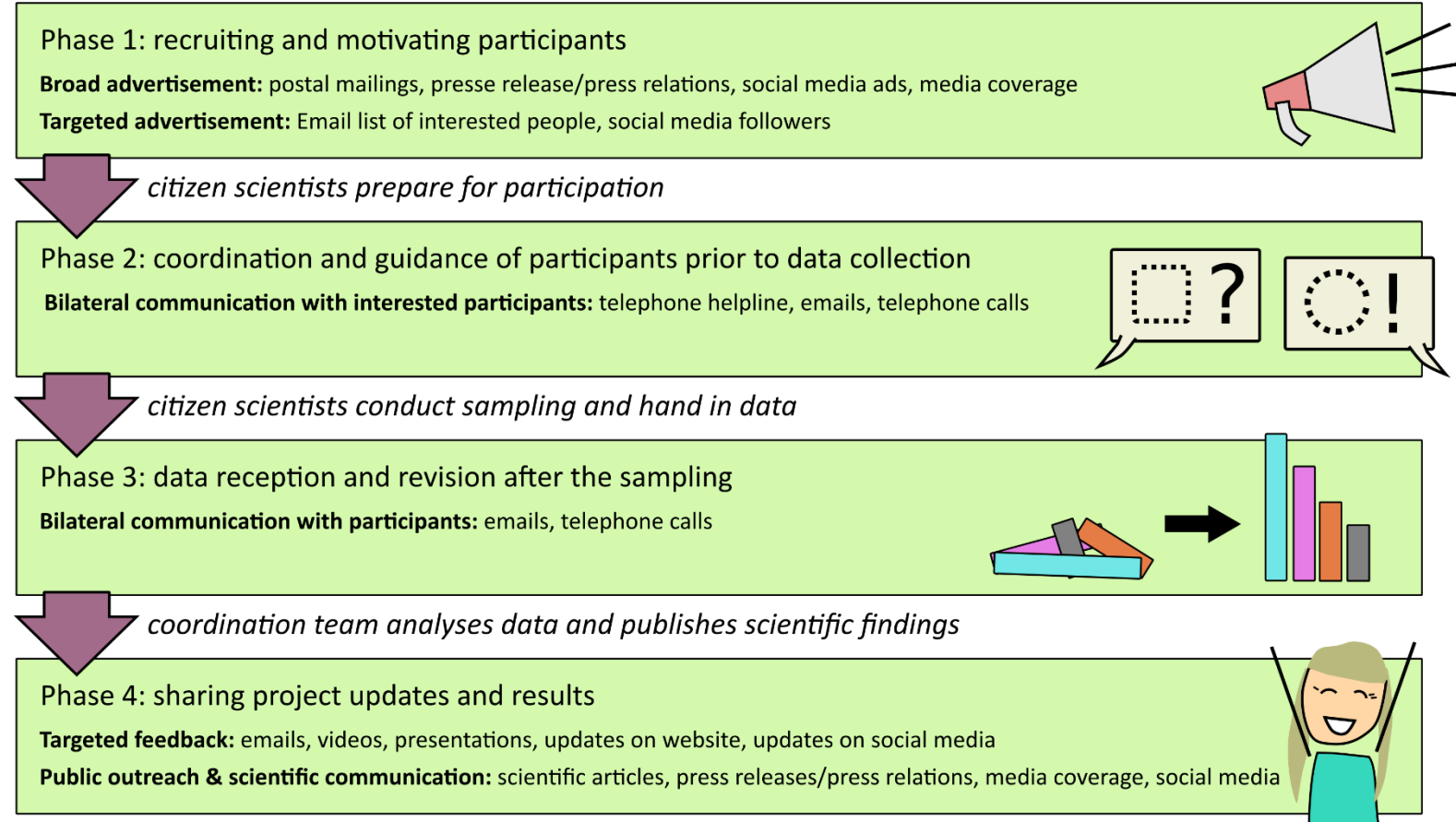
Table S2-2: Reasons for the rejection of datasets from groups assessing riverside litter in sampling circles.

	Number of datasets
Groups that conducted riverside litter sampling	360
– schools and organizations that did not provide vital information about sampling	21
– groups that did not follow methodology	17
– groups that did not submit legible data	10
– groups that did not communicate how many sampling stations they had surveyed	25
– groups that did not submit at least one photograph for any sampling circle	80
– groups with inexplicable differences between litter counts and material composition on photographs upon comparison to submitted data sheets	28
Datasets accepted	179

Kiessling et al. 2019: “Plastic Pirates sample litter at rivers in Germany–Riverside litter and litter sources estimated by schoolchildren” Environmental Pollution 245, 545-557, <https://doi.org/10.1016/j.envpol.2018.11.025>

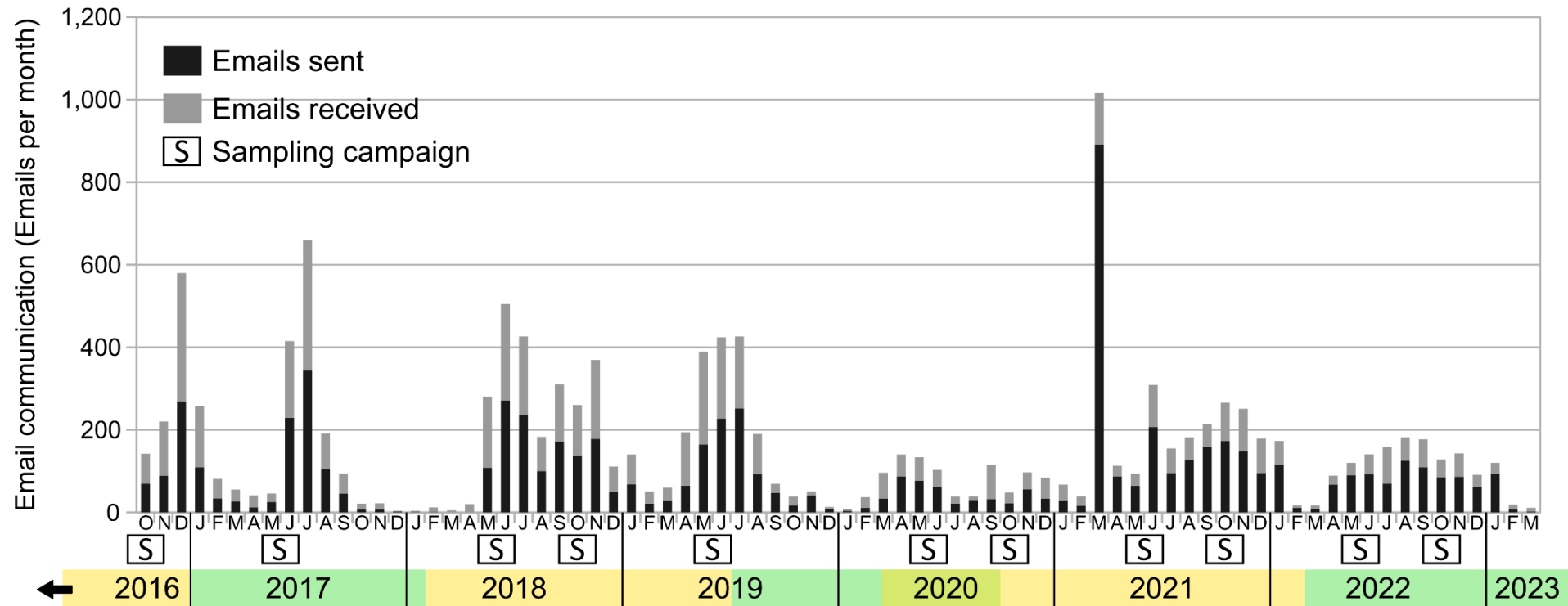
# COMMUNICATION IN THE PLASTIC PIRATES PROGRAM

Communication phases within the *Plastic Pirates* citizen science program



From Dittmann et al. (2023) "Sharing communication insights of the citizen science program Plastic Pirates - best practices from 7 years of engaging schoolchildren and teachers in plastic pollution research" *Frontiers in Environmental Science*, <https://doi.org/10.3389/fenvs.2023.1233103>

# COMMUNICATION IN THE PLASTIC PIRATES PROGRAM



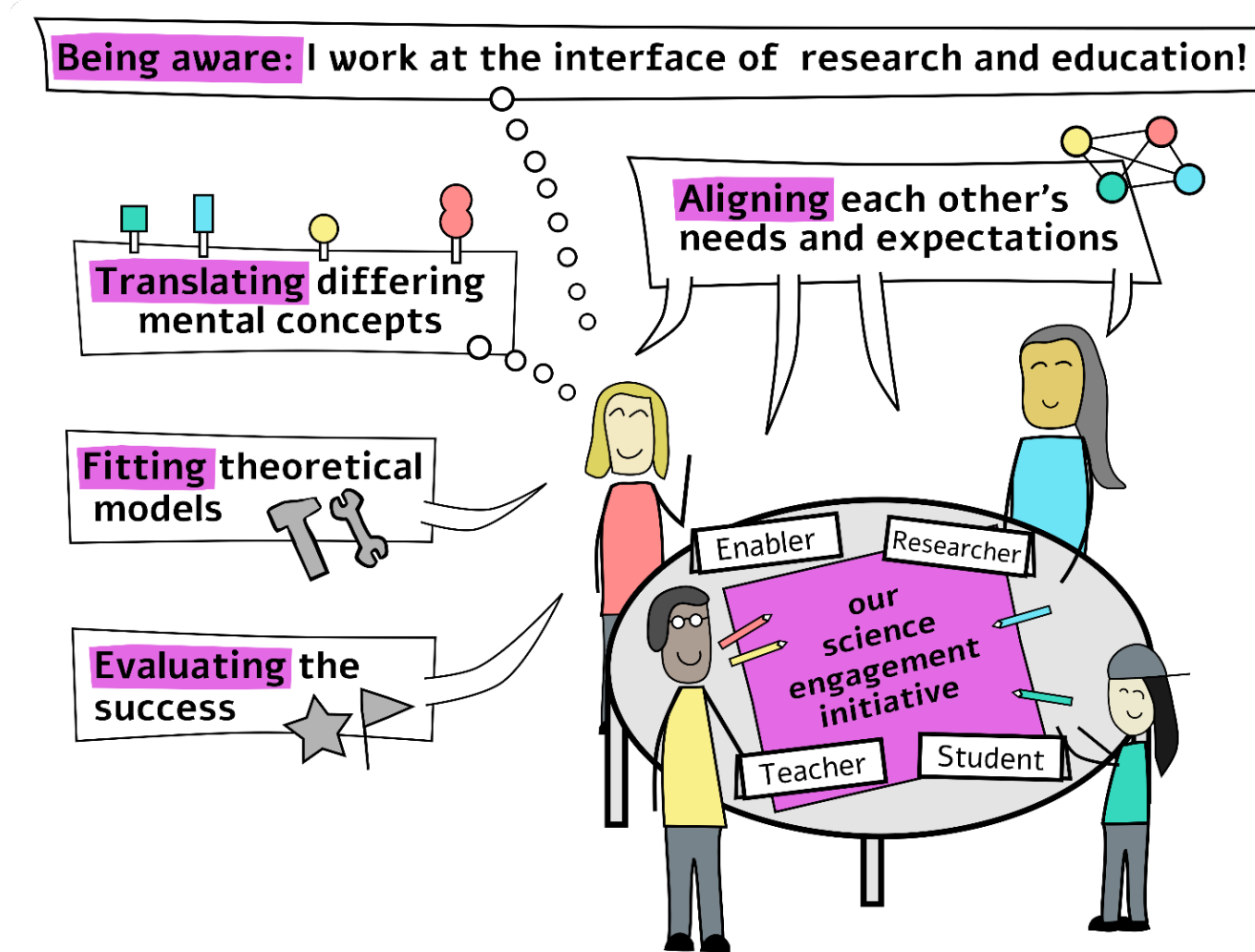
In total 12,767 emails were registered (7,237 emails sent, 5,530 emails received). This represented a little more than 1,000 h of work, assuming every email required 5 minutes of attention, and therefore approximately 37 weeks of employment time (given a work contract typical of the program of ~29 h per week). From Dittmann et al. (2023) “Sharing communication insights of the citizen science program Plastic Pirates - best practices from 7 years of engaging schoolchildren and teachers in plastic pollution research” *Frontiers in Environmental Science*, <https://doi.org/10.3389/fenvs.2023.1233103>



# SOME INSIGHTS FOR CITIZEN SCIENCE COMMUNICATION

- Communication is key in collaborative research initiatives and usually the main work package
- Try to foresee phases with extra communication workload and enlist help
- Use communication channels the participants are familiar with (dedicated forms and websites may make your life easier but not necessarily that of participants)
- Find a solution to the common problem that processing, analysing and publishing output of participants takes a long time (e.g. regular small updates via email or social media, illustrating progress and failure)
- Be transparent and share insights into how science works, also after the active involvement of participants in the research initiative
- Identify as an enabler of science engagement initiative

# ROLES OF PEOPLE IN SCIENCE ENGAGEMENT INITIATIVES

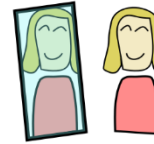


From Kiessling et al. (submitted to Journal of Science Communication) "How can we enable school students to learn and participate in science engagement initiatives? Roles and tasks of enablers"

# ENABLER OF SCIENCE ENGAGEMENT INITIATIVES

## Ten recommendations for enablers in science engagement initiatives

- 1 Identify as an enabler and reflect on your role among other participants (e.g. school students, teachers and researchers).



- 2 Evaluate whether these tasks apply to your role: aligning needs and expectations, translating mental concepts, integrating theoretical models, and evaluating initiatives.



- 3 Treat your work as iterative rather than confined to the design stage. Implement feedback loops and plan recurring discussions with participants.



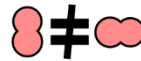
- 4 Learn from others; there are many enablers with different backgrounds identifying as science communicators, science facilitators, mediators, teachers, or journalists.



- 5 Realise that groups and individuals have different goals and expectations; facilitate sharing and negotiating these (some might be implicit).



- 6 Use interviews and focus groups to identify shared and differing mental concepts among participants, focusing especially on differing ones.



- 7 Integrate existing theoretical models to ensure quality, connectivity and a holistic approach of your initiative.



- 8 Identify meaningful indicators of success and methods to measure them beyond participant numbers.



- 9 Harness the potential of working in a transdisciplinary team with unique perspectives, experience, and expertise.



- 10 Share your experience as an enabler in publications, via workshops or lectures, detailing your work and role, especially how processes were implemented.

From Kiessling et al. (submitted to Journal of Science Communication) “How can we enable school students to learn and participate in science engagement initiatives? Roles and tasks of enablers”

# WHY DO RESEARCH WITH SCHOOLS?

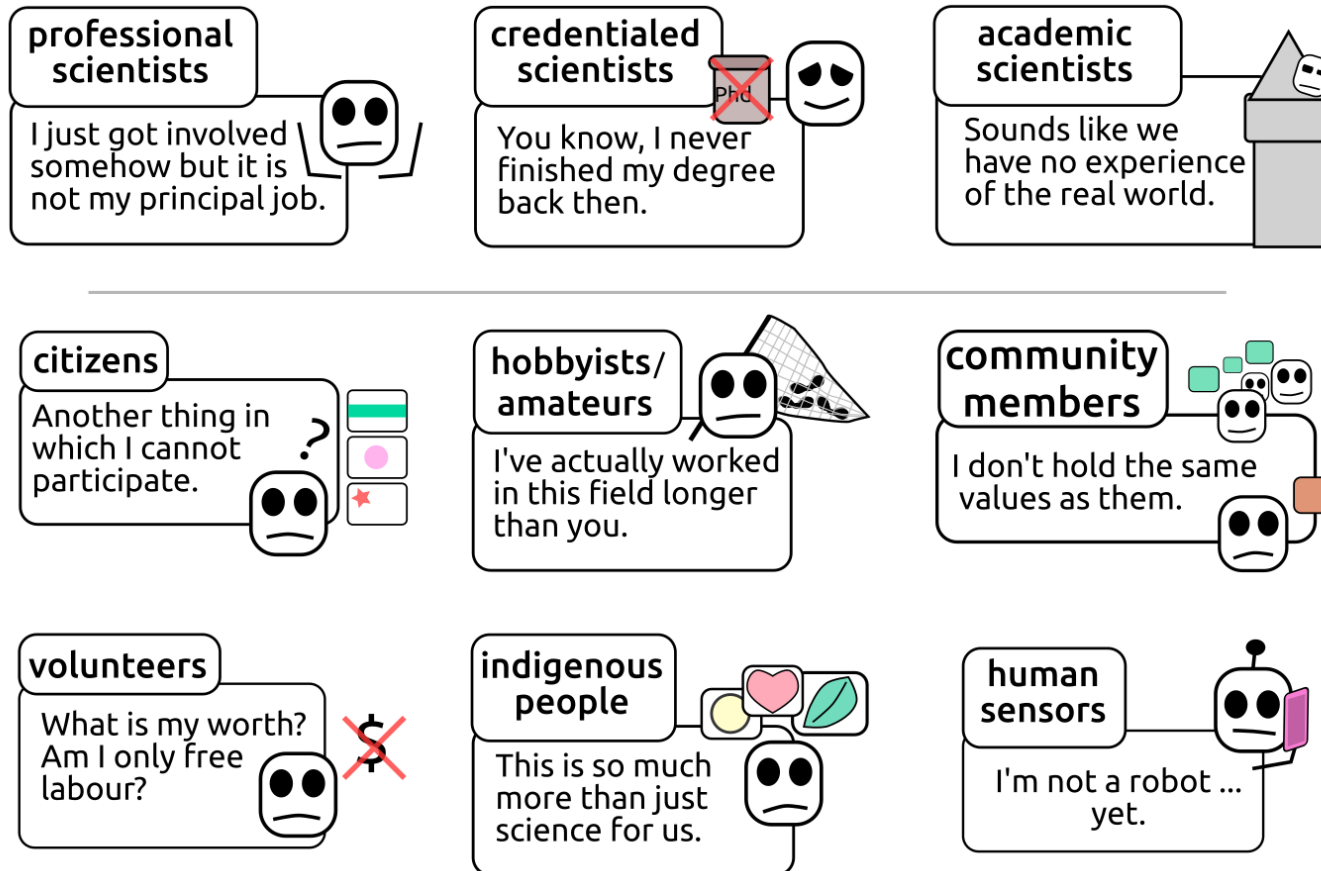


by Tim Kiessling, published in Kruse et al.  
(2020) Dem Plastikmüll auf der Spur – Ein internationales Citizen Science-Projekt zur Förderung der naturwissenschaftlichen Grundbildung von Schülerinnen und Schülern. CHEMKON, <https://doi.org/10.1002/ckon.201800093>.  
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# CALLING PEOPLE NAMES

## What to call people involved in citizen science projects?



by Tim Kiessling, published in Eitzel et al. (2017). Citizen science terminology matters: Exploring key terms. *Citizen Science: Theory and Practice*, 1-20, <https://doi.org/10.5334/cstp.96>.  
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