



# The Erasmus Maris Initiative: Achieving Quality Assurance in Citizen Science; Measurements of Microplastics by Involving Science-teachers in Inter-Laboratory Comparisons

**EuroQCharm Final Conference,  
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*European Commission EC-JRC-Geel /  
AYAM Sailing Europe*

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# JRC sites

Headquarters in **Brussels**  
and research facilities located  
in **5 EU Countries:**

- **Belgium (Geel)**
- **Germany (Karlsruhe)**
- **Italy (Ispra)**
- **The Netherlands (Petten)**
- **Spain (Seville)**





## DG JRC's Mission:

“Science for Policy, The Joint Research Centre provides independent evidence-based knowledge and science, supporting EU policies to positively impact society”

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JRC-Geel has the Reference Materials Unit, formerly @IRMM

(we still have and sell the CRMs from the IRMM and BCR programme)

Mainly **MATRIX** Reference Materials!

# Reference Materials Unit in a nutshell

- JRC F.6 is a leading global matrix-RM producer -20,000 RMs sold per year
- ISO17034 accreditation since 2004
- RMs play a central role in the standardisation of measurements
- JRC RMs support implementation of EU legislation
- Develops, produces and distributes non-nuclear RMs in the EU and globally
- Skilled and dedicated staff and excellent facilities **-Acknowledgement to all co-workers involved in the MP-work shown in this presentation!**

<https://visitors-centre.jrc.ec.europa.eu/virtual-tour/refmat/en/index.html>

# Reference Material (RM)



Material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process.

ISO Guide 30:2015 Reference materials  
– selected terms and definitions

# Certified Reference Material (CRM)



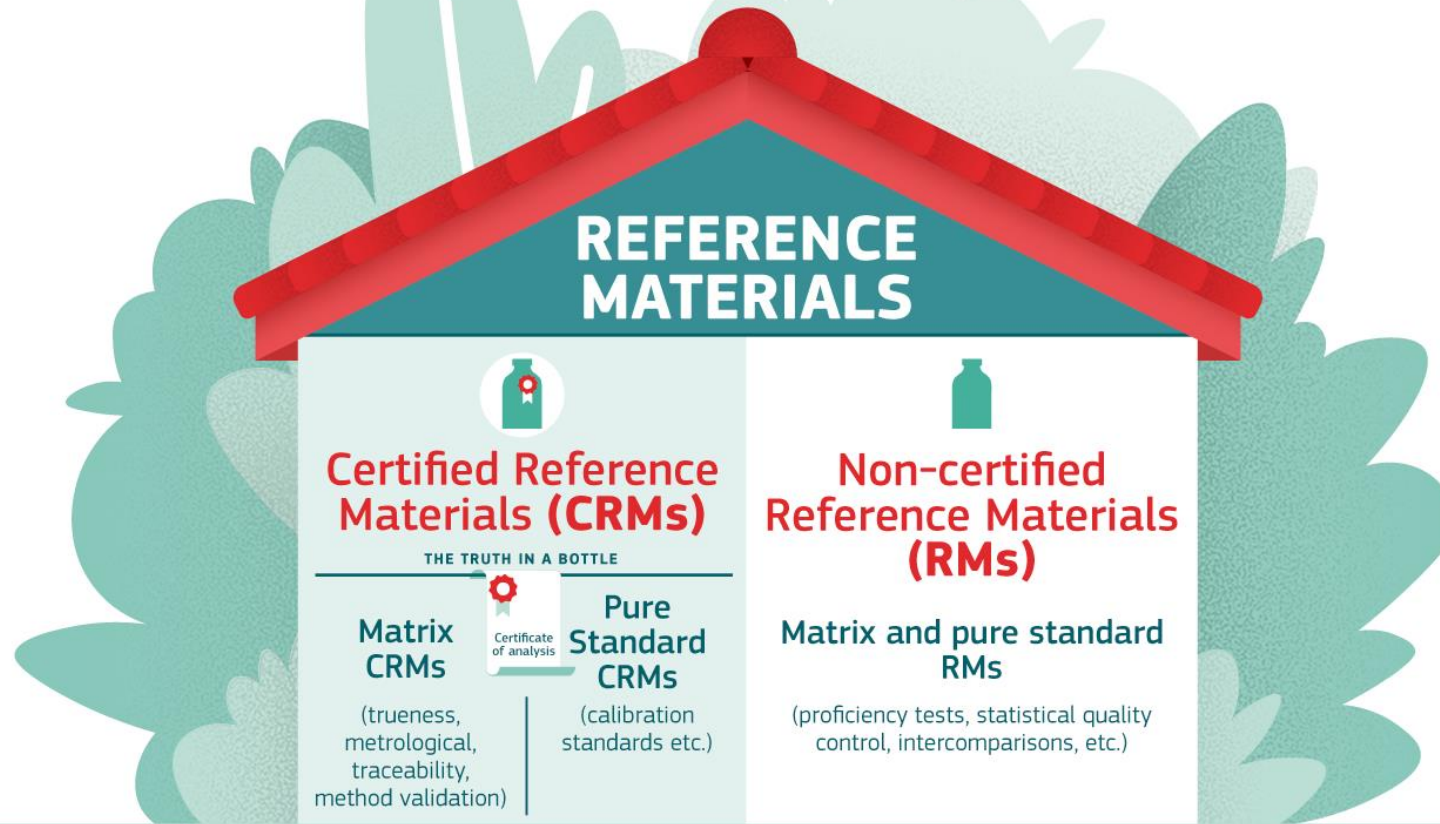
Reference material (RM) characterized by a metrologically valid procedure for one or more specified properties, accompanied by an RM certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability.

ISO Guide 30:2015 Reference materials  
– selected terms and definitions



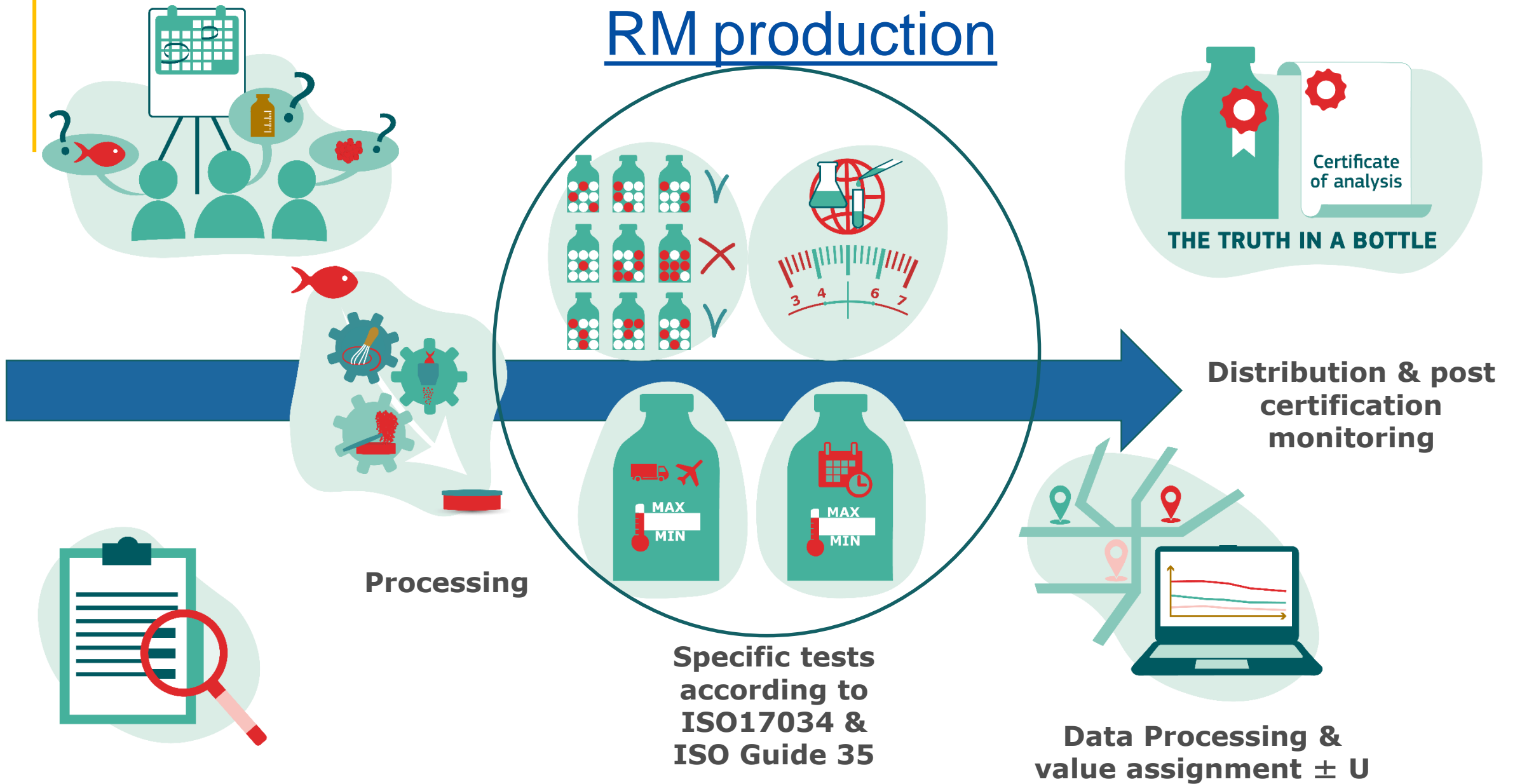
# Reference Materials

All materials under one roof



ISO Guide 30:2015 Reference materials  
– selected terms and definitions

# RM production



**Feasibility & Planning**

**Tests are generic for all CRMs !**

**Data Processing & value assignment  $\pm U$**



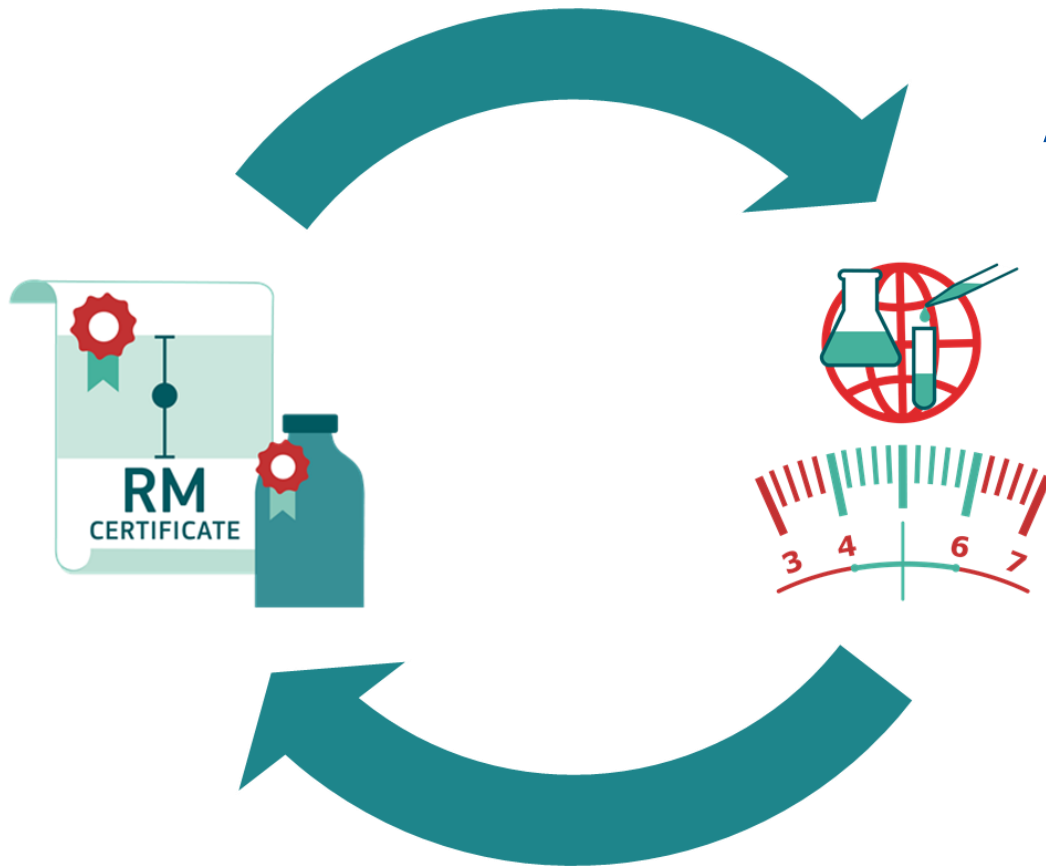
# The RM/Method Causality Dilemma



Accurate and validated methods are needed to produce CRMs

In emerging fields both RMs and reliable methods tend to be missing

What to do?



## Reference Materials

All materials under one roof



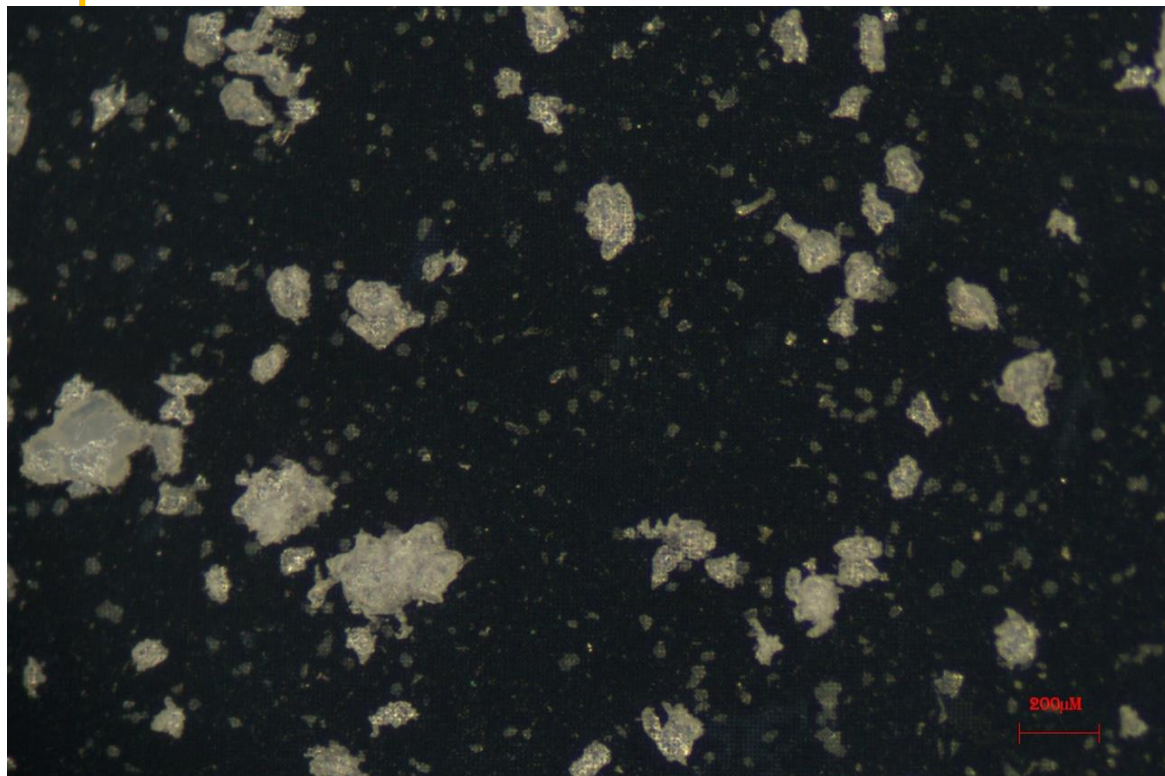
# What is going on? Microplastic can be found everywhere!?



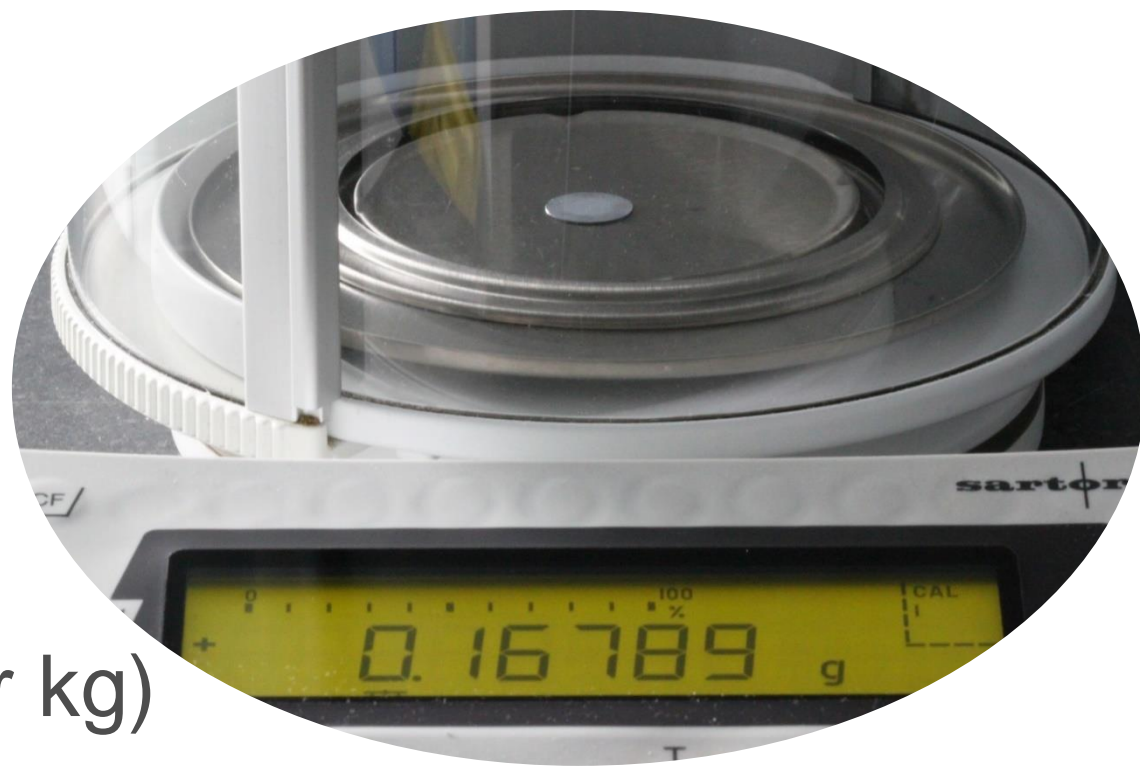
**Microplastic pollution in Seas, Rivers Lakes  
and Sediments: Pieces of plastic <5 mm  
(primary or secondary origin)**



# What can we measure when it comes to microplastics?



Mass of MP per litre (or / kg)  
you must be aware of contamination!

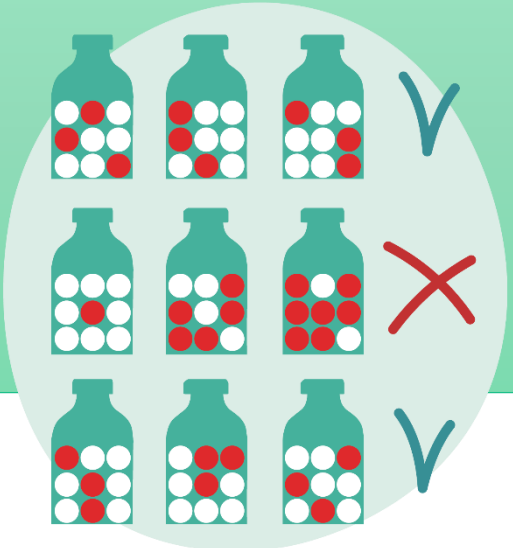


Number of MP-particles per litre (or kg)  
you must be aware of particle size!

# The main difficulty when making RMs for MP

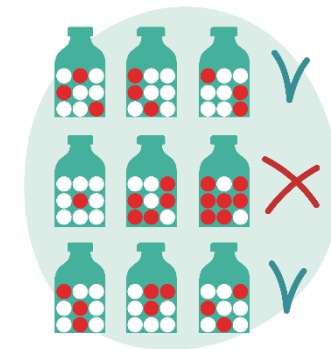
Reference materials for microplastics

1. Homogeneity ✓
2. Homogeneity ✗
3. Homogeneity ✓



With a mass-based approach using a balance, we can incorporate a common point of reference (metrological traceability and trueness) for what we intended to measure = A CRM can tentatively be produced

# Example from the area of Microplastics, MP



First evaluation of homogeneity using ultra micro-balances

**Between bottle heterogeneity 14 %**

Analytical and Bioanalytical Chemistry (2022) 414:385–397

<https://doi.org/10.1007/s00216-021-03198-7>

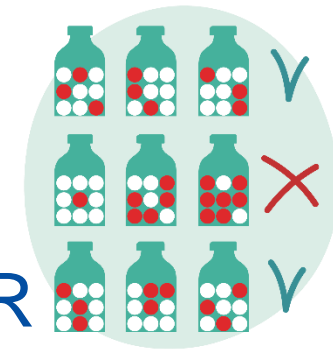
RESEARCH PAPER



## Preparation of a reference material for microplastics in water—evaluation of homogeneity

John Seghers<sup>1</sup> • Elzbieta A. Stefaniak<sup>1</sup> • Rita La Spina<sup>2</sup> • Claudia Cella<sup>2</sup> • Dora Mehn<sup>2</sup> • Douglas Gilliland<sup>2</sup> • Andrea Held<sup>1</sup> • Ulf Jacobsson<sup>1</sup> • Håkan Emteborg<sup>1</sup>

# Example from the area of Microplastics, MP



## Second evaluation of homogeneity using quantitative $^1\text{H-NMR}$

**Between bottle heterogeneity 7.9 %**

Analytical and Bioanalytical Chemistry (2023) 415:3033–3040

<https://doi.org/10.1007/s00216-023-04567-0>

RESEARCH PAPER



### Feasibility of using quantitative $^1\text{H-NMR}$ spectroscopy and ultra-microbalances for investigation of a PET microplastic reference material

John Seghers<sup>1</sup> · Marcel Günther<sup>2</sup> · Andreas Breidbach<sup>1</sup> · Nadine Peez<sup>2</sup> · Wolfgang Imhof<sup>2</sup> · Håkan Emteborg<sup>1</sup>

**Same RM!**

**Better homogeneity than initially established thanks to method development!**



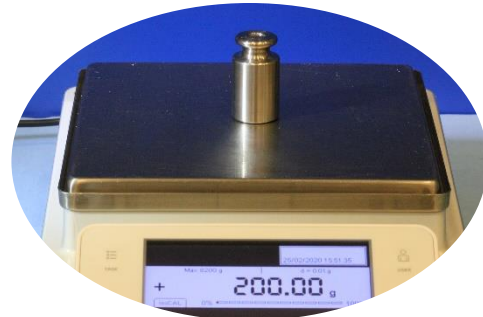
# A mass based approach for microplastics? Can it be done?



National Institute of Standards & Technology



Au



Au is dissolved

Dilute on balance

## Certificate of Analysis

Standard Reference Material<sup>®</sup> 3121

Gold (Au) Standard Solution

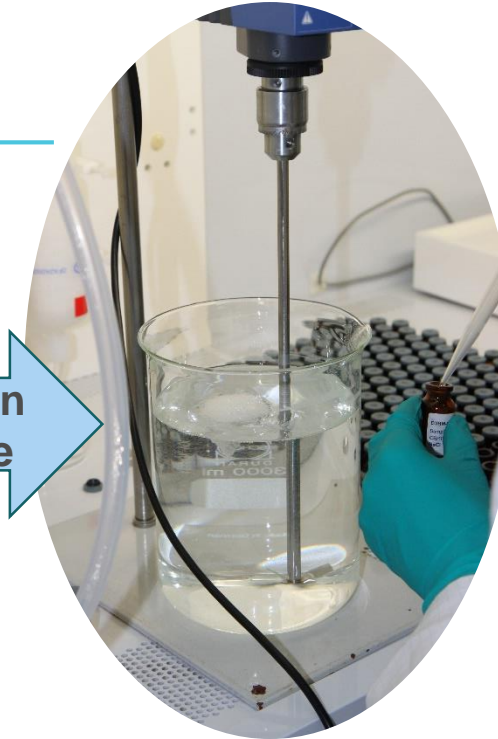
Lot No. 170531

This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of gold. One unit of the SRM consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of gold. The solution contains hydrochloric acid at a mass fraction of approximately 9%.

Certified Mass Fraction Value of Gold:

10.006 mg/g  $\pm$  0.019 mg/g

Rel U = 0.19 %!



PET in suspension

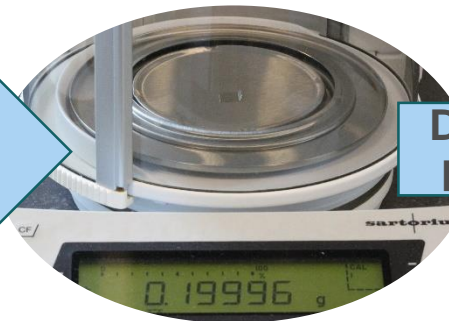
Rel U = ? %



PET



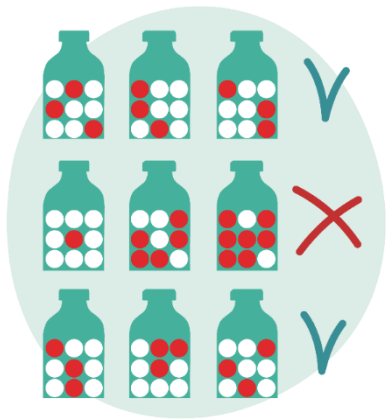
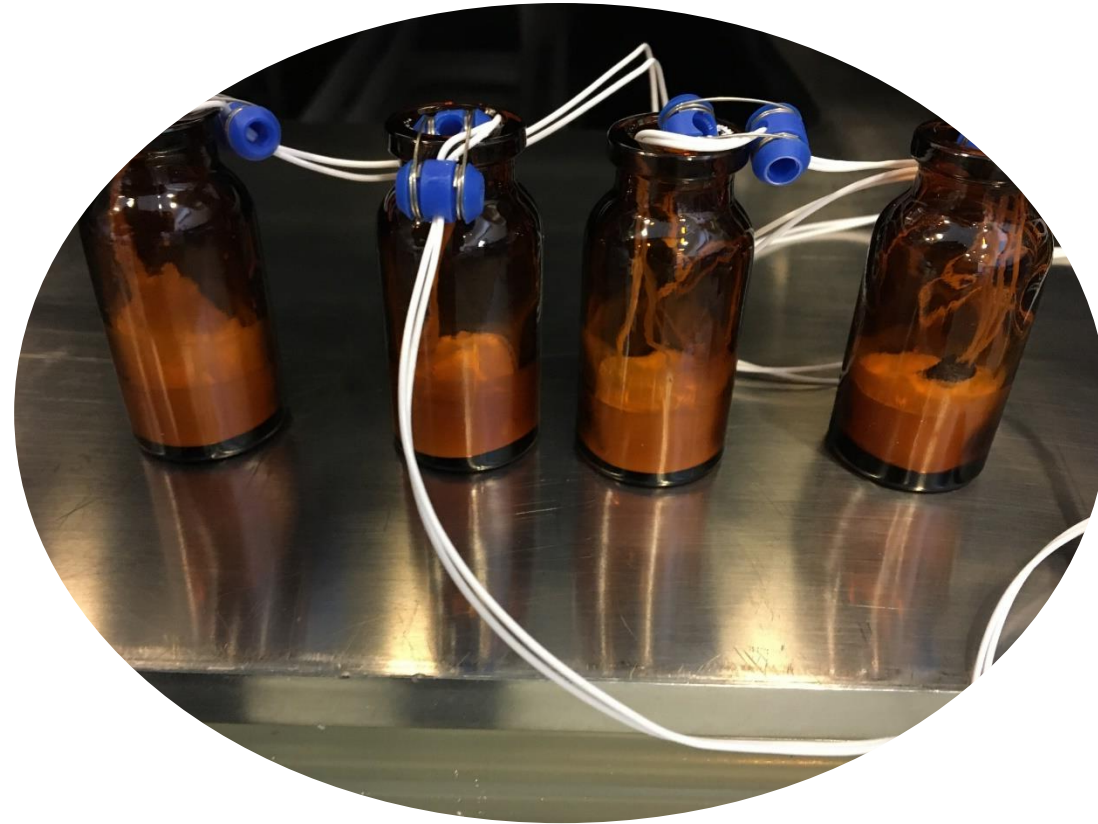
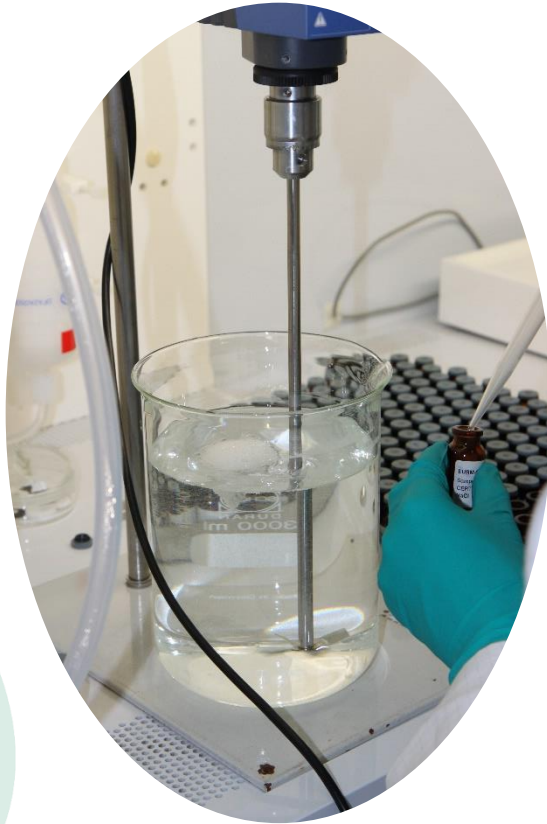
Adapt PSD



Dilute on balance



# Freeze-drying to immobilise MP in a salt cake



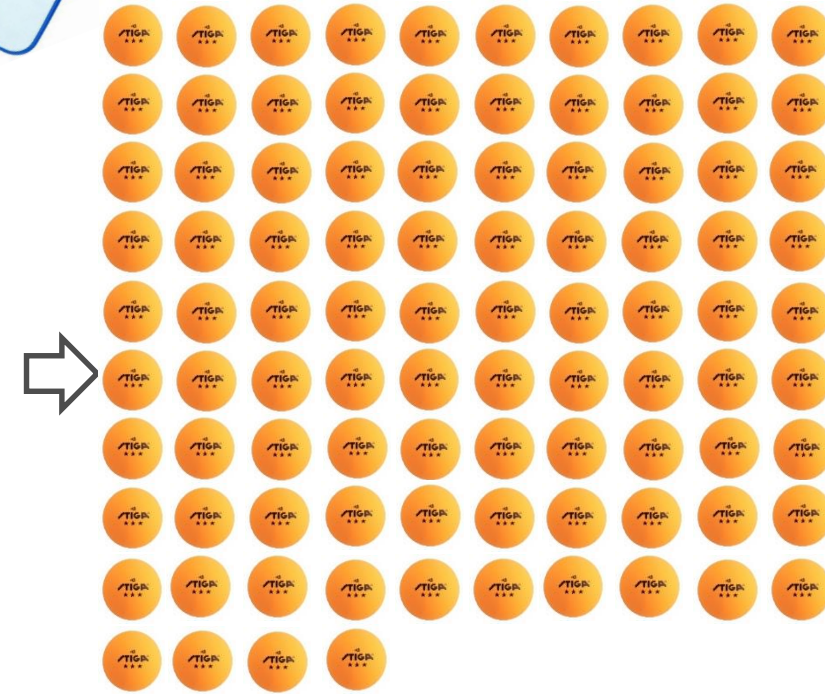
# Spiking and Recovery

100 added

Number/mass of MP particles per unit of volume



94 found



94 % recovery of c



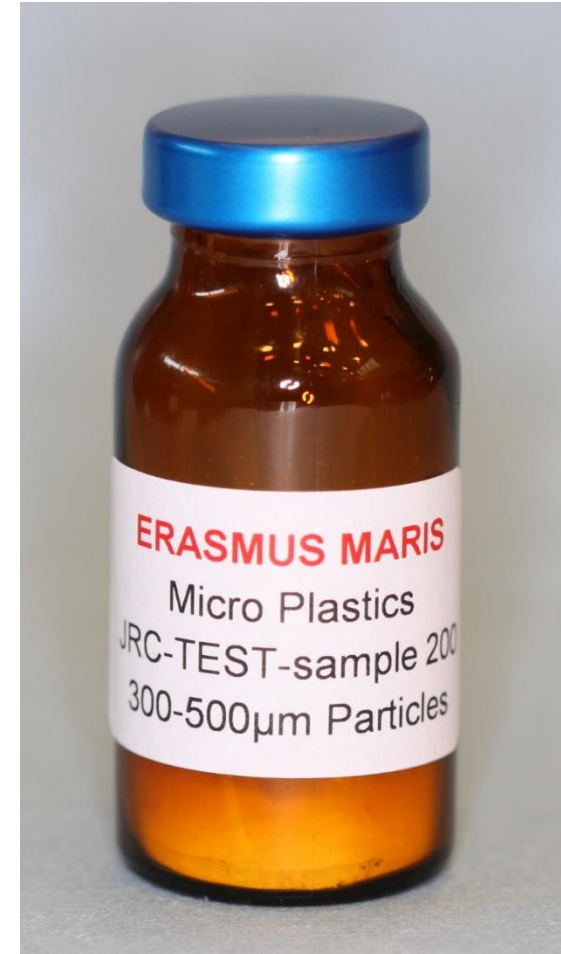
# PE/PP 300-500 $\mu\text{m}$ Ferret<sub>min</sub>



# Figures of merit

## Erasmus Maris test material for schools

- Repeatability of visual counting method 5.6 % (no spectroscopy)
- Between-bottle heterogeneity over RM-batch 5.0 % (600 samples)
- Global recovery from sea and river water  $85 \pm 11$  % (n = 24) with digestion step  $\text{ClO}^-$
- At this point the actual number of particles per vial cannot be revealed



# Validation of school-method

## Recoveries in sea water, %

Operator 1	Day 1	Day 2
Replicate 1	82	92
Replicate 2	75	93
Replicate 2	67	91
<b>Average</b>	<b>74 %</b>	<b>92 %</b>

Operator 2	Day 1	Day 2
Replicate 1	95	99
Replicate 2	80	91
Replicate 2	79	90
<b>Average</b>	<b>85 %</b>	<b>93 %</b>

## Recoveries in river water, %

Operator 1	Day 1	Day 2
Replicate 1	90	89
Replicate 2	86	90
Replicate 2	57	87
<b>Average</b>	<b>78 %</b>	<b>89 %</b>

Operator 2	Day 1	Day 2
Replicate 1	92	77
Replicate 2	90	80
Replicate 2	97	78
<b>Average</b>	<b>93 %</b>	<b>79 %</b>

Mean recovery from sea and river water  $85 \pm 11$  % (n = 24)

# Planned Inter-laboratory comparison within Erasmus Maris in 2024

## Secondary schools

Validated school method executed by trained teachers and students



## EM Scientific Alliance

More sophisticated analytical methods based on instrumental analysis



# Conclusions

A generally applicable concept using suspensions was developed for all kinds of MP-RMs (mass, number and type of polymer can easily be adapted)

Candidate RMs have been processed, checking each vial, mass of salt suspension and salt cake, upscaling proved and possible!

RM-batches produced under spotless conditions (as we only want to weigh MP!)

Validated and simplified SOP  $85 \pm 11$  % recovery in sea and river water





# EC-JRC's on-line reference material catalogue

- <https://crm.jrc.ec.europa.eu/>

QR-code to catalogue

European Commission Certified reference materials catalogue

Home About us Frequently asked questions Legal notice My account/login Contact us


European Commission > EU Science Hub > Reference and Measurement >  
Home > Search (erm-cz110) > ERM-CZ110 FINE DUST (PM2,5 like) (extractable ions)

**ERM-CZ110 FINE DUST (PM2,5 like)**  
**(extractable ions)**  
Article in stock

How to order  
Search tips  
Catalogue/price list (pdf)  
Accreditation  
Certificate revisions  
How to read our certificates  
User support / Application Notes  
Development of GMO CRMs  
Participation in CRM projects  
News

Put in shopping cart **€ 146,00**

Element content



**Downloads for this reference material**

- [Certificate/Prod. Info. Sheet ERM-CZ110\\_certificate.pdf](#)
- [Origin certificate ERM-CZ110\\_certificate of origin.pdf](#)
- [RM report ERM-CZ110\\_report.pdf](#)
- [SDS ERM-CZ110\\_msds.pdf](#)

**Product information**

CRM code	ERM-CZ110
Description on the invoice	FINE DUST (PM2.5 LIKE)™
Sales unit	vial
Net mass	0.150
Gross mass	30.000
Mass unit	Gram (g)
Storage temperature	+4 °C
Transport comment	Cooled shipment by courier service
Other information	to be opened with a 20 mm decapper



# <https://academy.europa.eu/courses/estimation-of-uncertainties-and-the-use-of-reference-materials-eurm>



The poster features a blue background with a white box containing the text 'Training course on the use of reference materials'. To the left of the box is a small vial labeled 'ERM-AD624'. The vial label includes 'Sample No. 00', 'CERTIFIED REFERENCE MATERIAL', 'Listeria monocytogenes', 'agarose plug', and 'European Commission, JRC'. The text '#EUAcademy' is written in yellow at the bottom right of the white box. The European Commission logo is in the top right corner. The bottom of the poster has a yellow bar with the text 'eu|academy'.

ERM-AD624  
Sample No. 00  
CERTIFIED REFERENCE MATERIAL  
Listeria monocytogenes  
agarose plug  
European Commission, JRC  
Tel: +32 (0) 24 45 11 11

European Commission

Training course  
on the use of  
reference materials

#EUAcademy

eu|academy





*Making science attractive!*

*Erasmus Maris - Citizen Science 2.0*

*Understanding the scientific process in a real-life situation*

## SCIENTIFIC PROCESS

**Ideation**

Hypothesis

**Gathering**

Teams  
Resources

**Study Design**

**Implementation**

sampling / analysis

**Evaluation**

**Dissemination**

Critical  
thinking

Active  
Participation  
(Data collection)

Awareness on the  
environmental issue

*Upper Secondary schools 15+ years*



# Approach to Citizen Science 2.0



Scientists empower the teachers



Teachers empower secondary school pupils

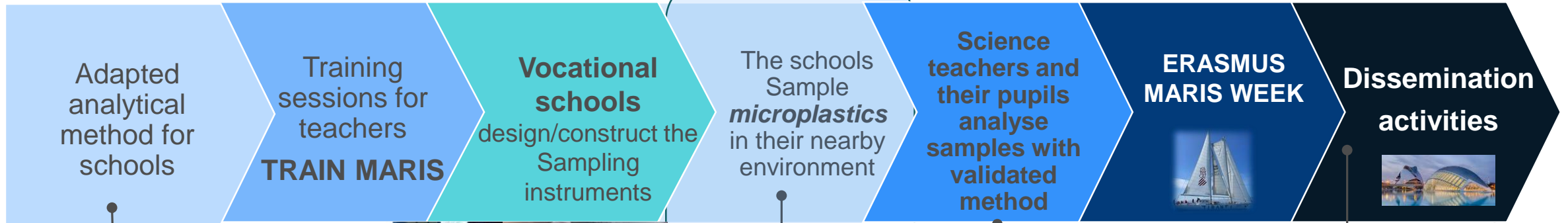


Pupils join forces between themselves and with scientists / teachers



Implementation of QA/QC tools and analytical methods

QA/QC



Validation of the method according to international standards using a **Reference Material**



**Inclusiveness - multiple skill sets necessary!**

**Citizen science 1.0**

**NB. Science teachers' results make up the reference data for reporting**

**Pupils and scientists discuss the scientific outcome**

**Pupils perform awareness campaigns**

**Scientists and teachers could publish results in sci-journals**





# Building blocks of *Erasmus Maris*

## Core Concept

*Empowerment within different teams*



**TrainMaris**  
Scientists empower teachers



**Scientific field campaigns**  
Teachers empower pupils

**Erasmus Maris Week**

Pupils join forces

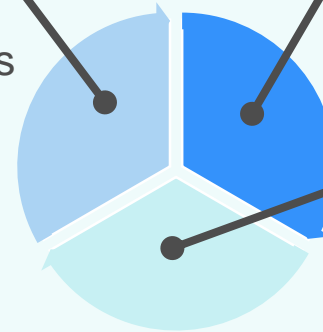


## Erasmus Maris' Alliances

*Guidance mechanism for implementation*

*Guiding implementation within respective domains*

Erasmus Maris Scientific Alliance



EM Educational Alliance

EM Nautical Alliance

## Regional Hubs

*Real world environments for testing and validation*

Focused and controlled implementation process

Customisation in function of regional needs

Building Momentum through success stories



Collaborative and interactive spaces targeting:

Teachers → **TrainMaris**

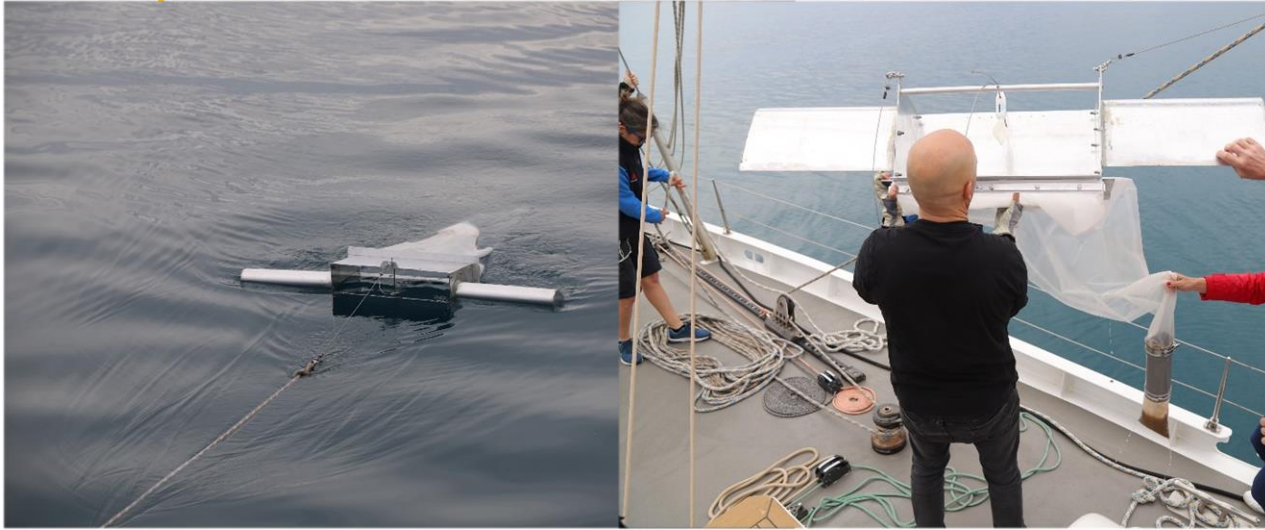
Students → **Erasmus Maris Week**



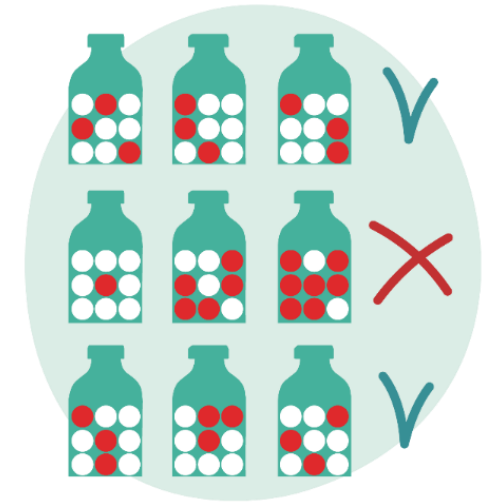
# Manta Net for sampling of micro-plastics



# Erasmus Maris in the field

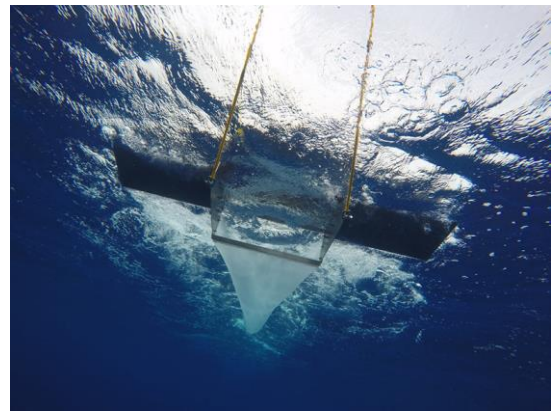






<https://www.erasmusmaris.eu/>

[eu/](https://www.erasmusmaris.eu/)



# Thank you and keep in touch



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