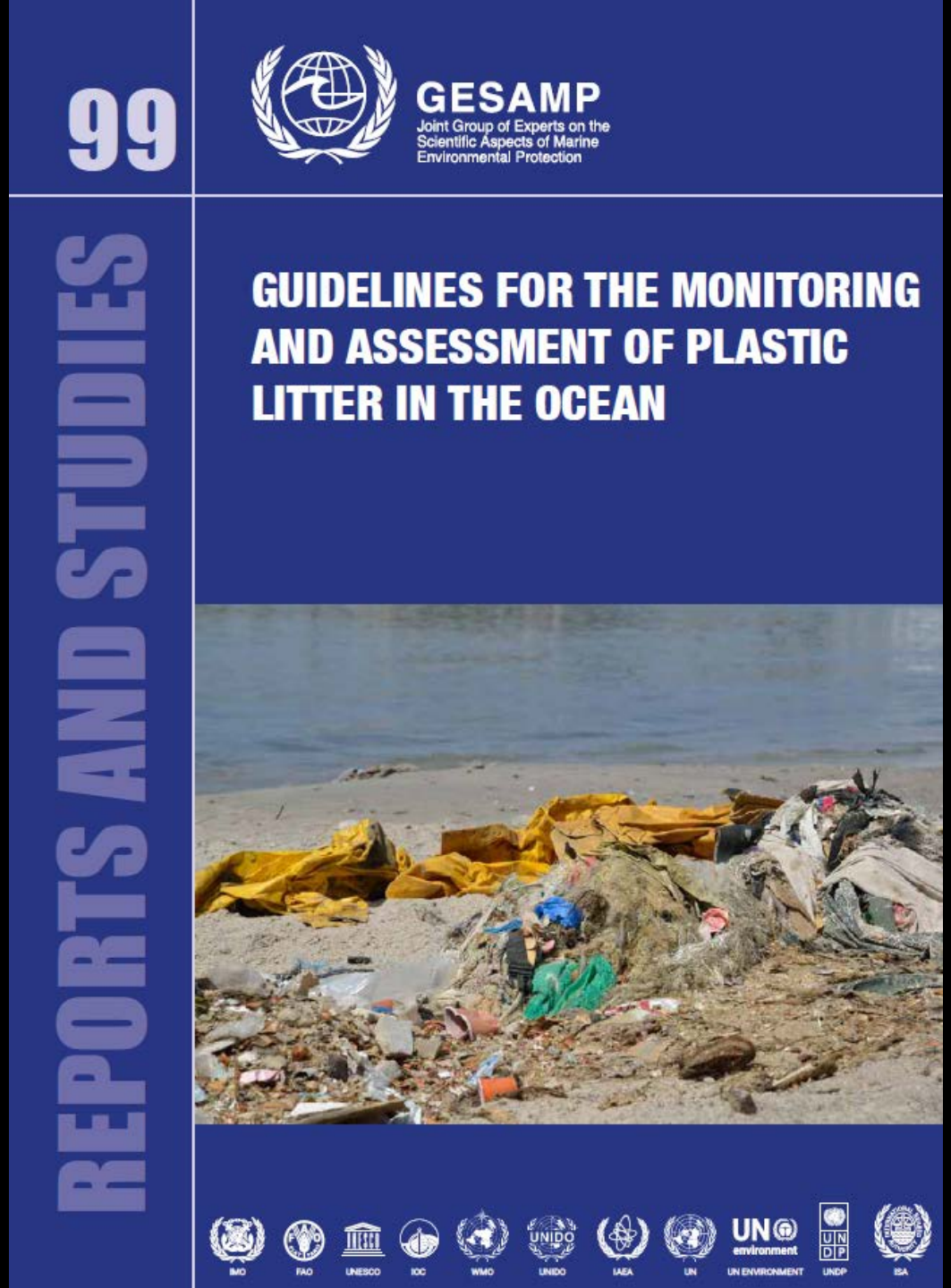


**Dr. Sherri "Sam" Mason**
**Sustainability Coordinator**
**Penn State Behrend**

http://www.gesamp.org/publications

## What do you want to know?

- Where, what & how much litter is there?
- Is there a trend in space or time?
- What are the potential sources?
- What impacts are being caused?
- Can mitigation measures be identified?
- Are mitigation measures effective?

## Where do you look?

- SHORELINE
- SEA SURFACE & WATER COLUMN
- SEA FLOOR
- BIOTA

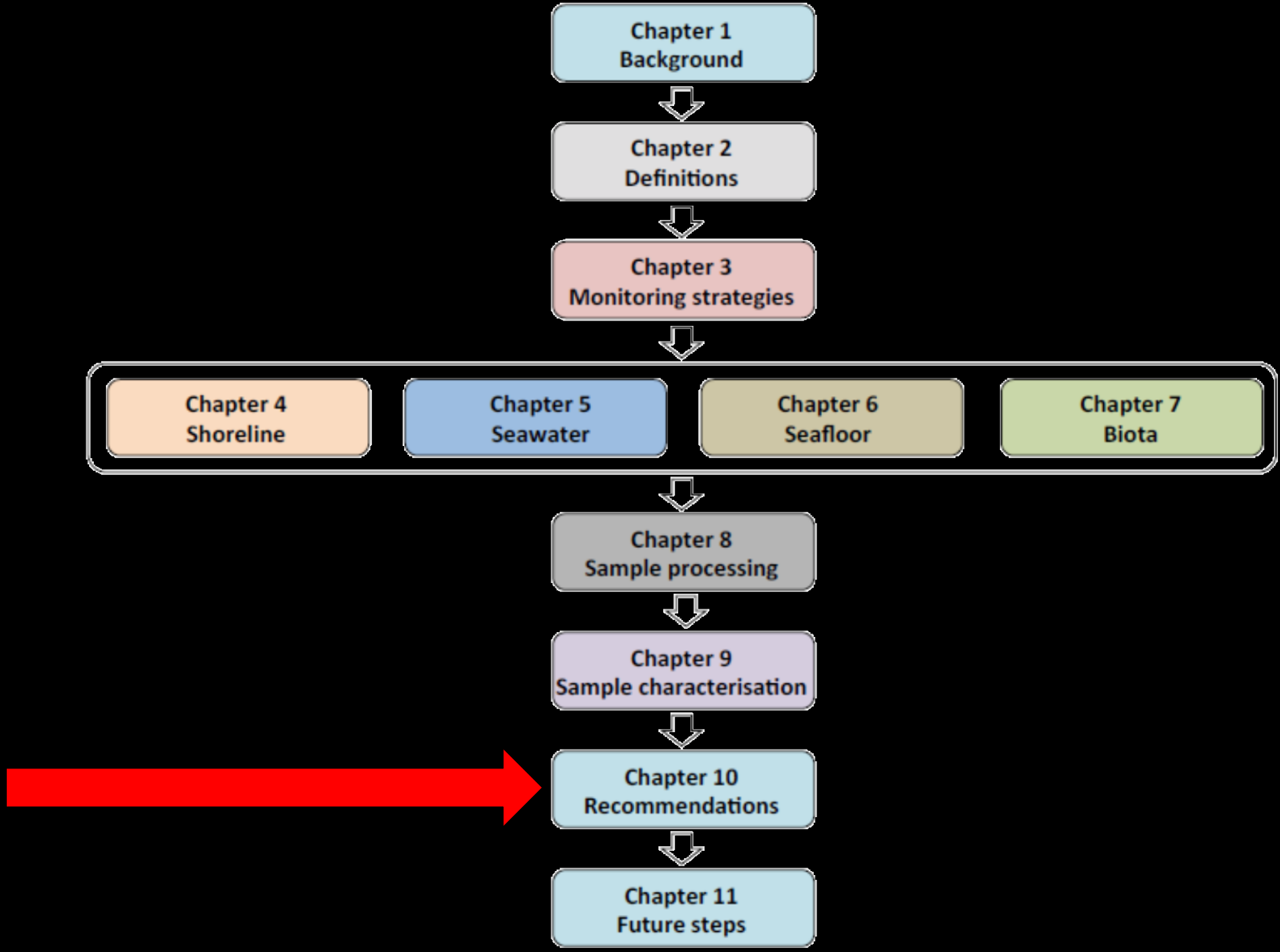
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**Table 10.3:** Estimated costs and level of expertise for the different protocols adapt
L: Low (< 10K USD) ; M Medium (<50K USD); H High (<100K USD); VH Very High (>100K
Vehicles.

| Component | Beach | Seafloor | | | Seawater | | Biota | | M |
|---|---|---|---|---|---|---|---|---|---|
| Protocol | Visual | Diving <20m | Trawling <800 m | ROV* | Trawl | Ship surveys | Ingested | Entanglement | |
| Sampling | L | M | M | VH | L | M | M/H | M/H | L |
| Processing | L | L | L | M | L | M | H | M | M |

**Table 10.4.** Overview of sampling protocols for different litter size categories at three main shoreline types: Sandy Beaches, Rocky Shores (including cobble and boulder beaches) and Mangroves and Salt Marshes. R = recommended, F = feasible,. Values in parentheses indicate approximate transect widths to sample for different litter size categories.

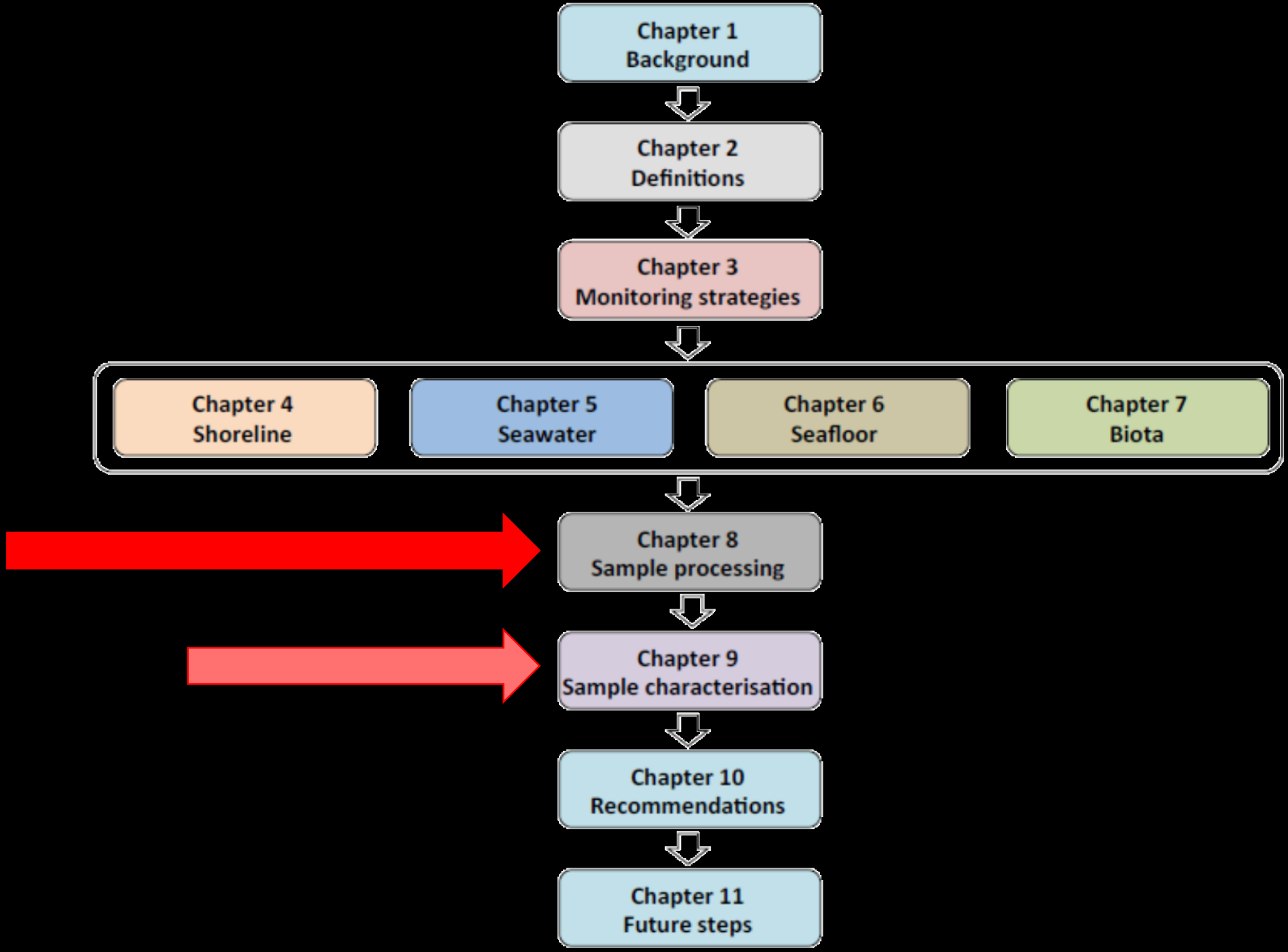
| Survey goal | Size | Sandy beaches | Rocky shores | Mangroves and Salt Marshes | Comments |
|---|---|---|---|---|---|
| Baseline surveys | Mega | R | F | F | One-off visual surveys |
| | Macro Surface | R | F[a] | F | One-off visual surveys |
| | Macro Buried | F | | | Sieve to collect litter; sample to at least 10 cm deep |
| | Meso | R | | | Sieve to collect litter to ≥5-10 cm deep |
| | Micro | F (core) | | F (cores) | Surface sieving or sediment cores |
| | | R | F | | Mark litter and resample at regular intervals |
| | | R | F | F | Remove litter and re-sample |
| | | | | | Accumulation estimates not feasible |

**Table 10.5** Overview of sampling protocols for different plastic size categories in two compartments. R = recommended, F = feasible.

| Compartment | Size | Recommendation | Method | Comments |
|---|---|---|---|---|
| Water Surface | Mega | F | Aerial survey | Expensive to charter a plane. |
| | Mega | R | Visual survey | Use ship as the platform to conduct survey. |
| | Macro | R | Visual survey | See above |
| | Meso | R | Net tow | Affordable a |
| | Micro | R | Net tow | Affordable a |
| | Micro | F | Bulk water pump | Costs involv microplastic |
| Water Column | Mega | F | Fisheries observer | Cost effecti |
| | Macro | F | Fisheries observer | Cost effecti |
| | Meso | F | Bulk water pump | Costs involv microplastic |
| | Meso | R | Underway sampling | Cost effecti training. |
| | Meso | F | Bongo net | Need vessel |
| | Micro | F | Bulk water pump | Costs involv microplastic |
| | Micro | R | Underway sampling | Costs involv microplastic |
| | Micro | F | Bongo net | Need vessel |

**Table 10.8** Overview of sampling protocols for different litter size categories in biota R = recommended, F = feasible.

| Survey goal | Size | Marine mammals | Birds | Fish | Invert-ebrates | Corals | Epibionts | Remarks |
|---|---|---|---|---|---|---|---|---|
| Ingestion | Mega | F | | | | | | Opportunistic, strandings |
| | Macro | F | R | | | | | OSPAR monitoring |
| | Meso | F | R | | | | | |
| | Micro | F | R | R | R | F | F | |
| Entanglement | Mega | R | R | | | F | | Opportunistic strandings |
| | Macro | R | R | | | F | | |
| | Meso | | | | F | F | | |
| | Micro | | | | | | | |
| Habitat | Mega | | | | | R | R | |
| | Macro | | R | | | F | R | |
| | Meso | | F | | | F | R | |
| | Micro | | | | | | R | |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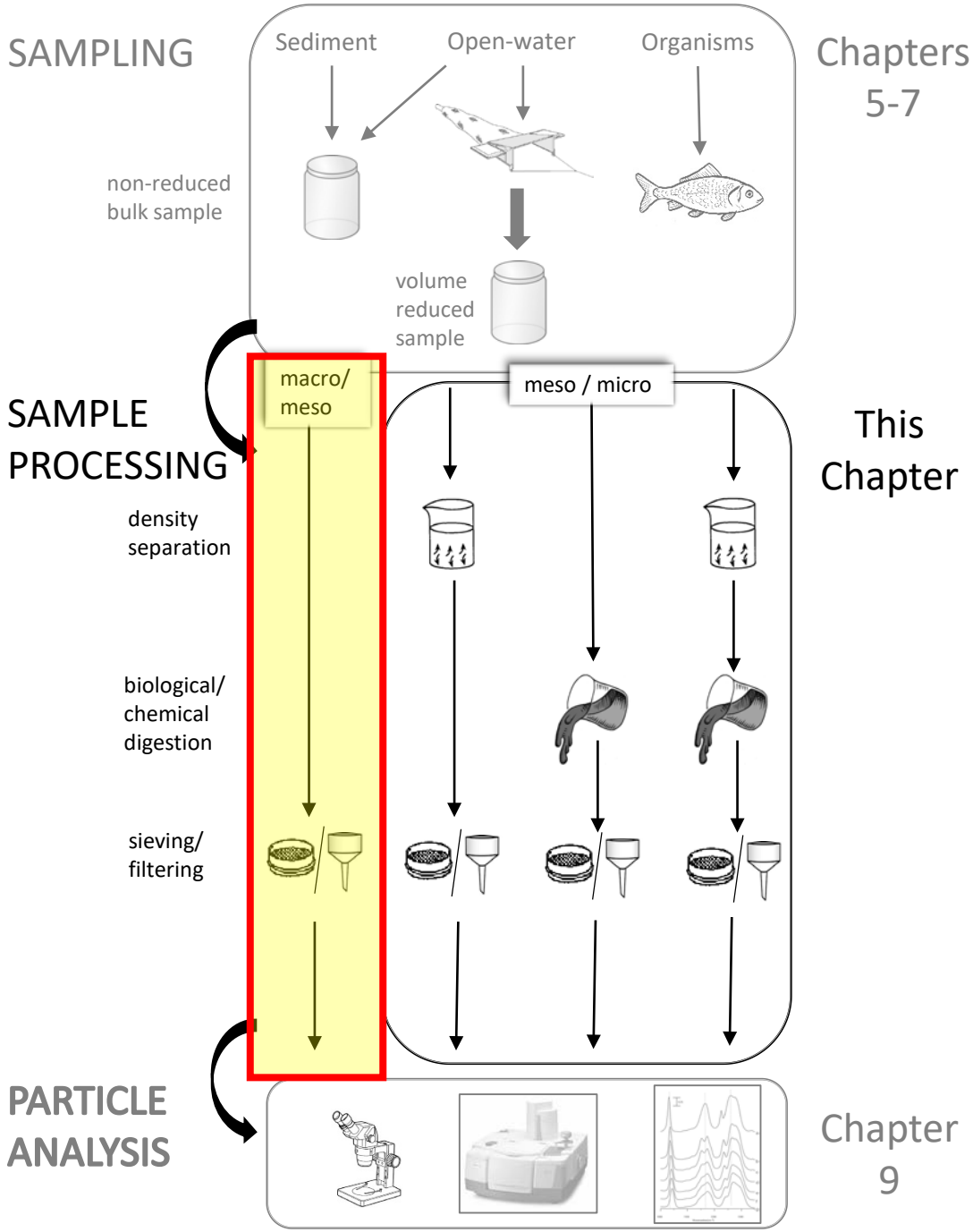
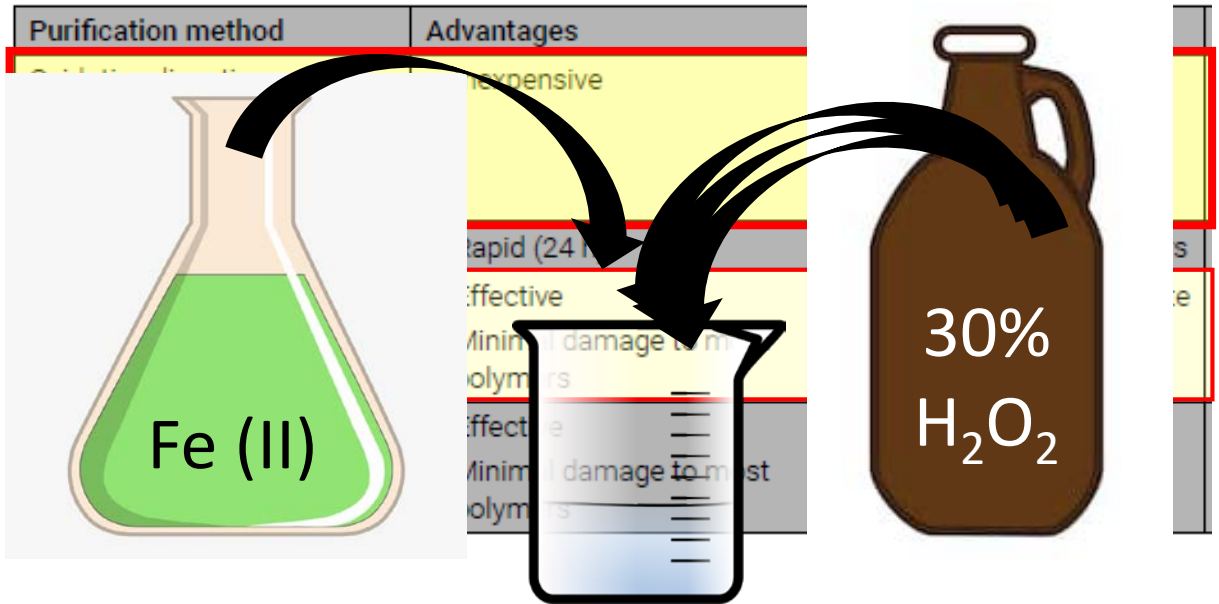



# Density Separation

| Salt | Density (g cm-3) | Reference |
|---|---|---|
| Sodium Chloride (NaCl) | 1.2 | Hidalgo-Ruz *et al.* 2012 |
| Sodium Polytungstate (PST) | 1.4 | Hidalgo-Ruz *et al.* 2012 |
| Sodium Iodide (NaI) | 1.6 | Claessens *et al.* 2013 |
| Zinc Chloride (ZnCl2) | 1.7 | Imhof *et al.* 2012 |
| | 1.6 | Zobkov and Esiukova 2017 |

# Biological/Chemical Digestion



Open Water

initial

| Salt | Density (g cm-3) |
|---|---|
| Sodium Chloride (NaCl) | 1.2 |

Eriksen et al., 2013

➢ few fibers

since

| Purification method |
|---|
| Oxidative digestion |

WPO

Mason et al., 2016a (Lake MI)
Sutton et al., 2016 (SF Bay)
Mason et al., 2016b (WWTP)
Baldwin et al., 2016 (Tributaries)

Sediment

| Salt | Density (g cm-3) | |
|---|---|---|
| Zinc Chloride (ZnCl2) | 1.6 | Zobkov and Esiukova 2017 |

| Purification method |
|---|
| Oxidative digestion |

WPO

Lenaker et al., *in prep*

Fish

| Purification method |
|---|
| Alkaline digestion |

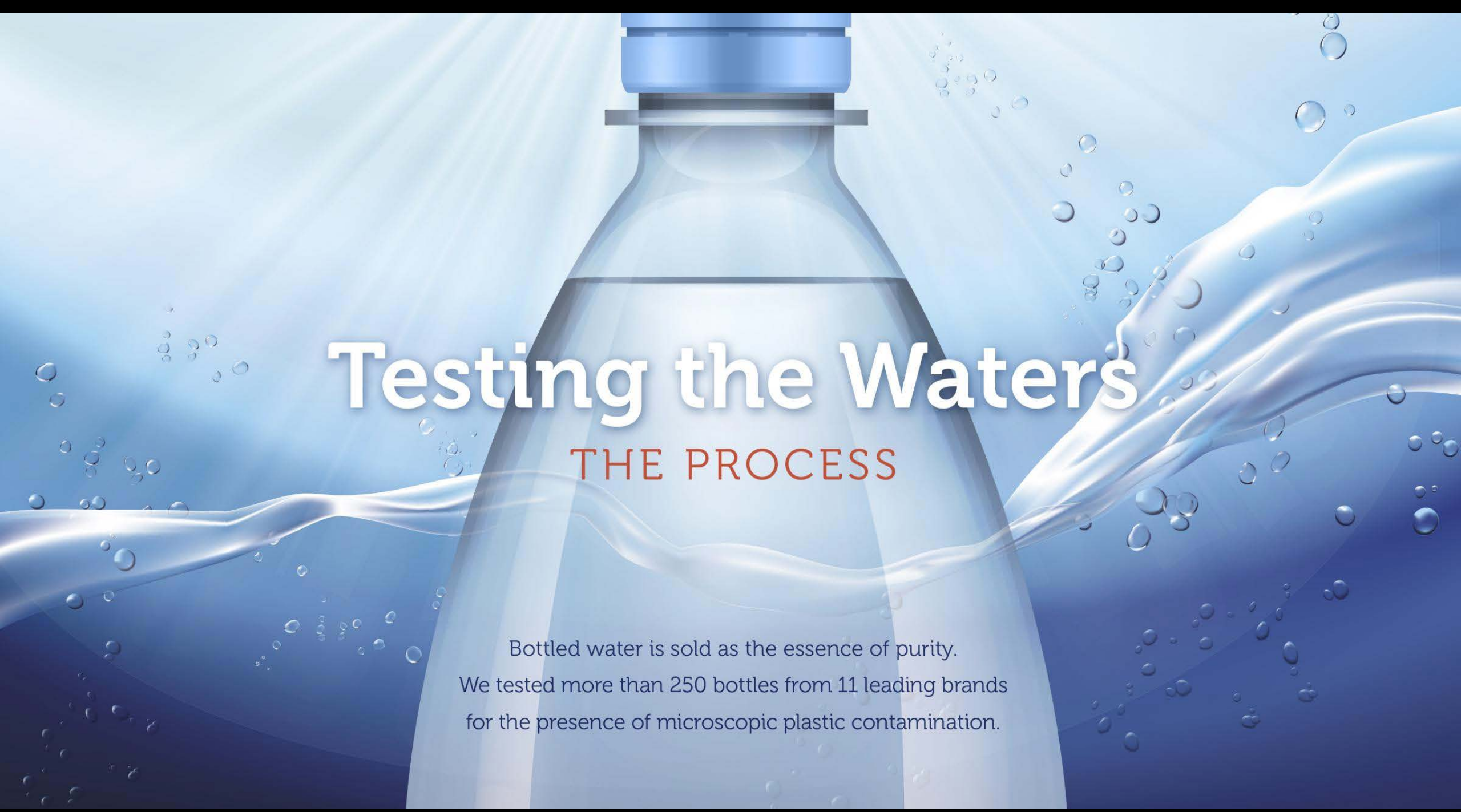
| Purification method |
|---|
| Oxidative digestion |

WPO

Ricotta et al., *unpublished work*


# BOTTLED WATER

- Mason et al., *Frontiers in Chemistry,* 2018.


Testing the Waters
THE PROCESS
Bottled water is sold as the essence of purity.
We tested more than 250 bottles from 11 leading brands
for the presence of microscopic plastic contamination.

# PREPARATION

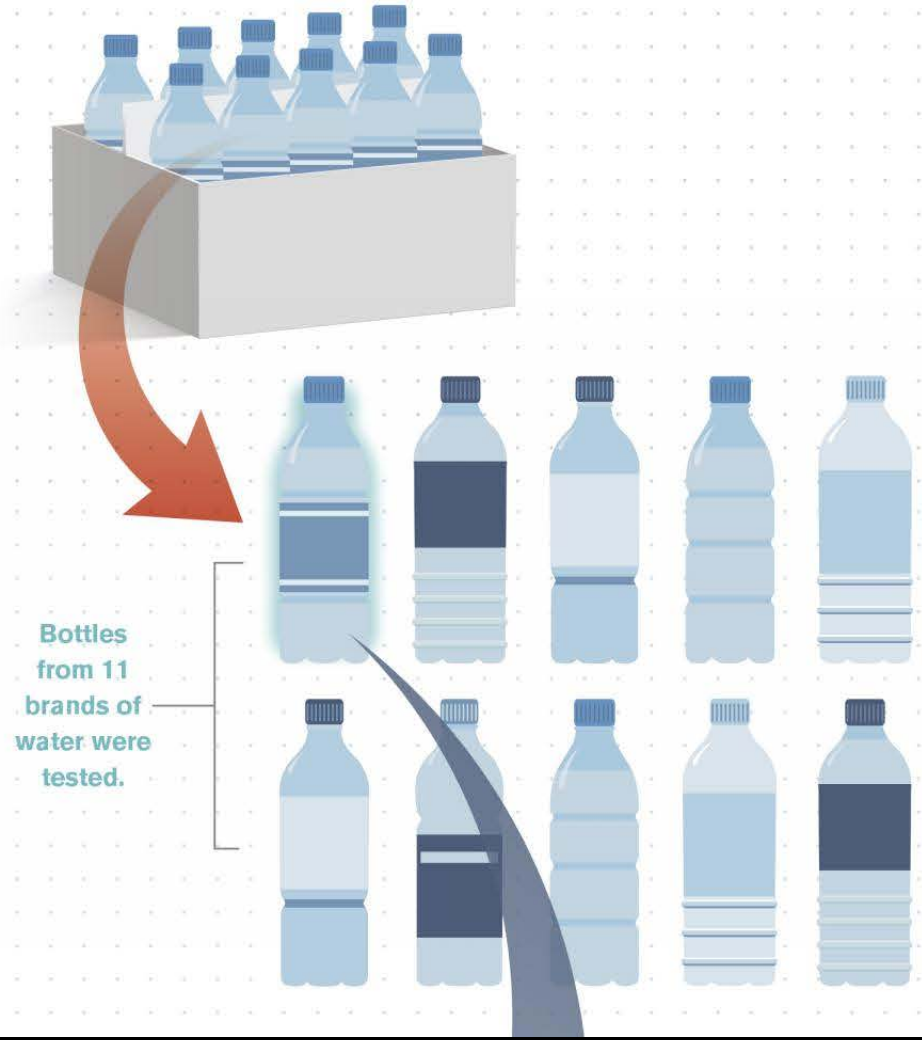
STAGE .01

FIG. I

## The sample

From each case of bottled water, 10 bottles are randomly chosen to be tested.

**Where did the bottled water come from? Discover more.**



The bottles are opened in the laboratory under a laminar airflow hood.

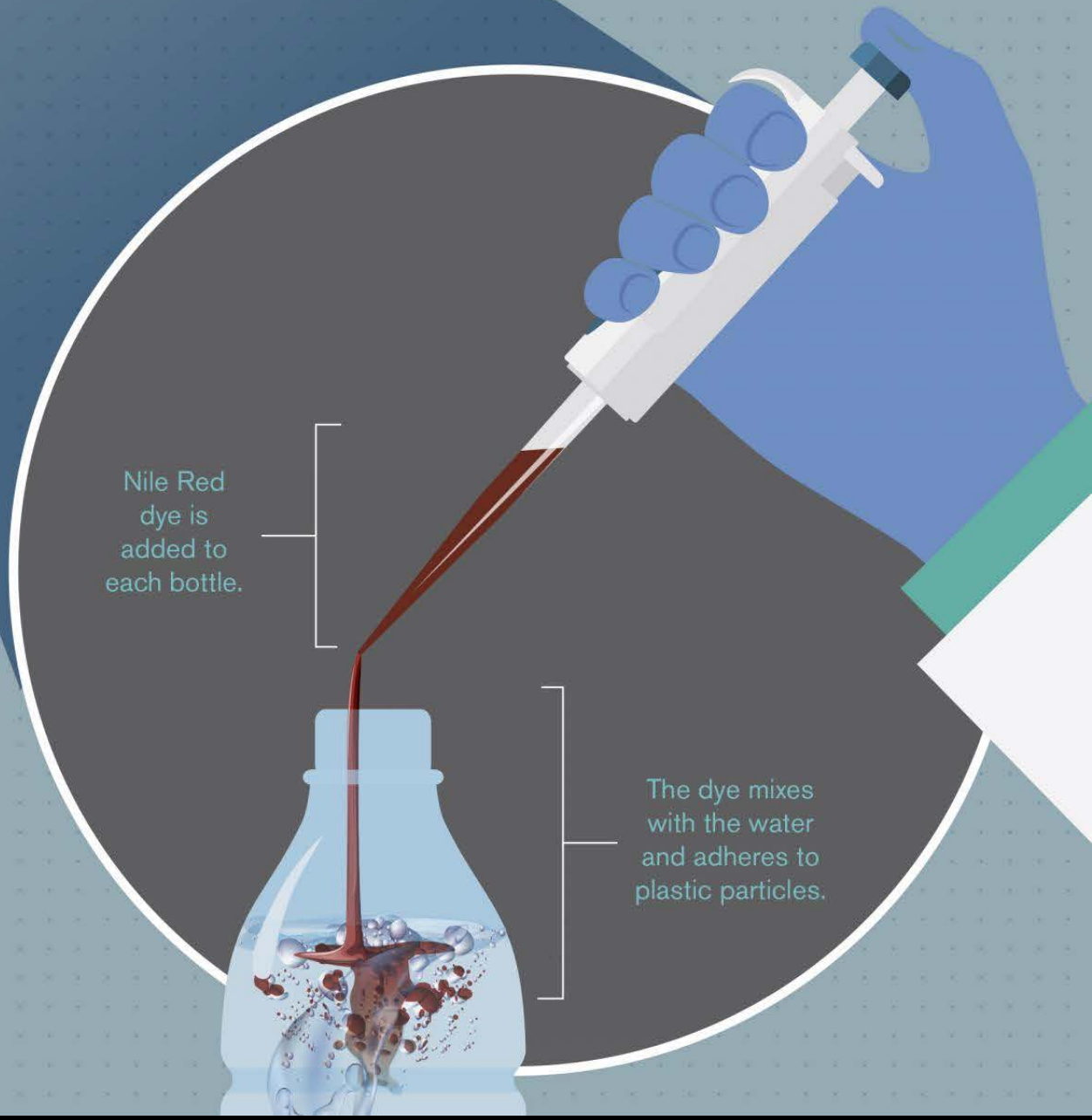
Precautions are taken to avoid contamination.

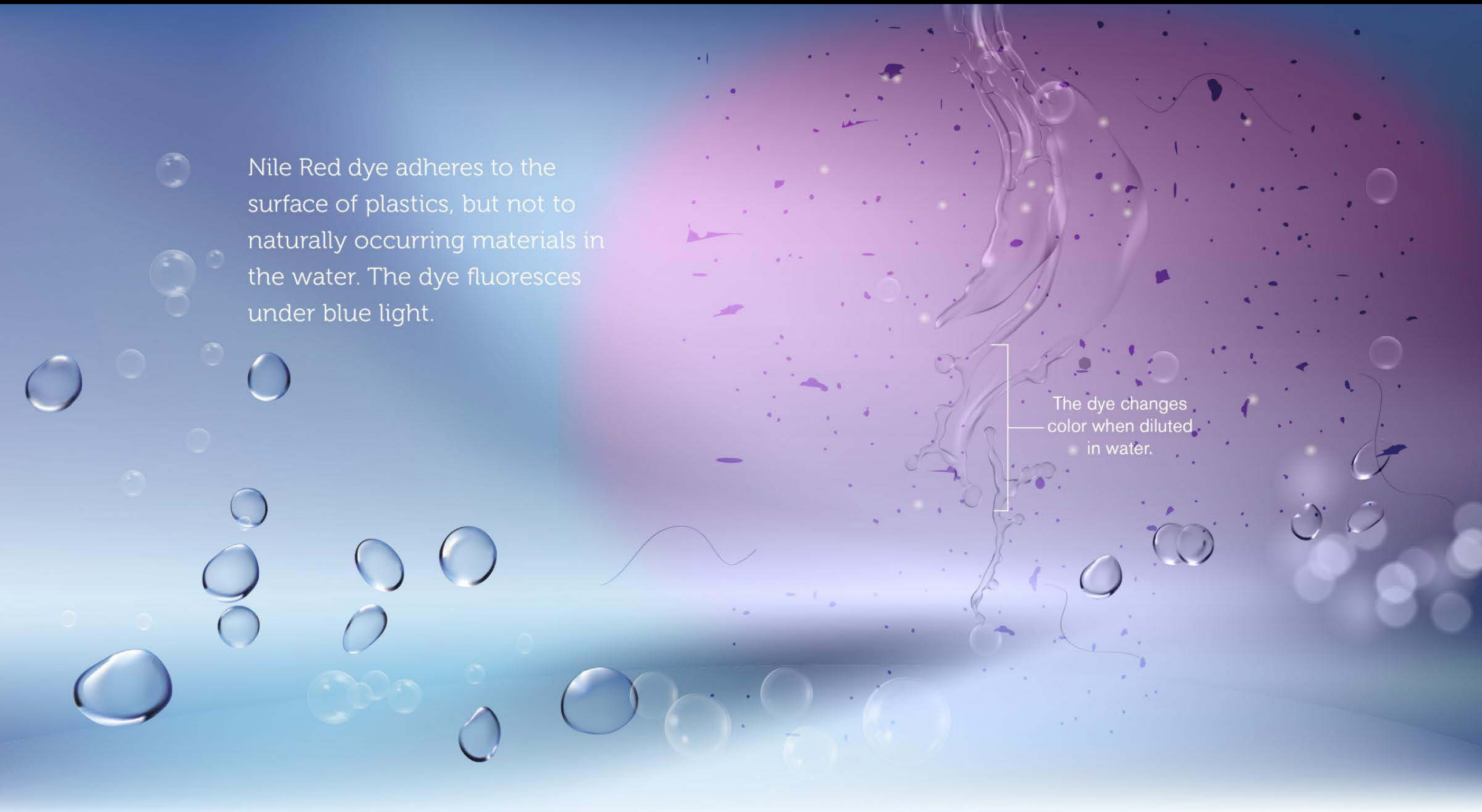
FIG. II

# Adding dye

Each bottle is injected with Nile Red dye, which attaches to plastic particles in the water.


The bottles with the dye stand in the fume hood for 30 minutes.




Nile Red dye adheres to the surface of plastics, but not to naturally occurring materials in the water. The dye fluoresces under blue light.
The dye changes color when diluted in water.

# FILTERING

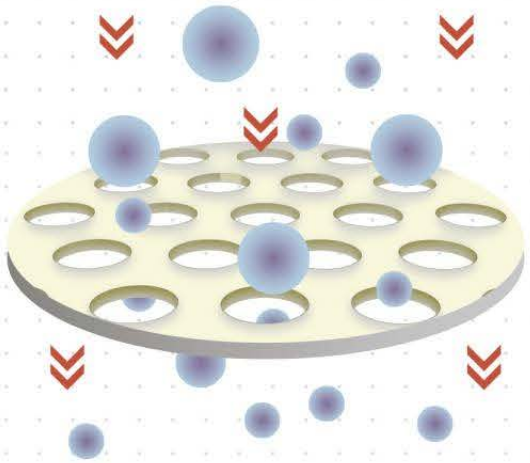
STAGE .02

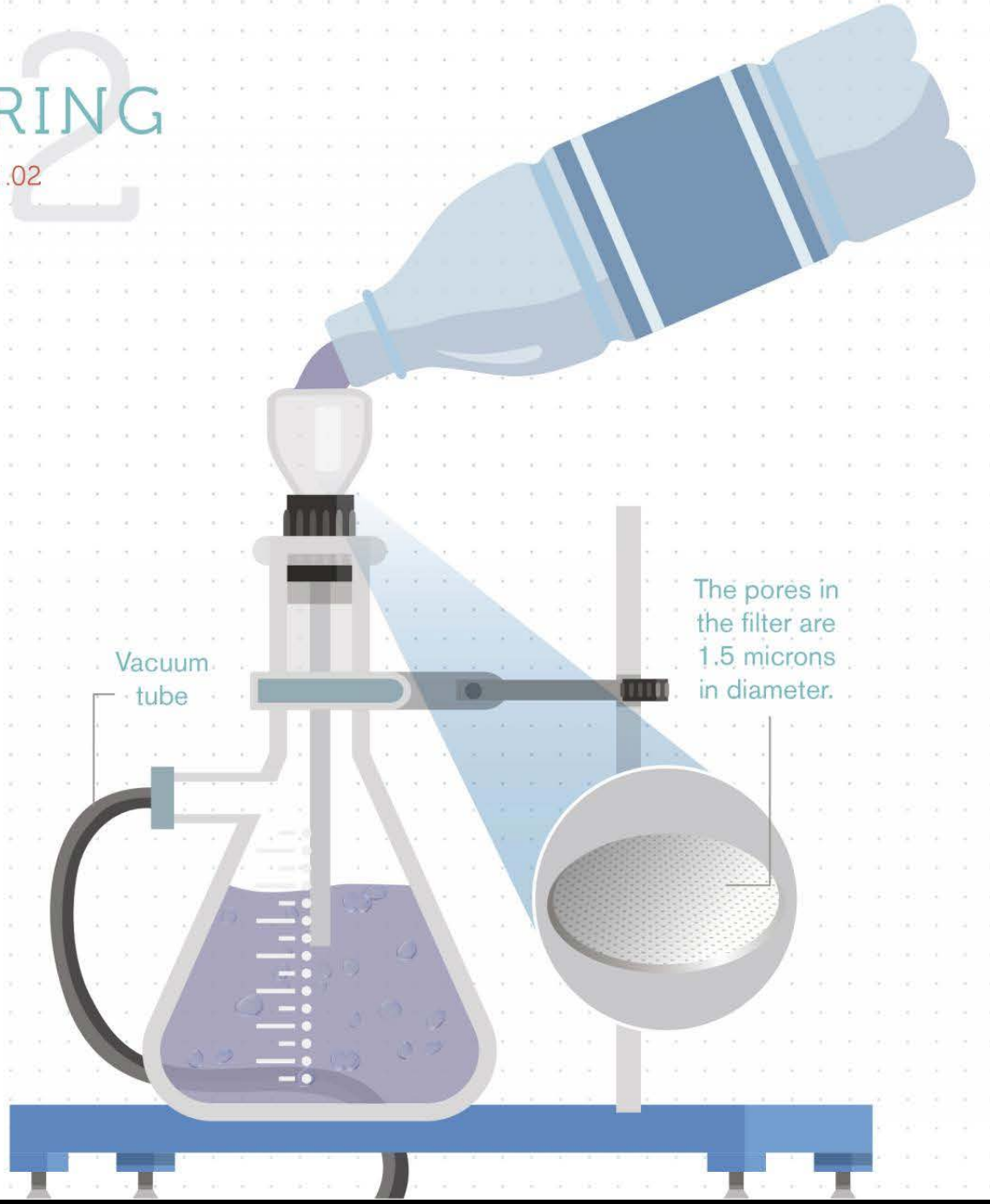
FIG. III

## Vacuum filtering

The bottled water with the dye is filtered through glass fiber filters.

Filtering is performed twice to capture particles that may have passed through the first filter.





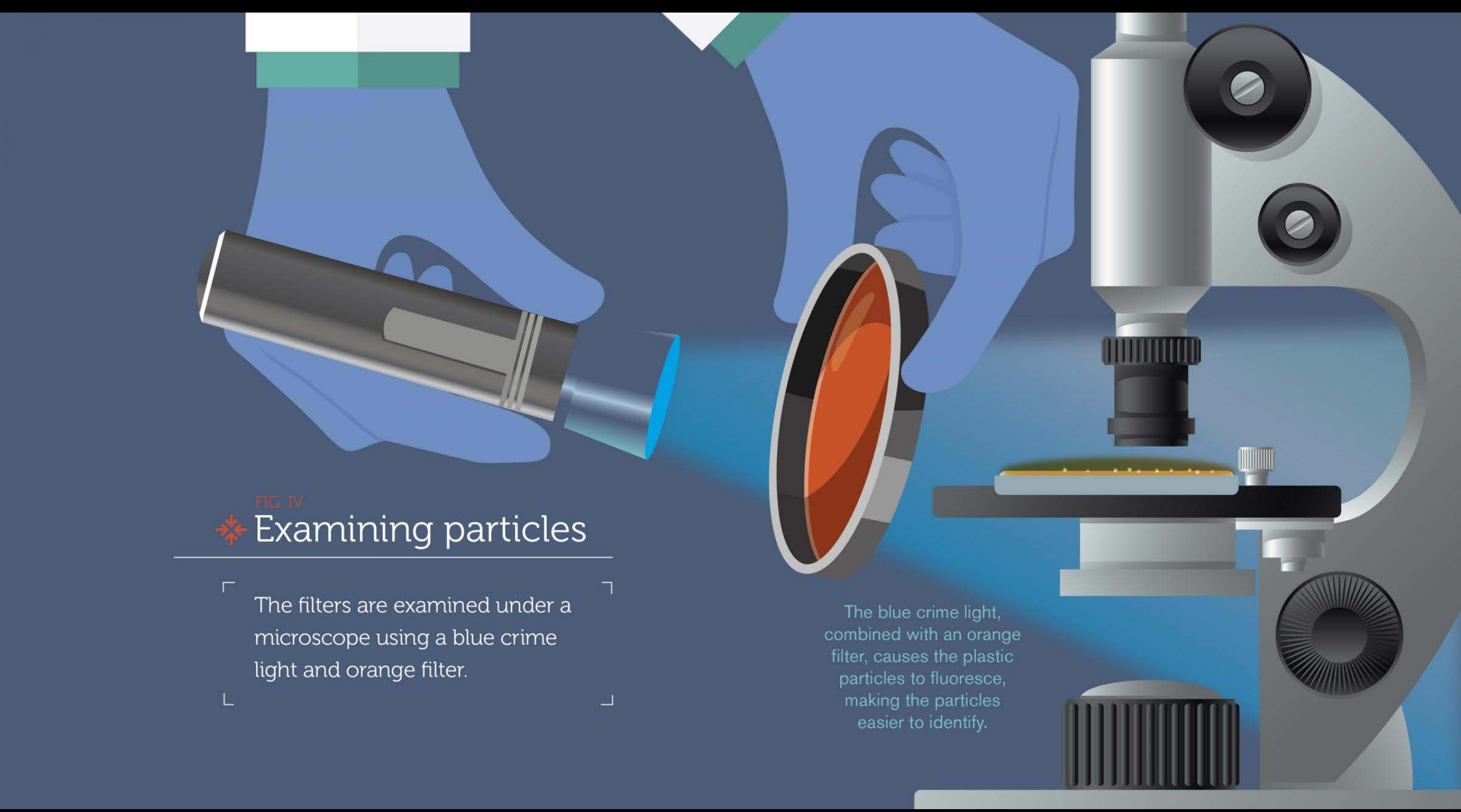
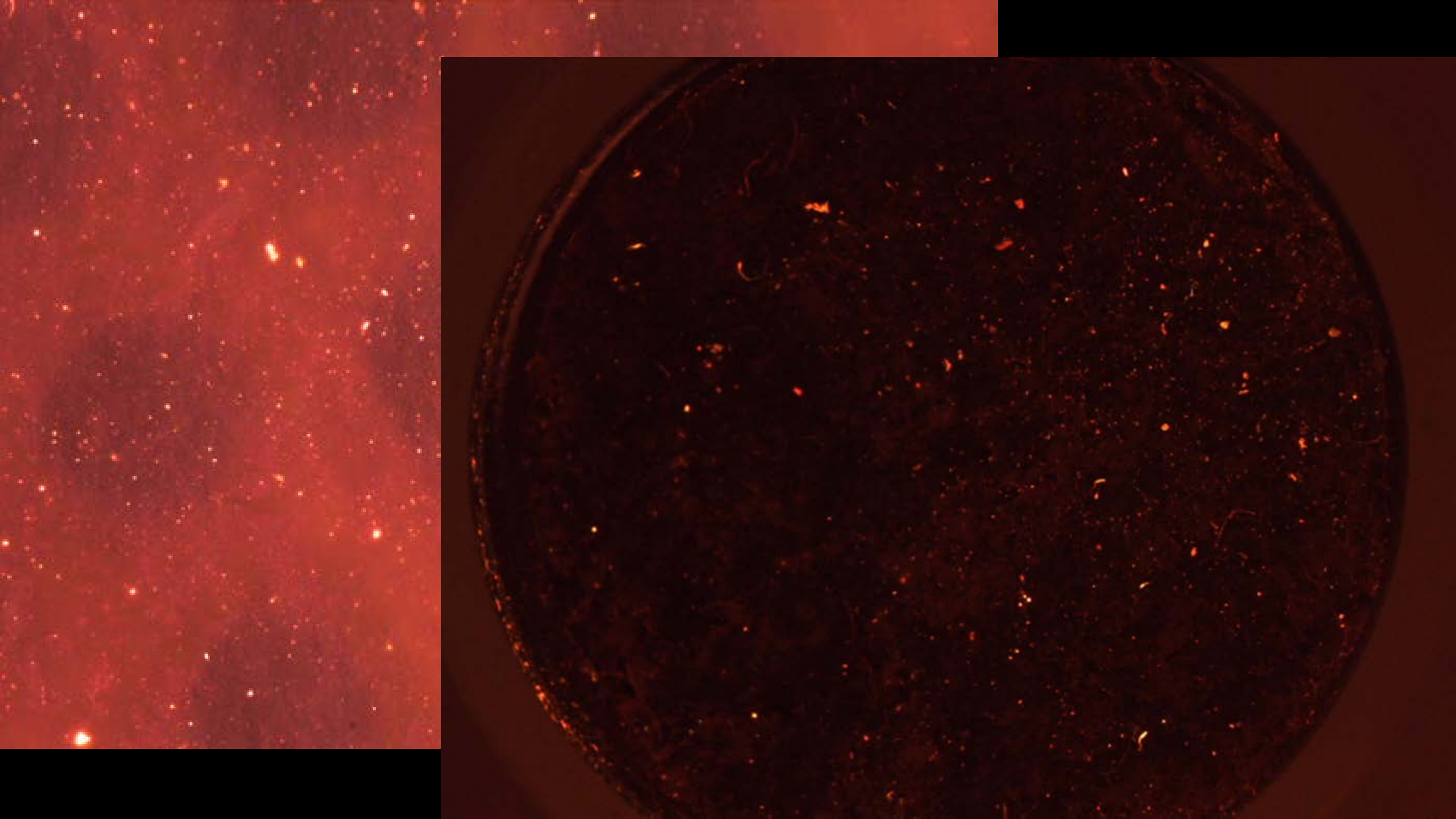


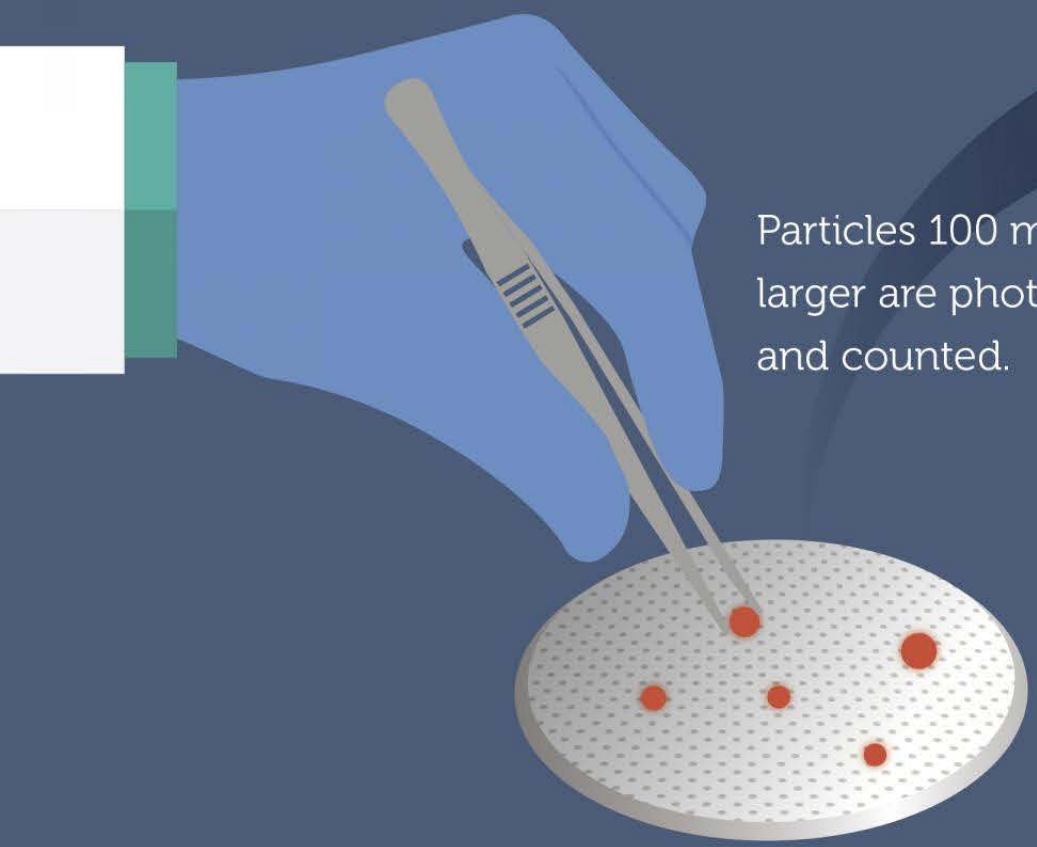
FIG. IV

## Examining particles

The filters are examined under a microscope using a blue crime light and orange filter.

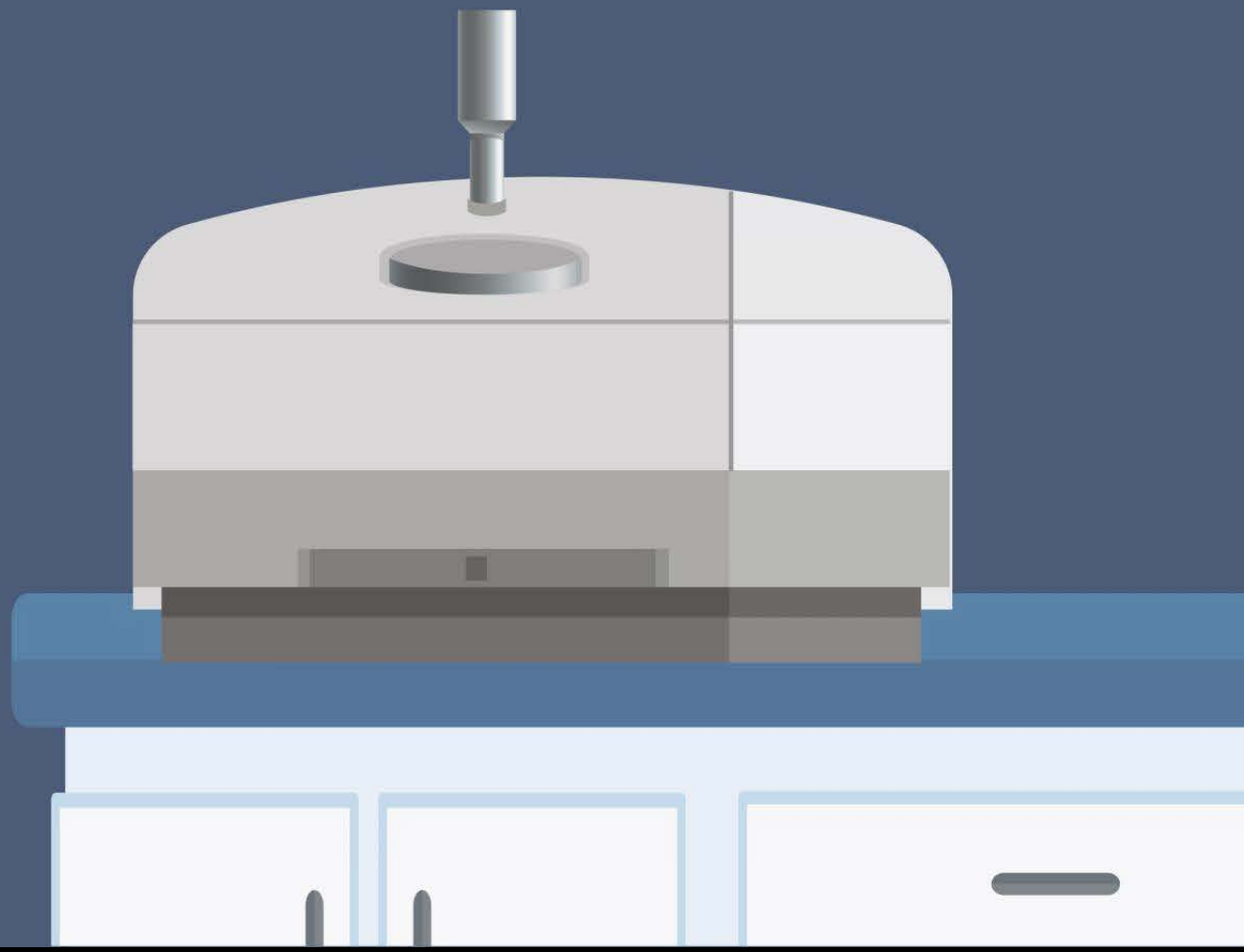
The blue crime light, combined with an orange filter, causes the plastic particles to fluoresce, making the particles easier to identify.



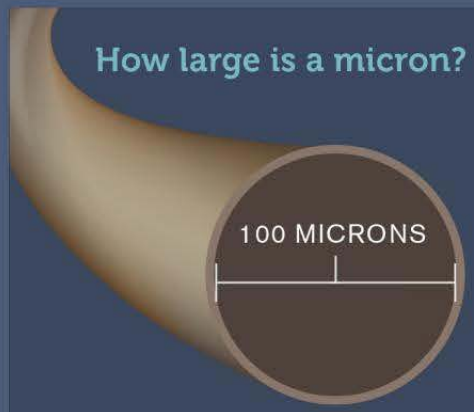


Particles 100 microns or larger are photographed and counted.

The particles are placed in a Fourier-Transform Infrared Spectrophy (FTIR) machine which uses infrared light to identify the type of plastic.



## How large is a micron?




A human hair measures approximately 100 microns in diameter

# Thank You!


THE HEINZ AWARDS

PennState Behrend

5GYRES

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