

EFFECTS OF PLASTICS AND MICROPLASTICS ON HUMAN HEALTH AND THE ENVIRONMENT

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THE PROBLEM WITH PLASTICS

What is Plastic?

What is Good about it?

What is Bad about it?

THE PROBLEM WITH PLASTICS

What is Harmful in Plastics ?

Plastics in the Environment

Human Health Effects

THE PROBLEM WITH PLASTICS

Macro Plastics

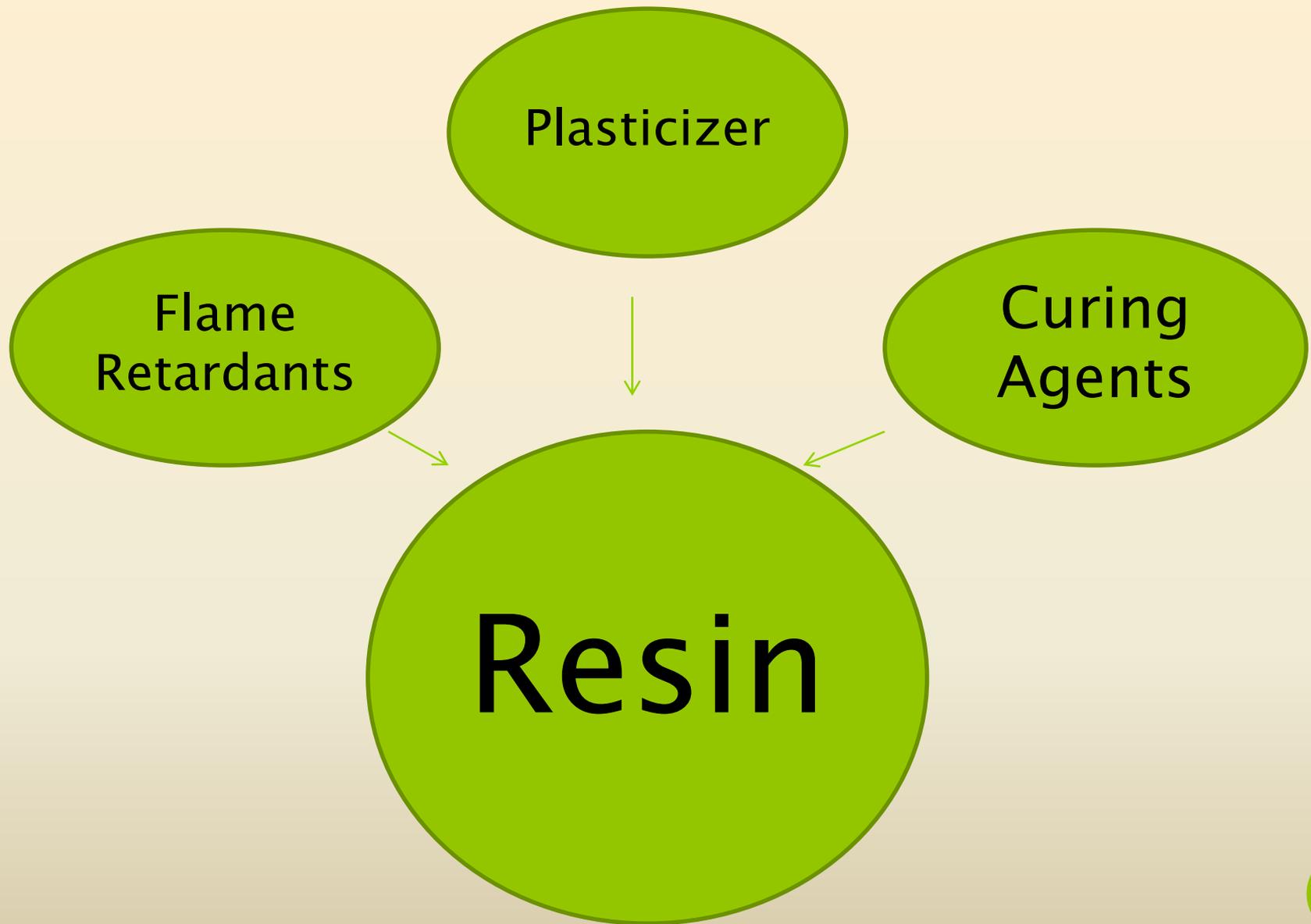
Microplastics

Particle Size/Surface Area
and Toxicity

THE PROBLEM WITH PLASTICS

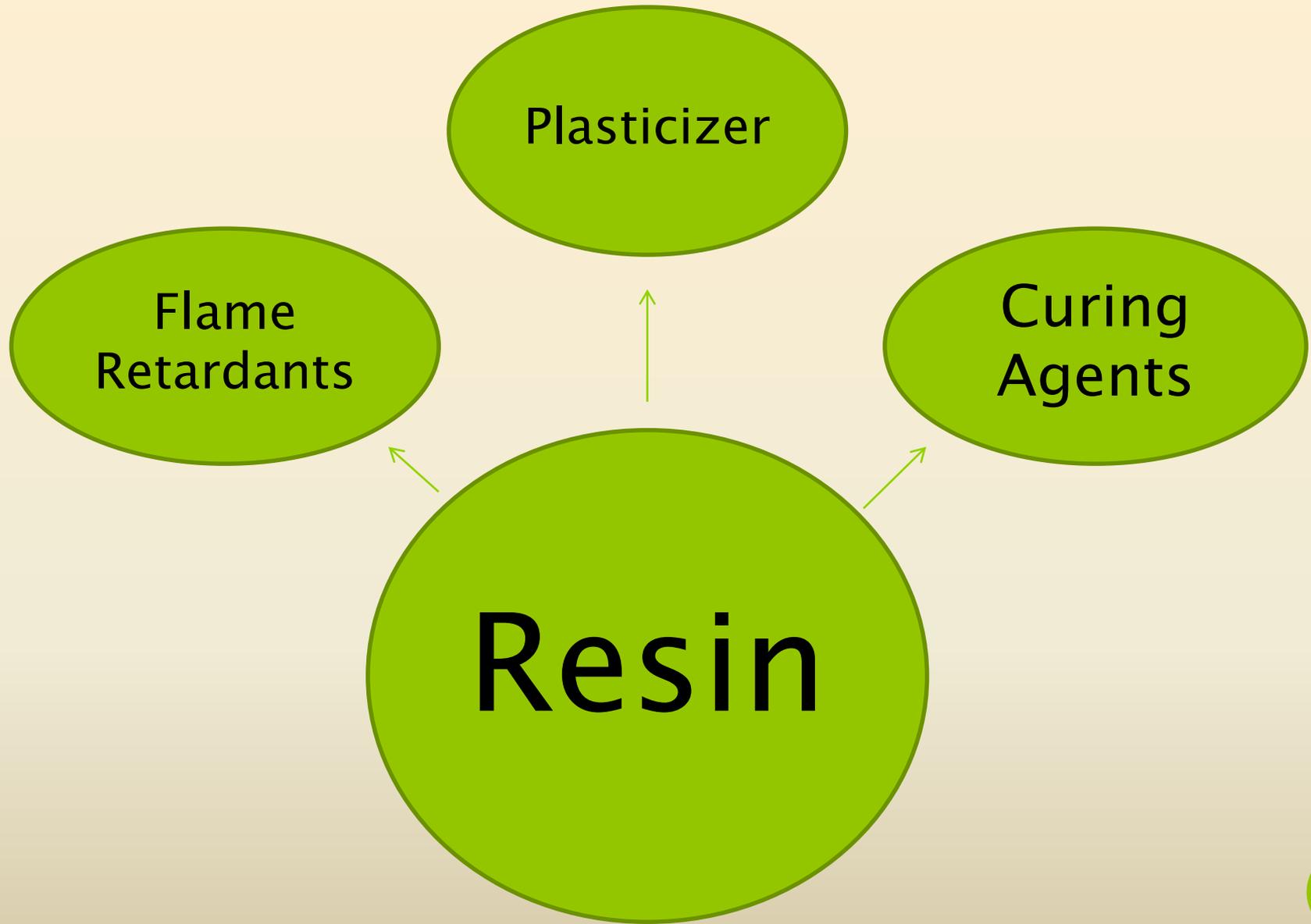
What is Plastic?

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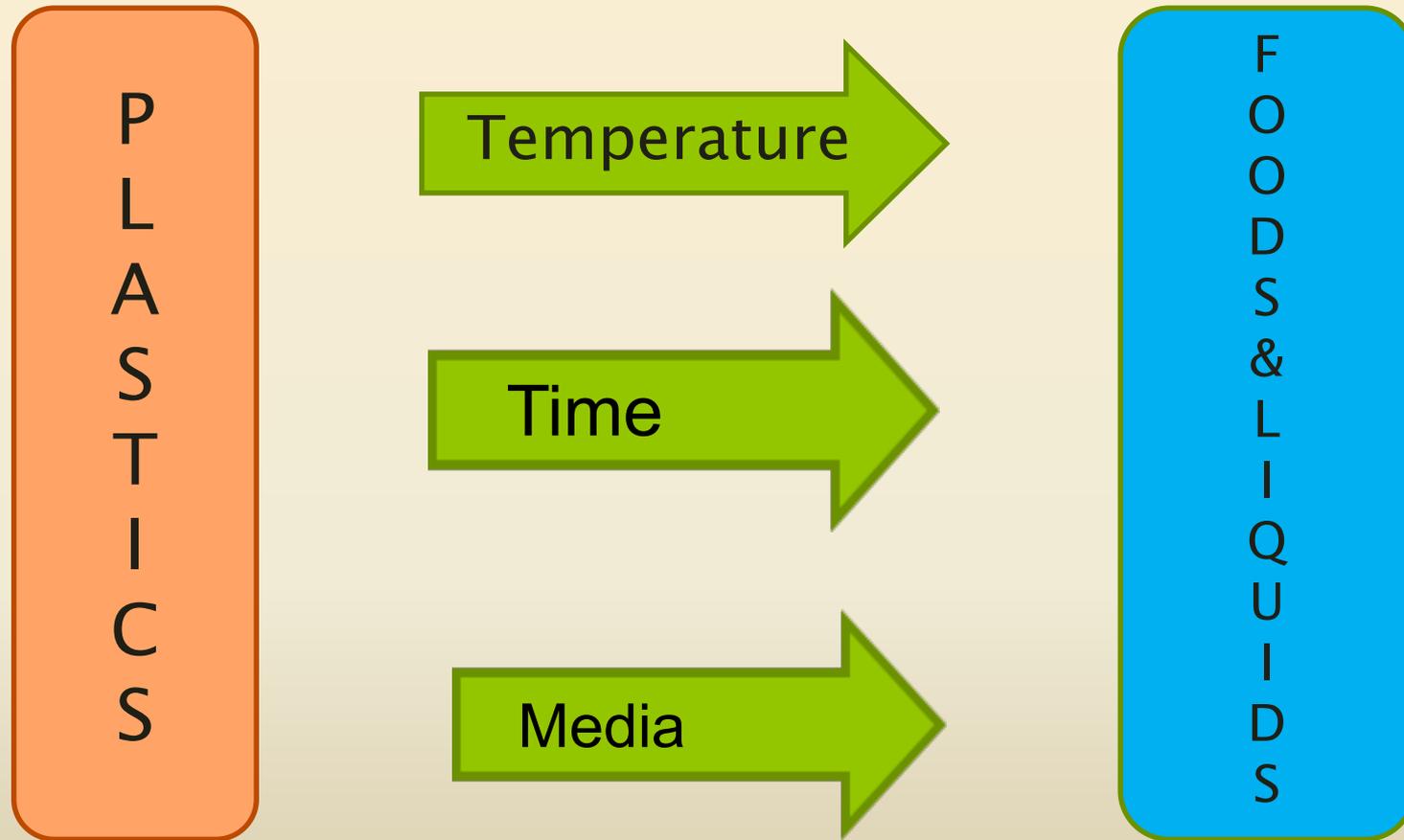


PLASTIC ADDITIVES

- Fillers
- Colorants
- Plasticizers
- Stabilizers
- Antioxidants
- Flame Retardants
- UV Absorbers
- Antistatic Agents
- Blowing Agents
- Antifoaming
- Lubricants
- Reinforcements



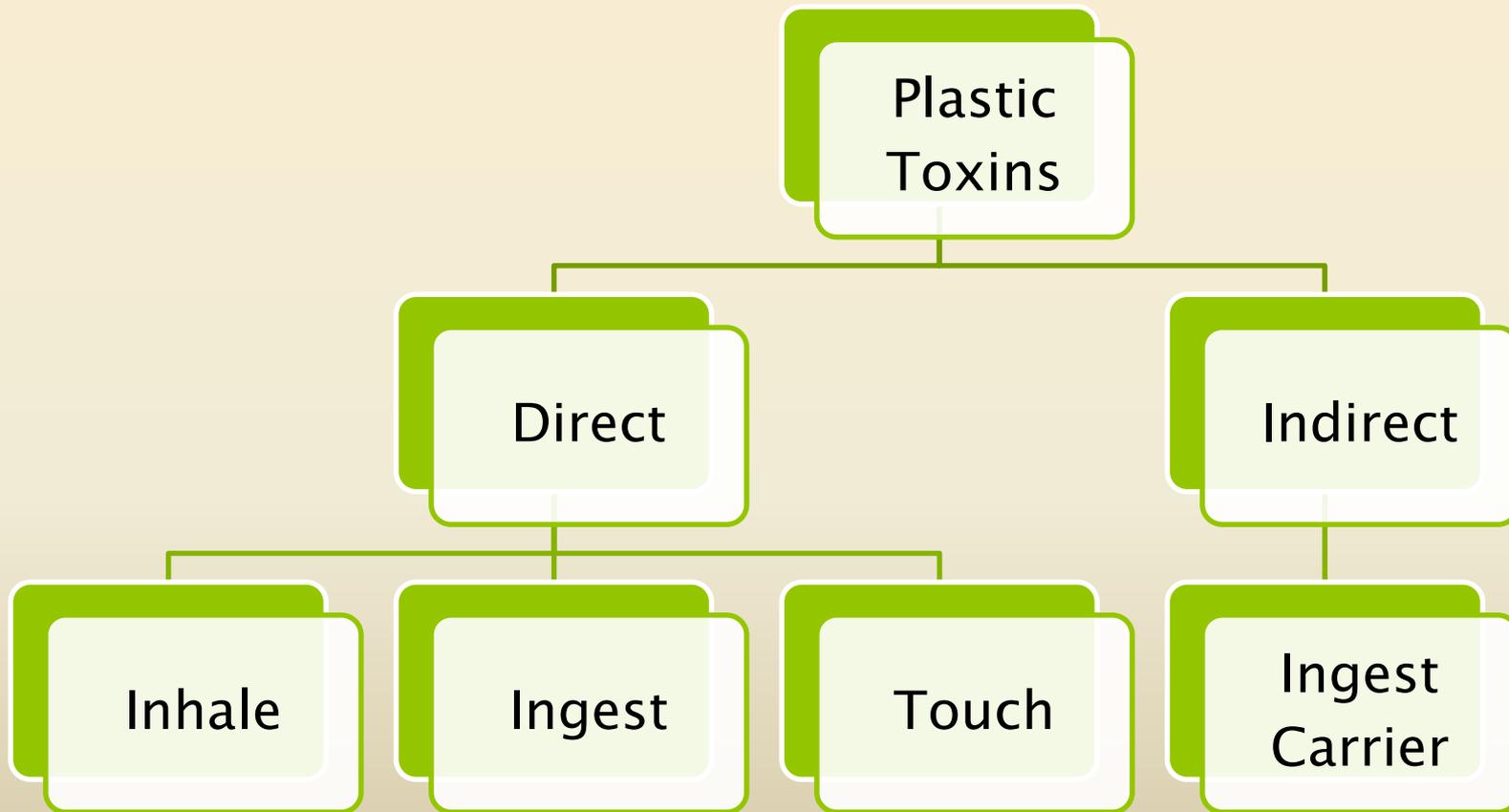
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THE PROBLEM WITH PLASTICS



MODES OF TOXICITY



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What is Good About Plastics

THE PROBLEM WITH PLASTICS

Versatile

Pervasive

Simple Design

Low Cost

Abundant Raw Materials

Persistent

THE PROBLEM WITH PLASTICS

What is Good About Plastics

What is Bad About Plastics



THE PROBLEM WITH PLASTICS

What is Bad about Plastic?

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THE PROBLEM WITH PLASTICS



THE PROBLEM WITH PLASTICS

What is Bad About Plastics

- ❖ Consumer Behaviors:
We forget “Reduce, Reuse, Recycle”
- ❖ Producers Profit Margins

THE PROBLEM WITH PLASTICS

Plastics in the Environment

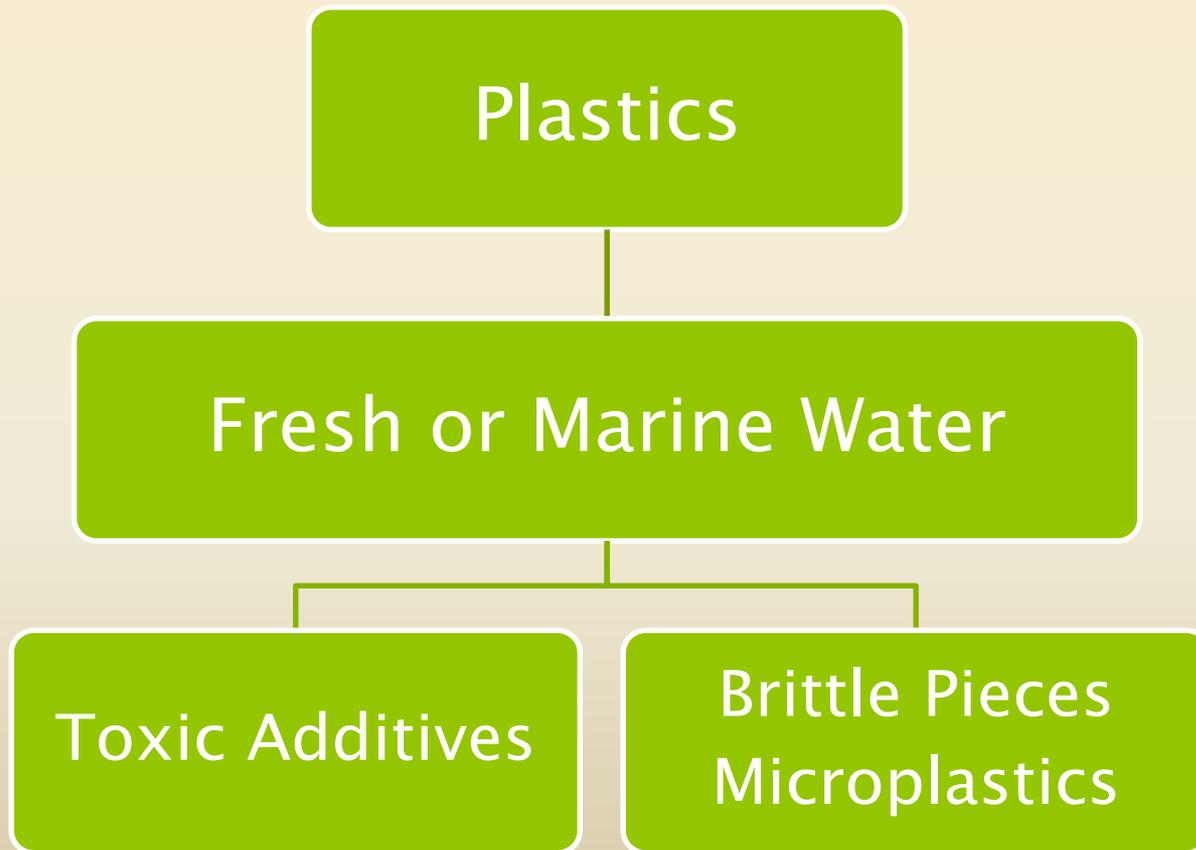


Birds and Marine Animals Ingest
Plastic Pieces & Microplastics



Birds and Marine Animals
Entangle in Plastic Pieces and
Fishing Gear

THE PROBLEM WITH PLASTICS



THE PROBLEM WITH PLASTICS

Small Fragments Adsorb/Absorb
Toxins

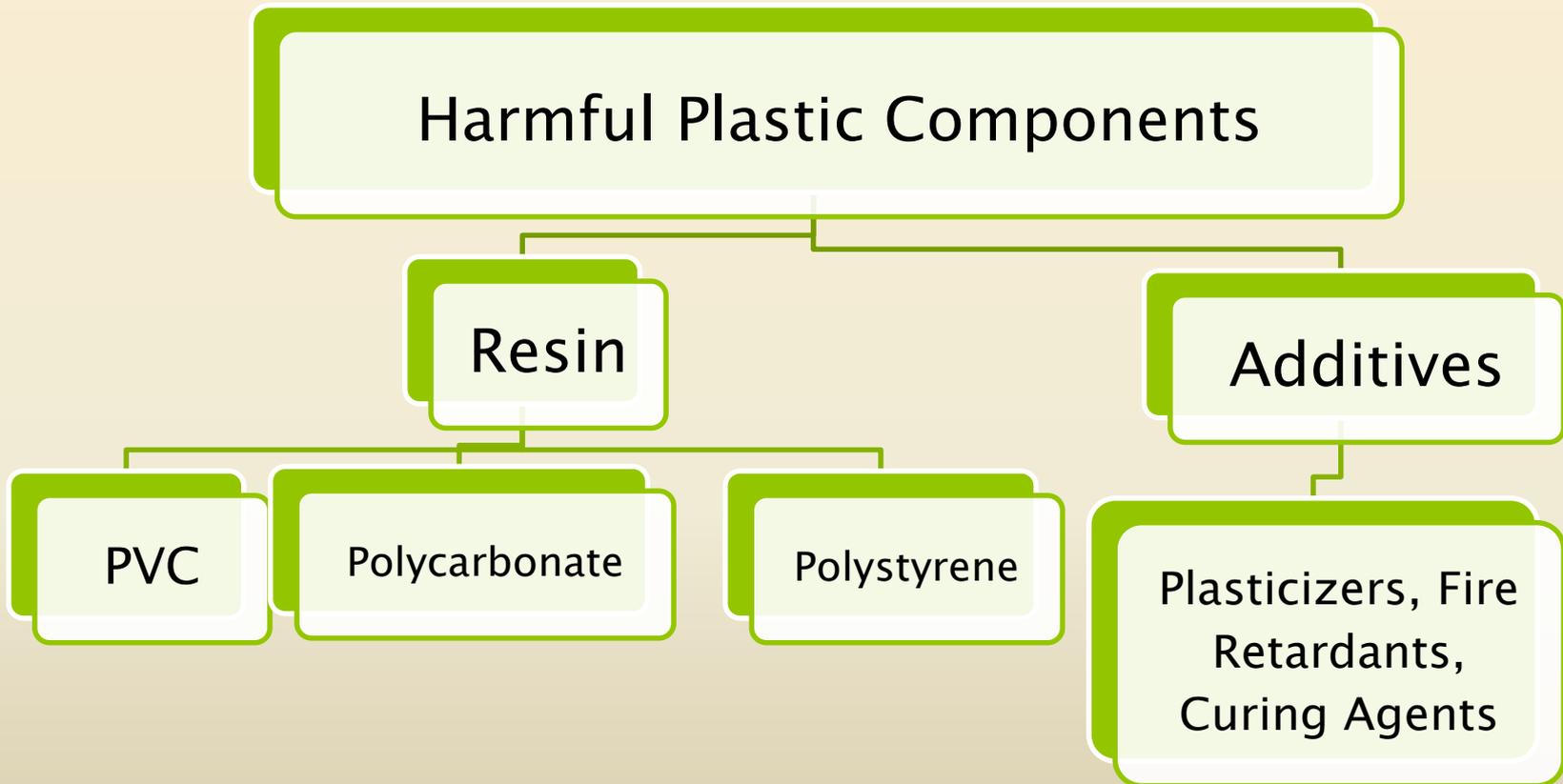


Toxins Concentrations $> 1000 \times$
that in Water



Fragments Settle to the Bottom or
are Ingested by Animals

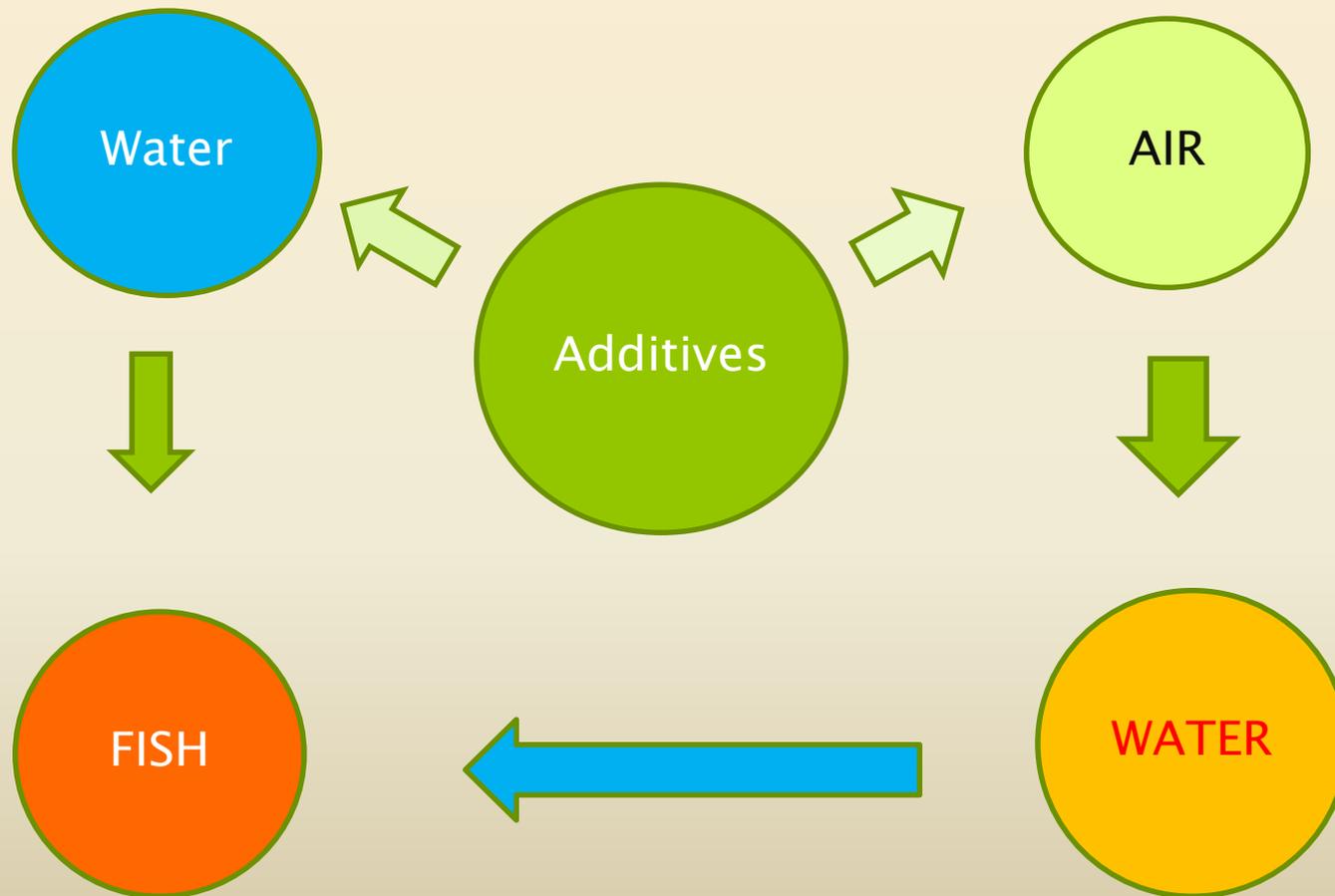
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HARMFUL PLASTIC RESINS

- PVC – Vinyl Chloride, Dioxine
- Polycarbonate – Bisphenol A
BPA
- Polystyrene – Polycyclic Aromatic Hydrocarbons
PAH

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Harmful Effects of Additives

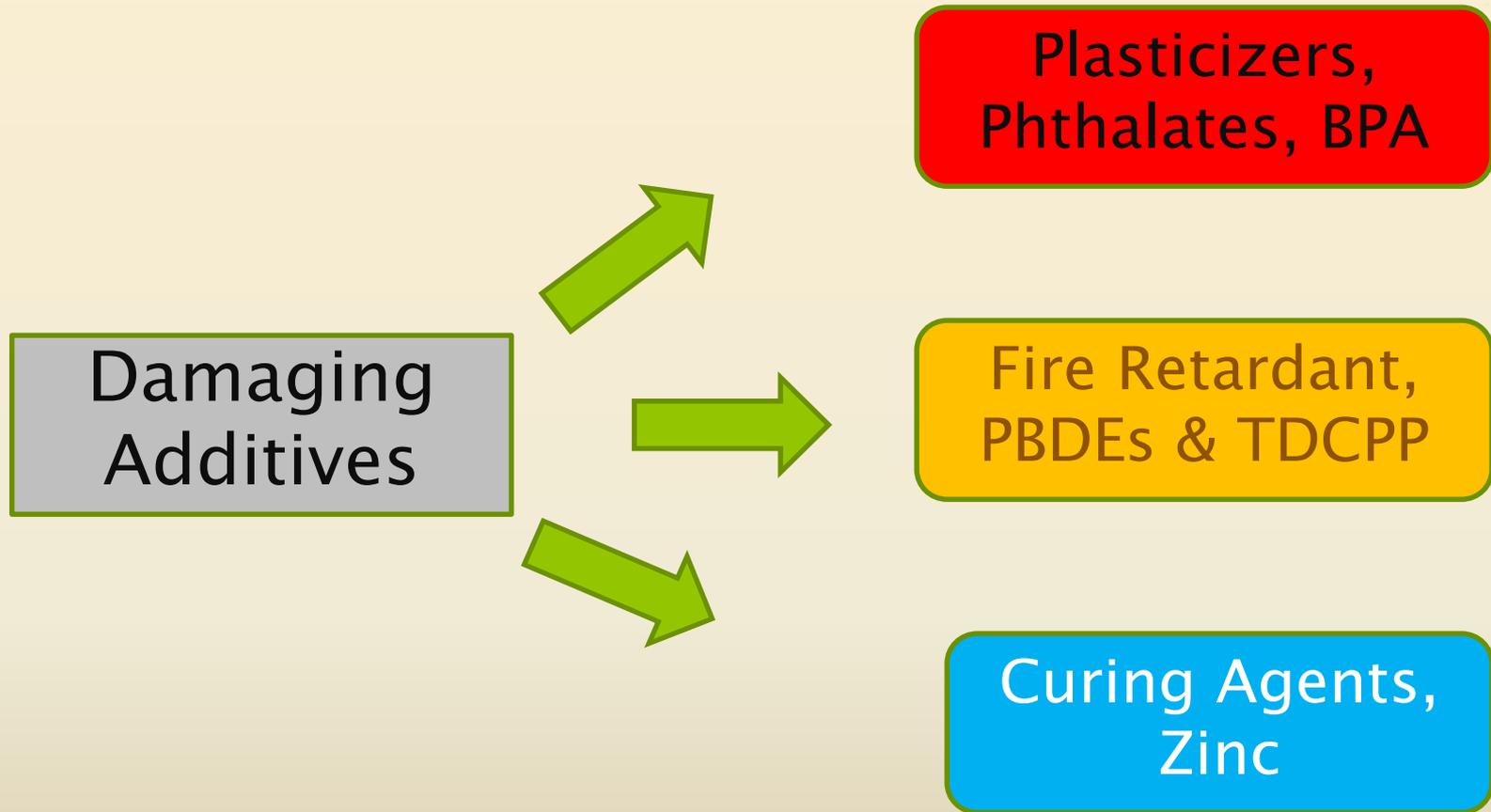
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Toxic Additives

Most Toxic Additives have unique properties in common:

- ❑ Lipophilic
- ❑ Persistent Bioaccumulative
- ❑ Endocrine Disrupting Compounds

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Harmful Effects of Curing Agents

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Zinc is an Essential Element in very Low Concentrations

Zinc is a Bioaccumulative Toxin–Liver, Kidney, Pancreas.

Developmental and Reproductive Toxin

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Harmful Effects of Fire Retardants

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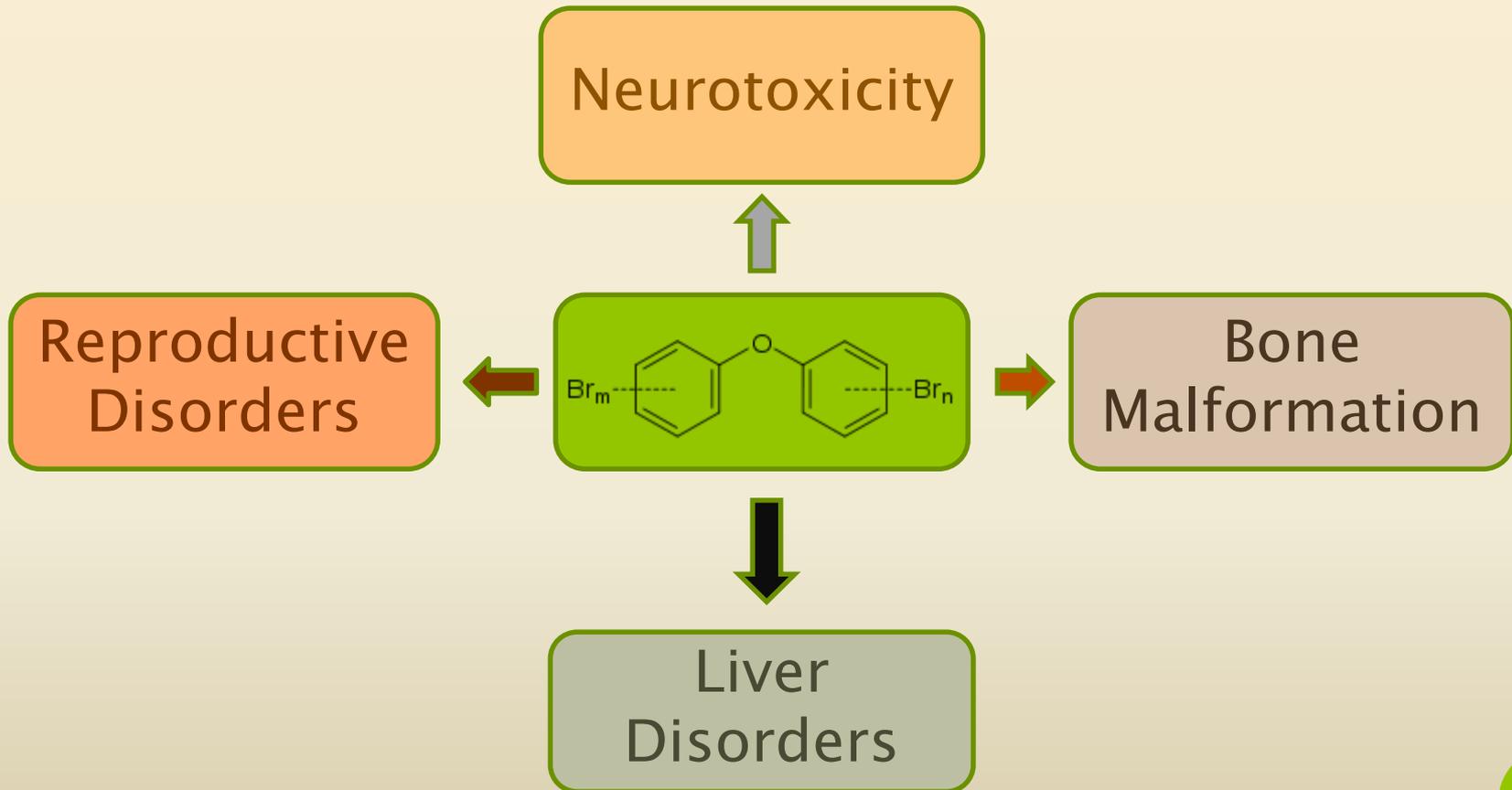
Exposure to PBDEs is thru Indoor Dust and Foods

Found in Fish, Polar Bears, Grizzly Bears and PS Orcas

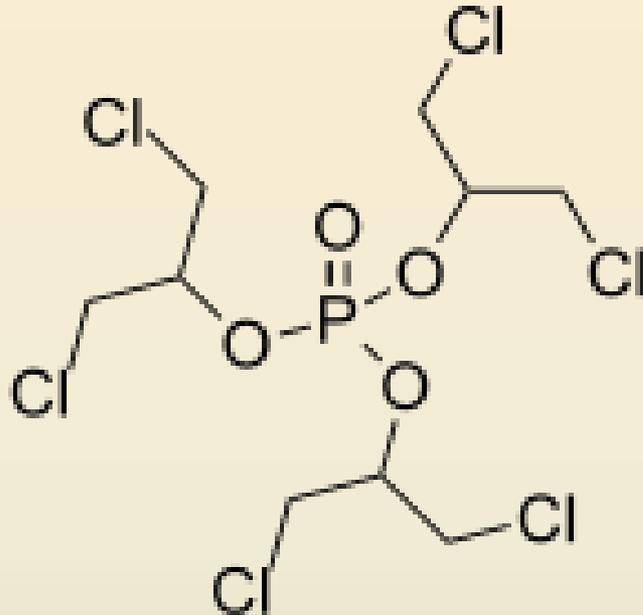
PBDEs Cause Neurotoxicity–Impacts Behavior, Learning & Memory

PBDEs are banned in Most States & Europe

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THE PROBLEM WITH PLASTICS



Tris (1,3-dichloro-2-propyl) phosphate (TDCPP)

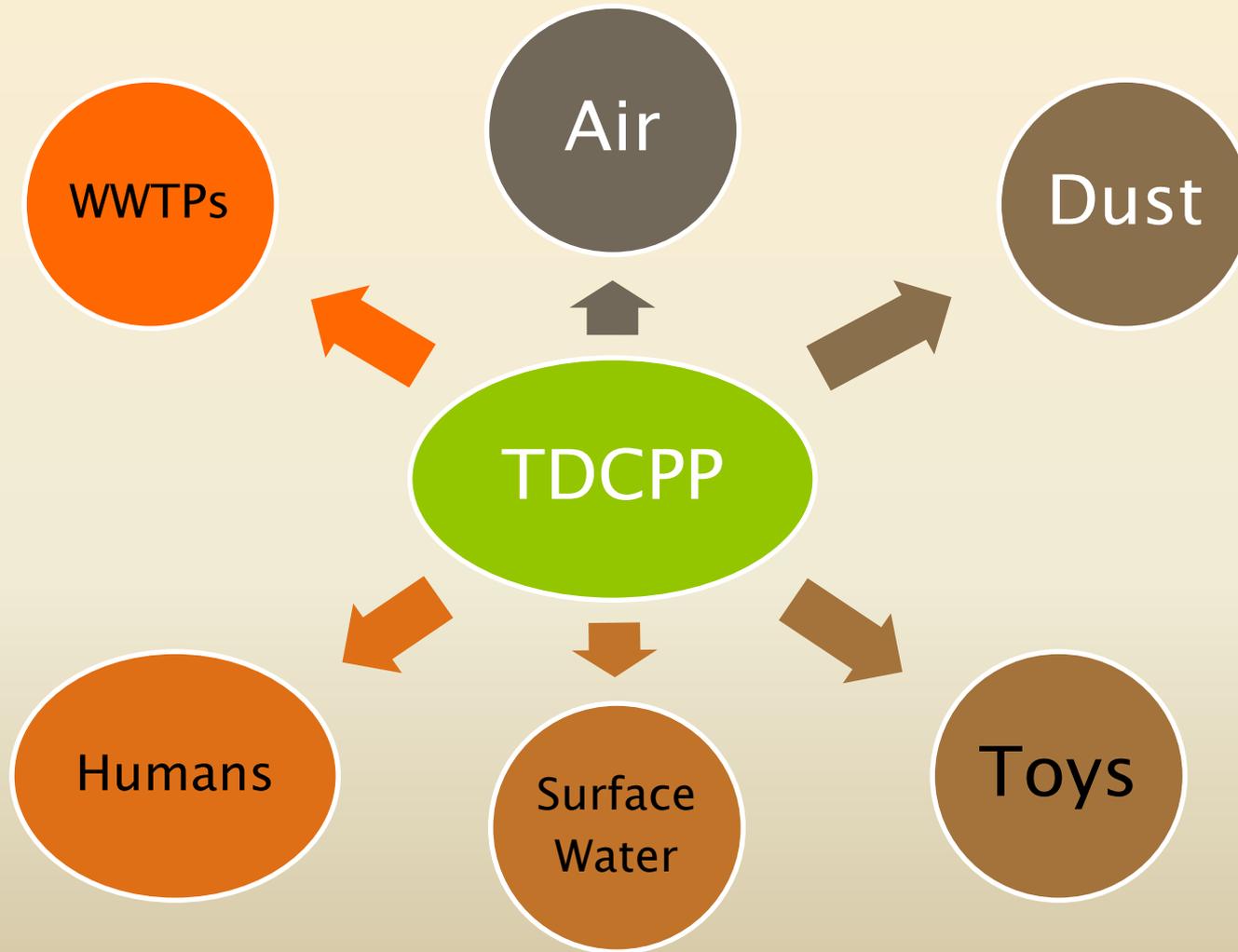
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TDCPP is a Flame Retardant

Originally, was considered "*Safe*"

Is added to Polyurethane Foam

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THE PROBLEM WITH PLASTICS

TDCPP Increases Tumors in Liver

Increases Benign Tumors in Kidney

Increases Benign Tumors in Testes

THE PROBLEM WITH PLASTICS

TDCPP is Genotoxic *in vitro*

TDCPP is Mutagenic in cells

TDCPP Metabolites are Carcinogenic

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EVIDENCE ON THE CARCINOGENICITY OF TRIS(1,3-DICHLORO-2-PROPYL) PHOSPHATE



Reproductive and Cancer Hazard Assessment Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

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Harmful Effects of Plasticizers

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THE PROBLEM WITH PLASTICS

Diethyl Hexyl Phthalate is a probable Human Carcinogen

Prenatal Phthalate Exposure Adversely Affect Male Reproductive Development

Phthalates are Banned from Children Care Items

Phthalates are replaced by Adipate esters.

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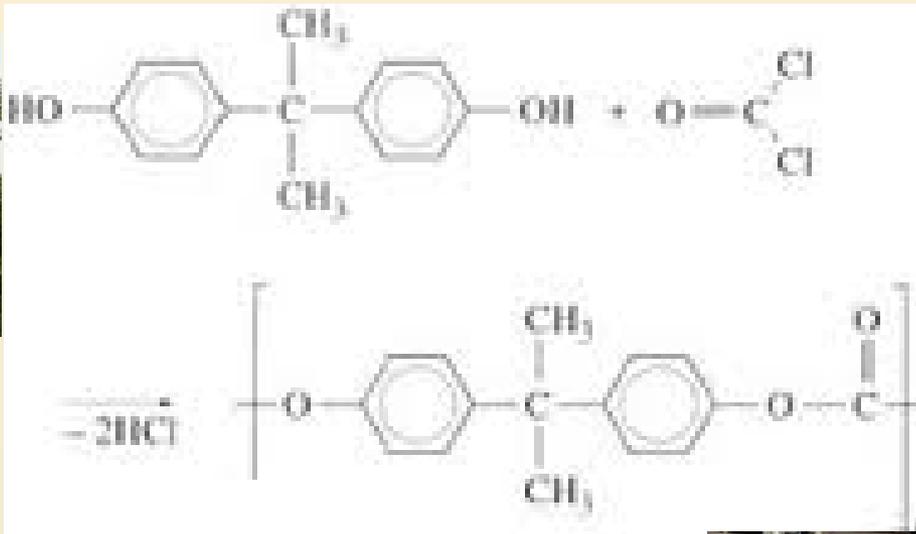
Harmful Effects of Resins

THE PROBLEM WITH PLASTICS

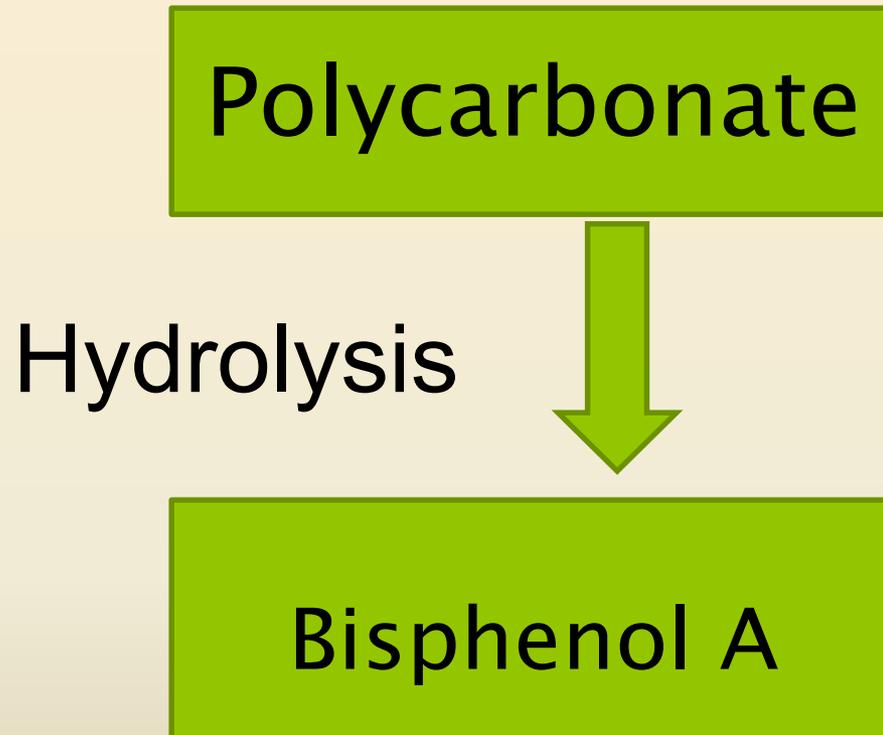
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Harmful Effects of Resins Polycarbonates

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THE PROBLEM WITH PLASTICS



HARMFUL EFFECTS OF PBA

- BPA is the monomer in Polycarbonate Resin.
- BPA is component of “Epoxy Resins”.
- Used as a Plasticizer.
- Used in “Heat Printing”, Cash Register, Credit Card Charging Receipts, Small Printers.
- Alternatives such as BPS, BPF, BPAF, BPZ

THE PROBLEM WITH PLASTICS

BPA was Found in the Urine of 93% of people
>6 Years Old

Higher BPA Concentrations in Adults Are
Associated with

Cardiovascular
Diseases

Diabetes

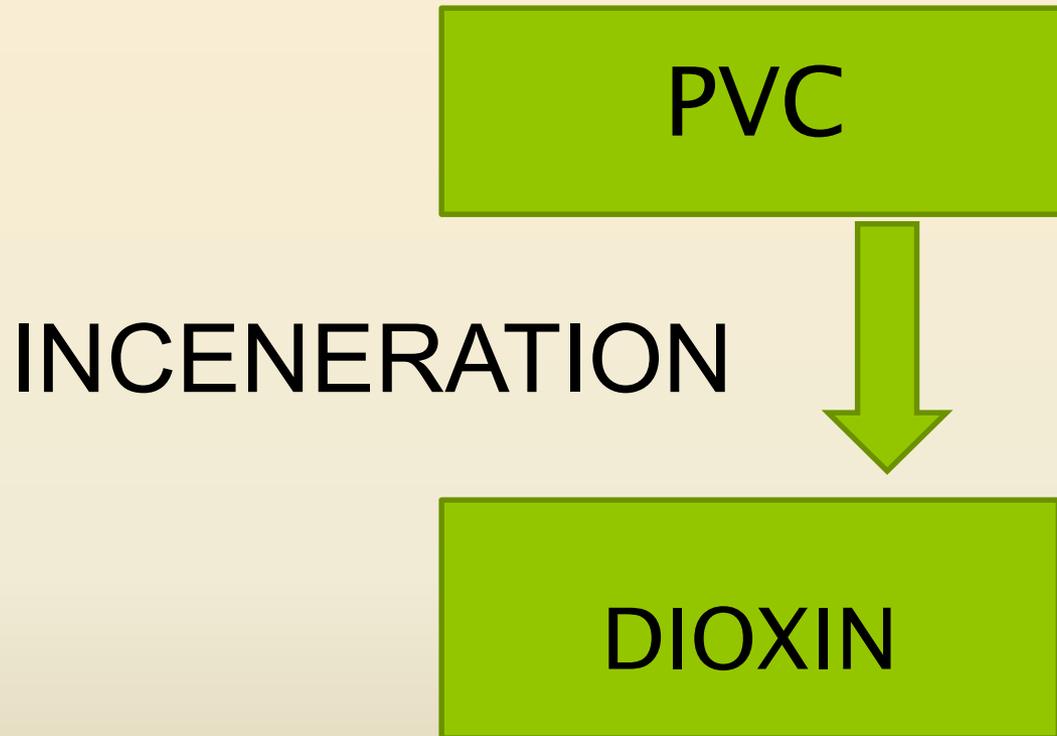
Liver Function

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Harmful Effects of Resins Poly Vinyl Chloride PVC

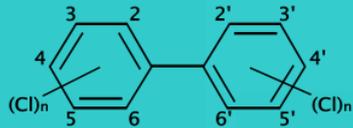
THE PROBLEM WITH PLASTICS



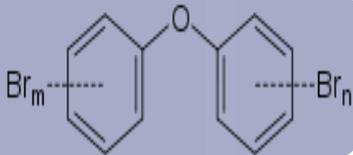
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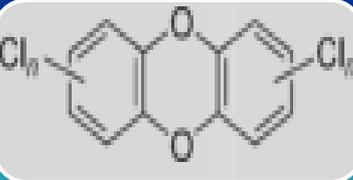
Persistent Bioaccumulative Toxins



PCBs

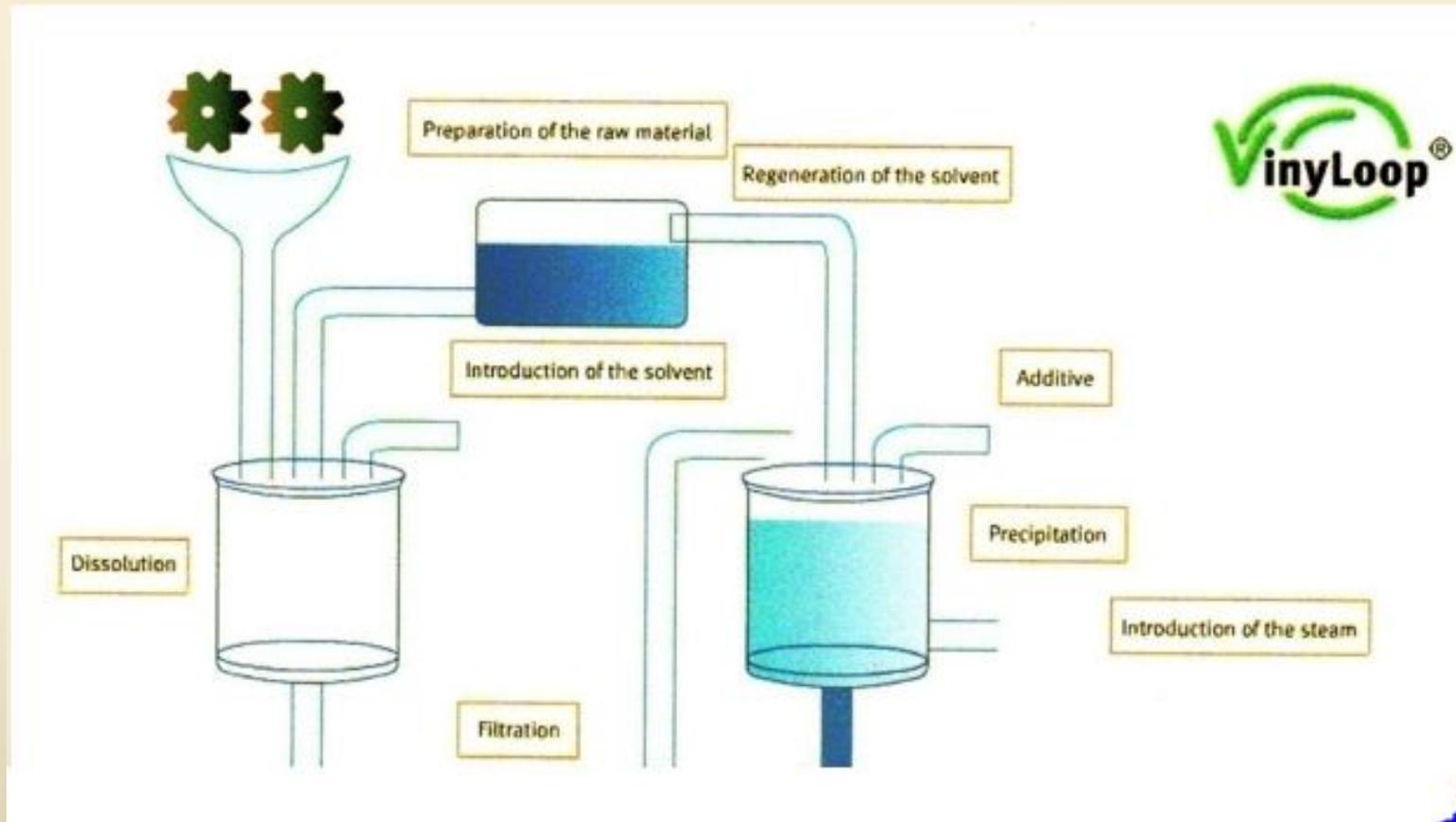


PBDEs



Dioxins

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The Take Home Message

THE PROBLEM WITH PLASTICS

In Our Homes:

Washing plastic containers, especially polycarbonate based items, in a dish washer

Accelerate the leaching of additives and BPA.



THE PROBLEM WITH PLASTICS

In Our Homes:

Heating Food and
liquids in a
Microwave Oven

Accelerates the
leaching of
additives and
BPA



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Polycarbonate Plastics



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Take Home Message:

1. Don't microwave food or drink in plastic containers.
2. Don't wash plastics with the number 7 in the dishwasher.
3. Use dishware made from glass or SS.
4. Store food in glass containers.
5. Discard scratched or worn plastic containers.
6. Recycle all plastics responsibly.

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MICROPLASTICS

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Microplastics are plastic particles smaller than 5 mm and larger than 0.33 mm (?).

Microplastics are formed in one of two ways:

- ❖ Primary Microplastics – Manufactured
Microbeads, Virgin plastic pellets (Nurdles)
- ❖ Secondary Microplastics – Formed when
larger plastic items are degraded

THE PROBLEM WITH PLASTICS

- Microplastics have a large surface area relative to their weight.
- Microplastic adsorb/absorb more materials from the environment than Macro plastics.
- The Microplastics leaches out more toxins than Macro plastics.

THE PROBLEM WITH PLASTICS

- Microbeads were first observed in Plankton tows along the coast of New England in the 1970s.
- Microbeads are used extensively in consumer products.
- On December 28, 2015 President Obama signed a law to ban the use of microbeads in Cosmetic Products and OTC in the USA.

THE PROBLEM WITH PLASTICS

- NOAA Marine Debris Program in Collaboration with the University of Washington – Tacoma developed Laboratory Methods for the Analysis of Microplastics in the Marine Environment.

THE PROBLEM WITH PLASTICS

- The method involves separation of the $< 5 \text{ mm} > 0.33 \text{ mm}$ particles, microscopic identification, and gravimetric determination.

THE PROBLEM WITH PLASTICS

- Analytical methods are being developed to determine the quantity of microplastic particles smaller than 0.1 mm.

MICROPLASTICS & MICROFIBERS

- Microplastics, especially microfibers were found in nearly all samples tested including:
- Deep in Beach Sand
- Fish
- Sea Salt
- Honey
- Beer
- Tap Water
- Bottled Water

THE PROBLEM WITH PLASTICS

- Plastic Microfibers are shed by the wear and tear of clothes and carpets. Tumble drying is another major source.

THE PROBLEM WITH PLASTICS

Microfiber Pollution and Apparel

- ❖ The effect on shedding microfibers from several jackets by washing in either a Front Loader or a Top Loader was quantified.
- ❖ Top Loading machine caused 2.7 times more shedding than the Front Loading machine.
- ❖ A jacket washed in an intensive 24 hours cycle “Aged” shed 1.6 times more Microfibers

THE PROBLEM WITH PLASTICS

Take Home Message

- ❖ Use a Front Loader machine or a Top Loader with no central agitator.
- ❖ Use lower water temperature.
- ❖ Use shorter cycle.
- ❖ Use a mild detergent.

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Questions ?

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THANK YOU