

MJPhD

PRODUCT DEVELOPMENT AND SCIENCE IN THE MEME AGE

MARK JONES
CREATIVE DIRECTOR
MJPHD, LLC

BIOT E-225 Biomedical Product Development, Prof Sujata K. Bhatia

30 September 2026



Spaghetti Sucks





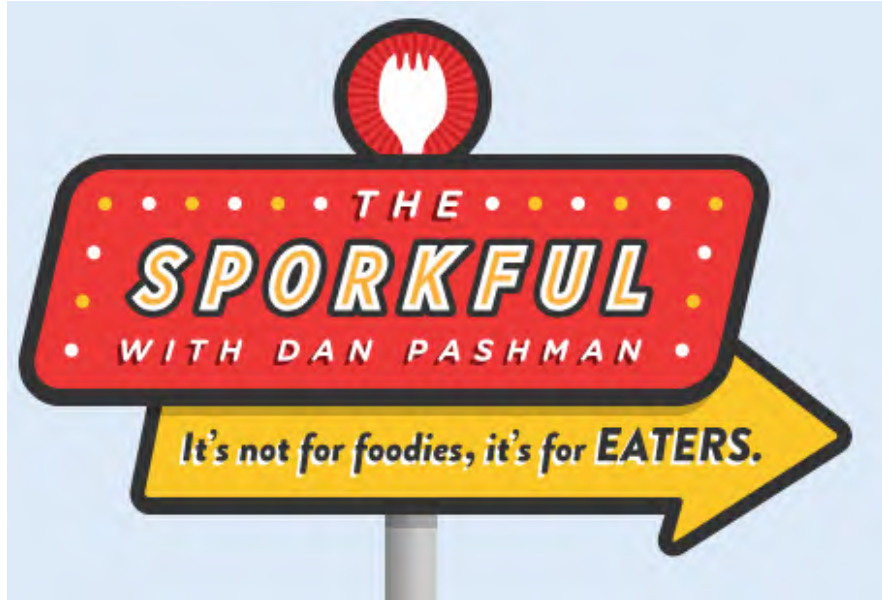




creation of a new pasta as an example of product development

memes science is impacting public perception (and is difficult to combat)

what are the costs and ethical implications of being wrong?



credit: sporkful.com



Dan Pashman

credit: Scott Gordon Bleicher

Dan did research.

He studied all the types of pasta



credit: sporkful.com



One important step in most product development stories is doing some kind of voice of the customer.

Dan didn't yet have a product.

He relied on expert opinions.



Dan consulted two pools of experts

Culinary experts

Pasta experts – folks with knowledge of production.

Some comments on invention. Can be by chance; can be because of an effort against a target.

Cascatelli is an example of going after a target.

serendipity

serendipity is making happy,
lucky, unexpected discoveries

zemblanity

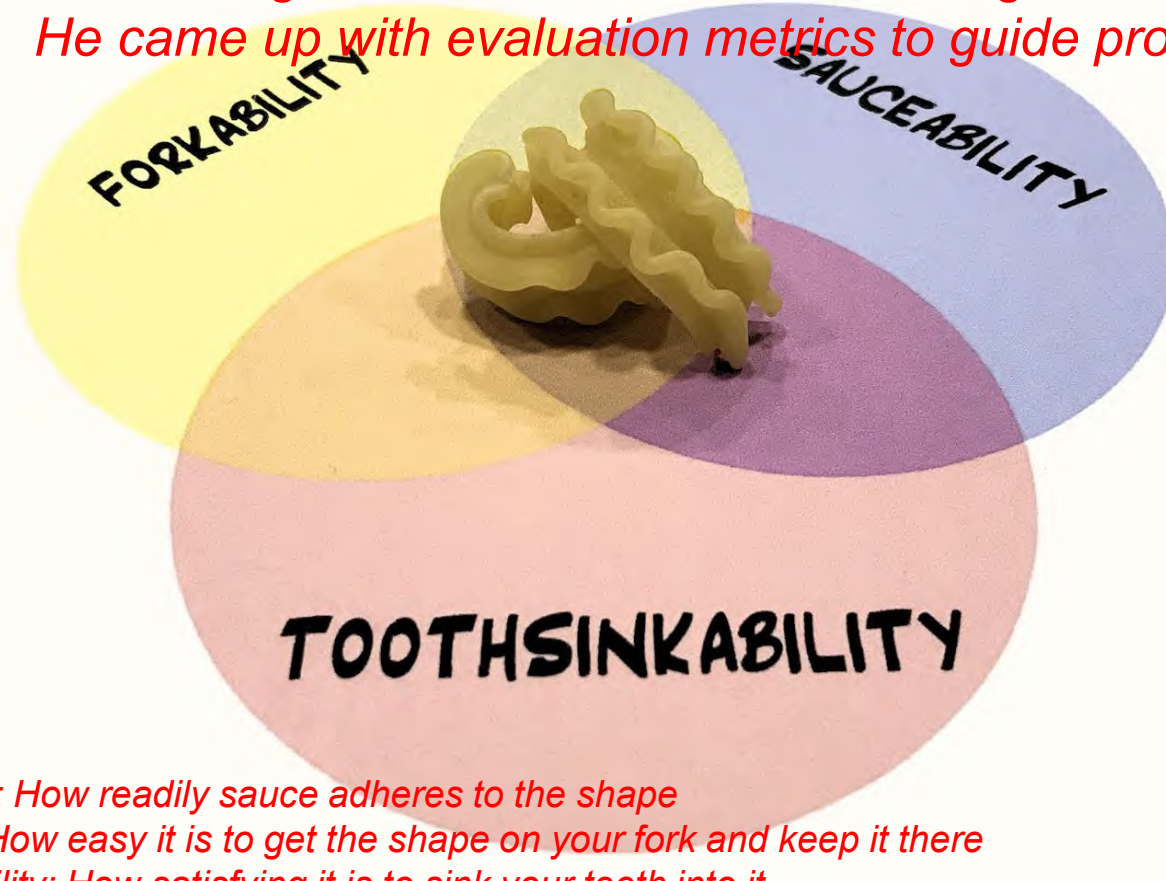
zemblanity is the opposite, making
unhappy, unlucky and expected
discoveries by design



credit: Dan Pashman

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Without formal training in science, Dan did something that is important. He came up with evaluation metrics to guide progress.



Sauceability: How readily sauce adheres to the shape

Forkability: How easy it is to get the shape on your fork and keep it there

Toothsinkability: How satisfying it is to sink your teeth into it

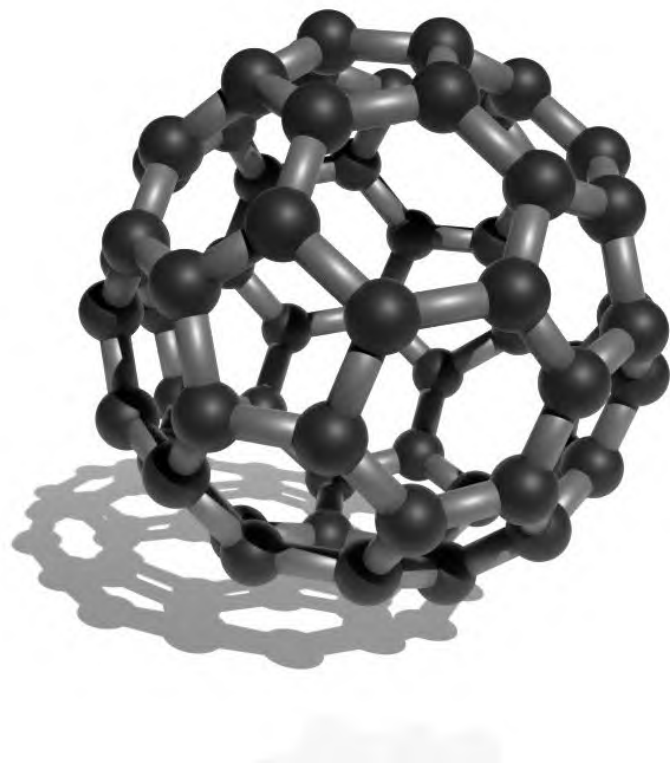
Some comments on invention versus innovation.



Invention is related to discovery.
It is the realization something is possible.



innovation is when something is
made useful. It requires both
reduction to practice and impact.



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Dan consulted two pools of experts

Culinary experts

Pasta experts – folks with knowledge of production.



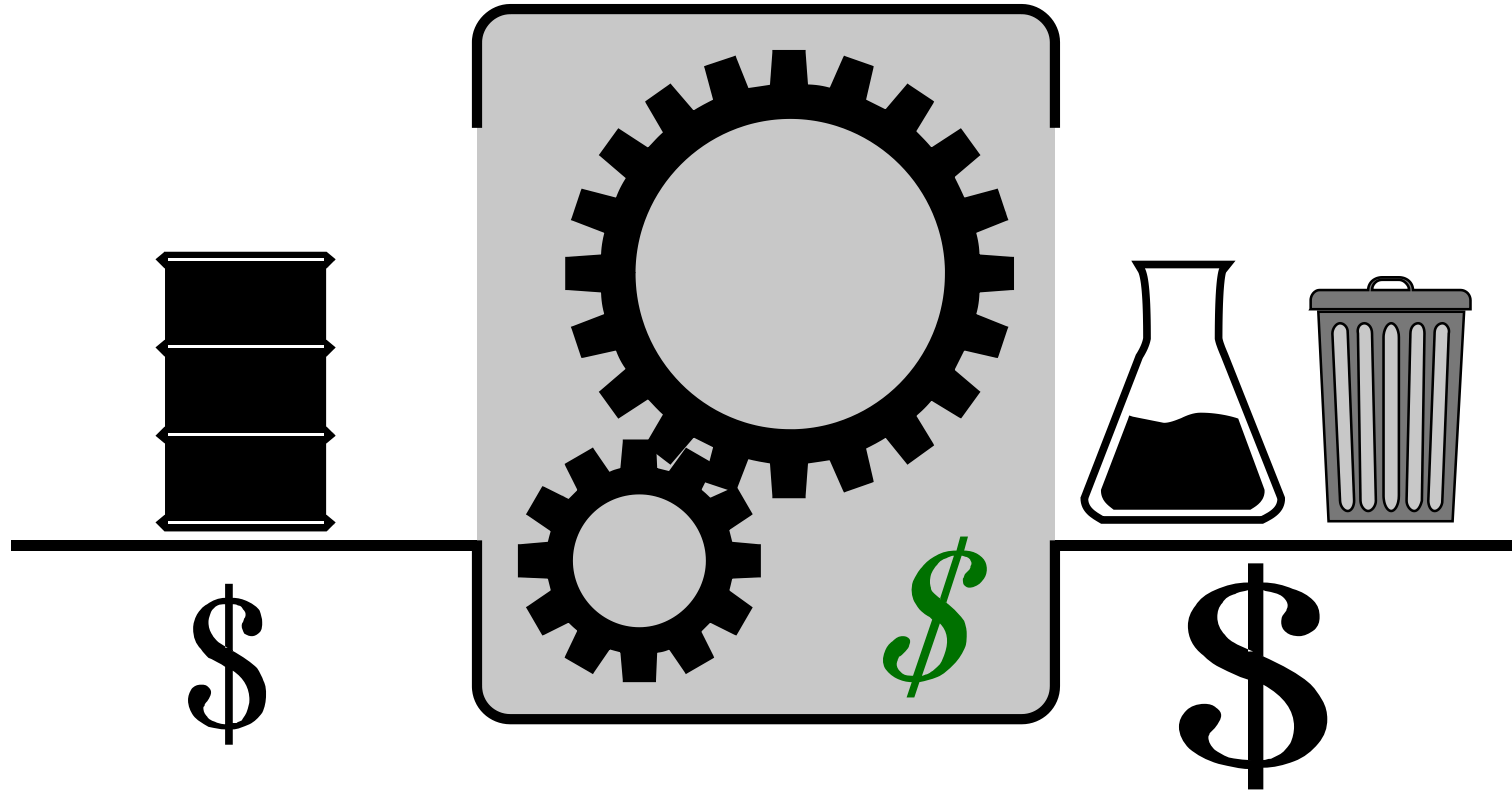
Dan's experts were initially critics.

They failed to see the opportunity.

They saw many difficulties.



SIMPLIFIED INDUSTRIAL PRODUCTION

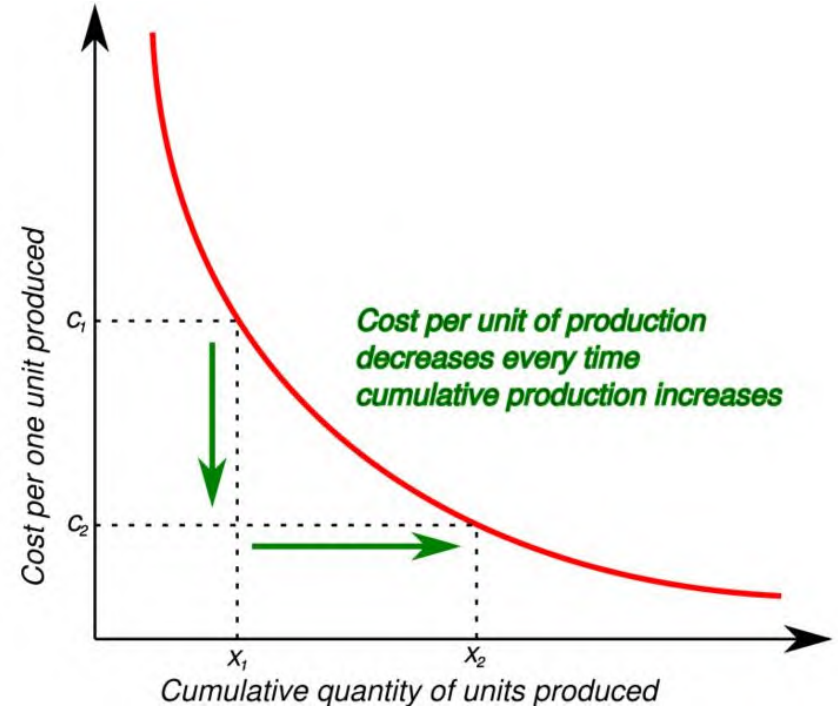


WAYS TO REDUCE CAPITAL EXPENSE

Scale



Experience



SCALE MOST OFTEN WINS



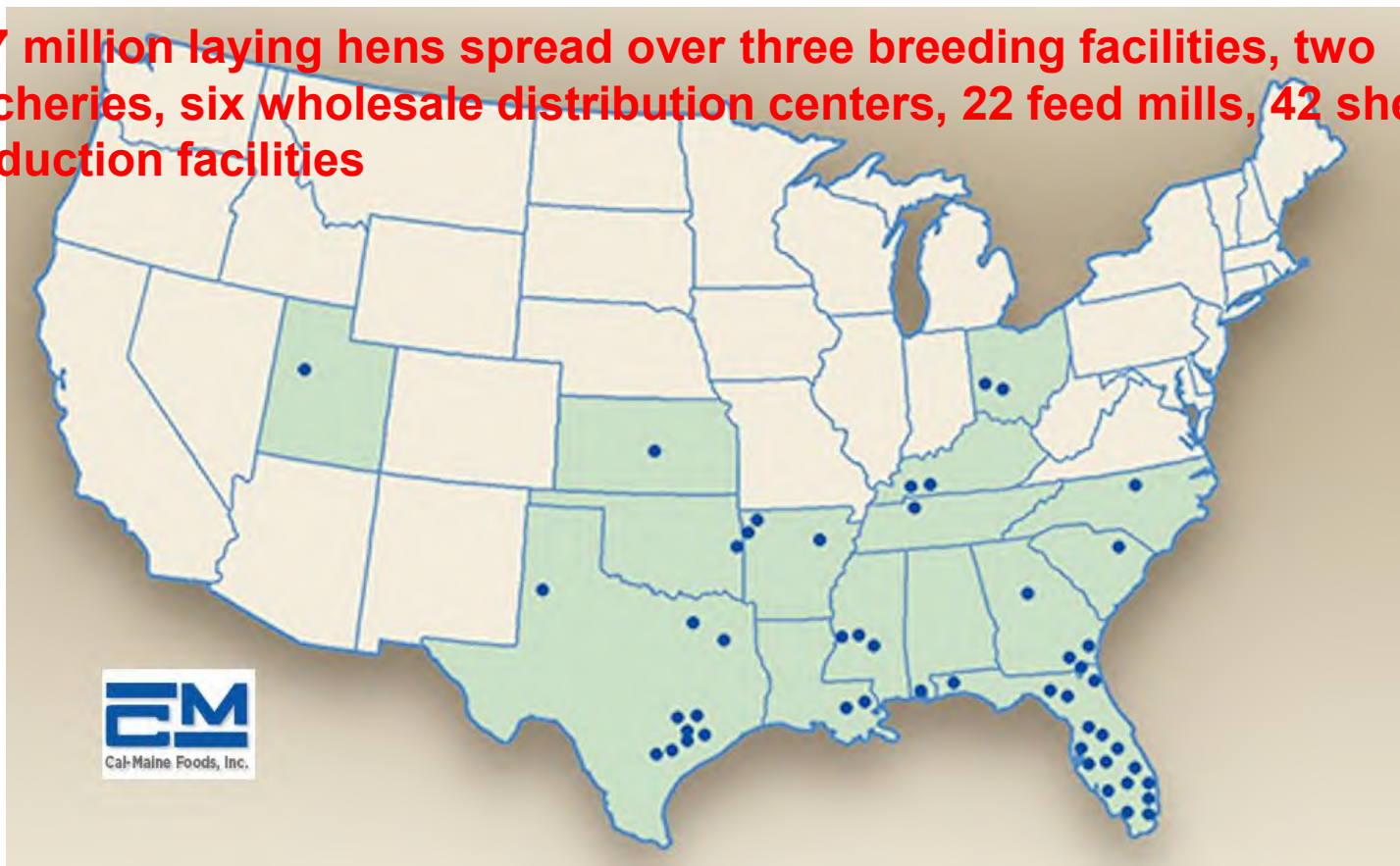
If you are moving mass around, scale reduces cost faster than experience.

THE EGG PRODUCTION UNIT



LARGEST US EGG PRODUCER: CAL-MAINE FOODS

42.7 million laying hens spread over three breeding facilities, two hatcheries, six wholesale distribution centers, 22 feed mills, 42 shell egg production facilities



SMALL SCALE PRODUCTION IS INEFFICIENT





EXPANDING FROM SIMPLE IDEA TO A BUSINESS OPPORTUNITY

- What product or service will your business provide?
- What value are you providing?
- What problem are you solving?
- How is your solution different/advantaged over what is known/in the market?
- Is there a customer who agrees this is a problem worth solving and thinks it is valuable?

NINE KEY TOPICS TO BUILD A BUSINESS CASE

1. Customer Segments
2. Value Proposition
3. Channel to Market
4. Customer Relationships
5. Revenue Streams
6. Key Resources
7. Key Activities
8. Key Partnerships
9. Cost Structure

Alex Osterwalder Business Model Canvas







credit: Dan Pashman



credit: Dan Pashman

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M



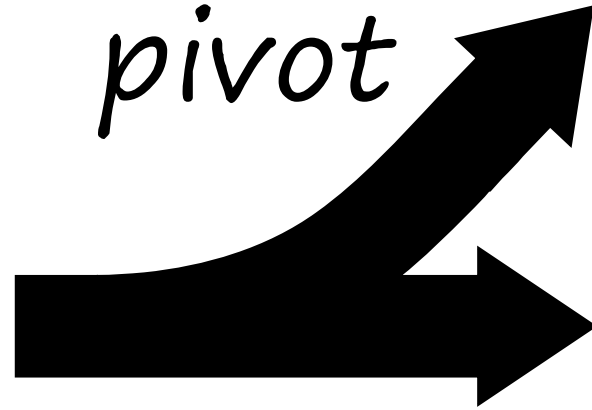
credit: Dan Pashman



credit: Dan Pashman



plan



pivot

Sobering Thought



Failure



Sunk Cost Fallacy











NY
SFOGLINI
PASTA
CASCATELLI
BY SPORKFUL



A BRAND NEW PASTA SHAPE

NET WT. 16 OZ (454 G)

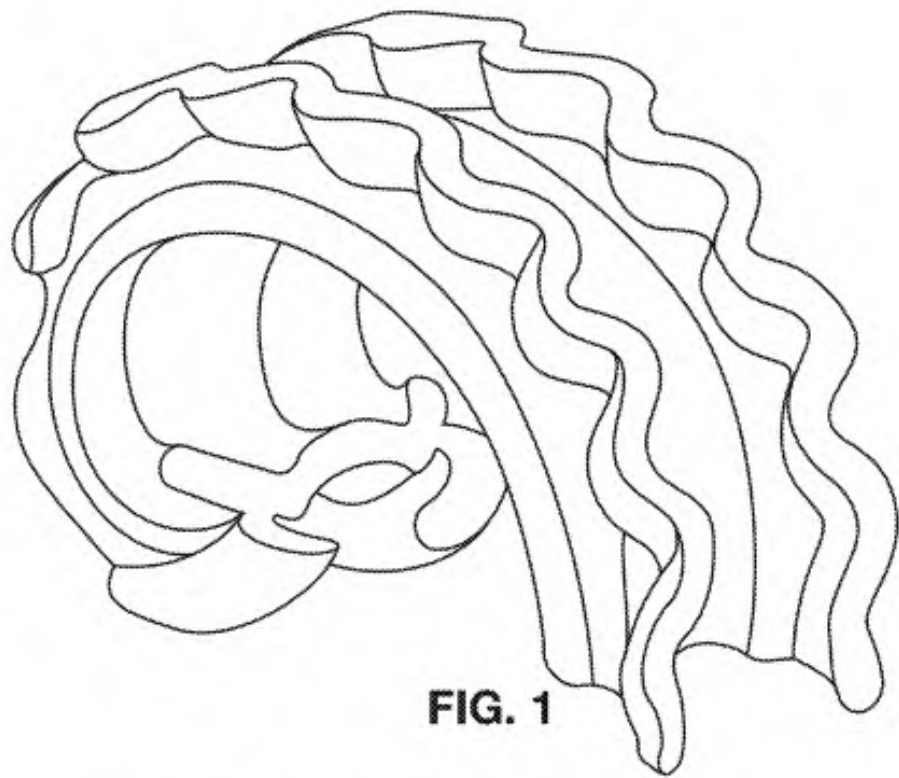


FIG. 1

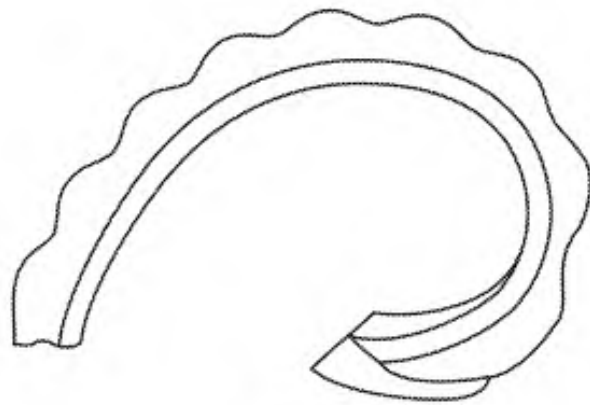


FIG. 2

U.S. Patent

Nov. 7, 2023

Sheet 1 of 2

US D1,003,564 S



quattrotini



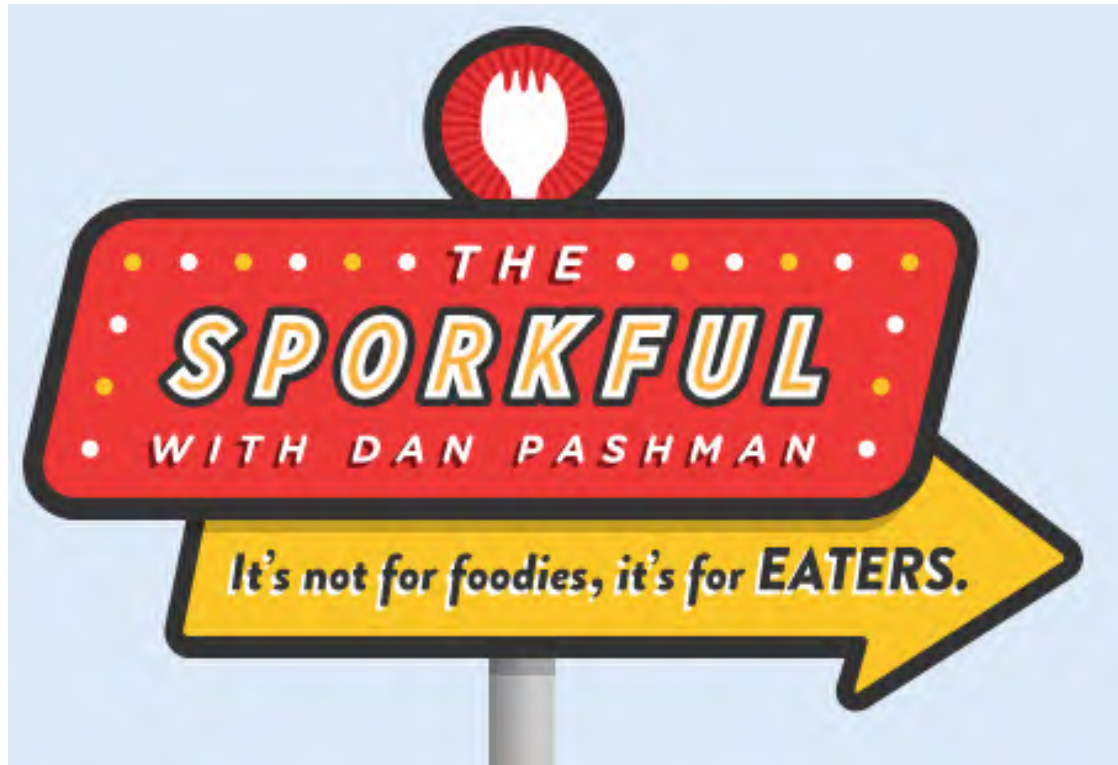
Cascatelli



Vesuvio

THANKS TO:

- Dan Pashman
- staff at the Sporkful, especially Emma Morgenstern
- Safia Mohamed



credit: sporkful.com



creation of a new pasta as an example of product development

memes are impacting public perception (and is difficult to combat)

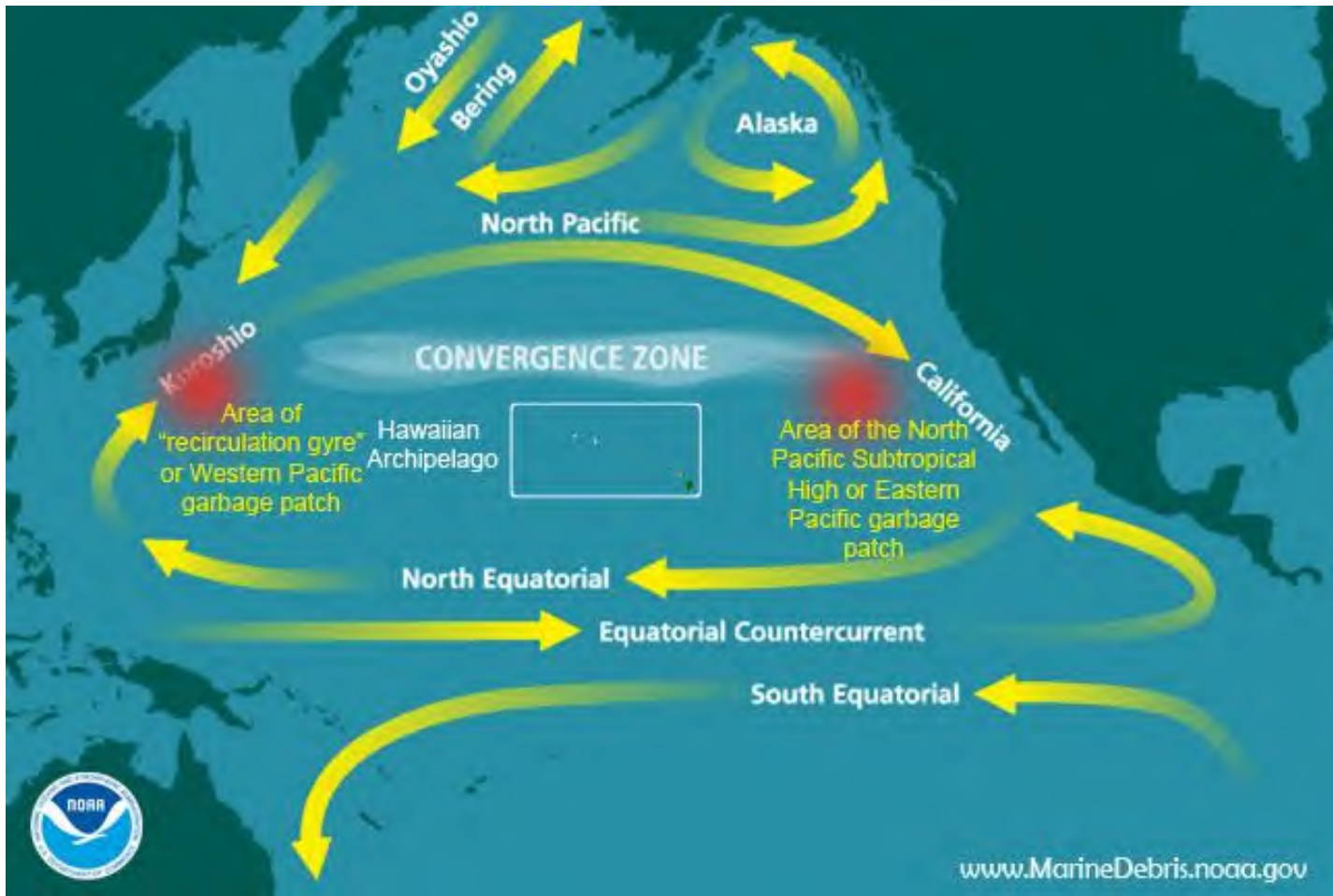
what are the costs and ethical implications of being wrong?

THE GREAT PACIFIC GARBAGE PATCH



Caption:
**A Part of the Great
Pacific Garbage Patch**

http://b.parsons.edu/~pany468/parsons/political_website/source2/index.html



THE GREAT PACIFIC GARBAGE PATCH



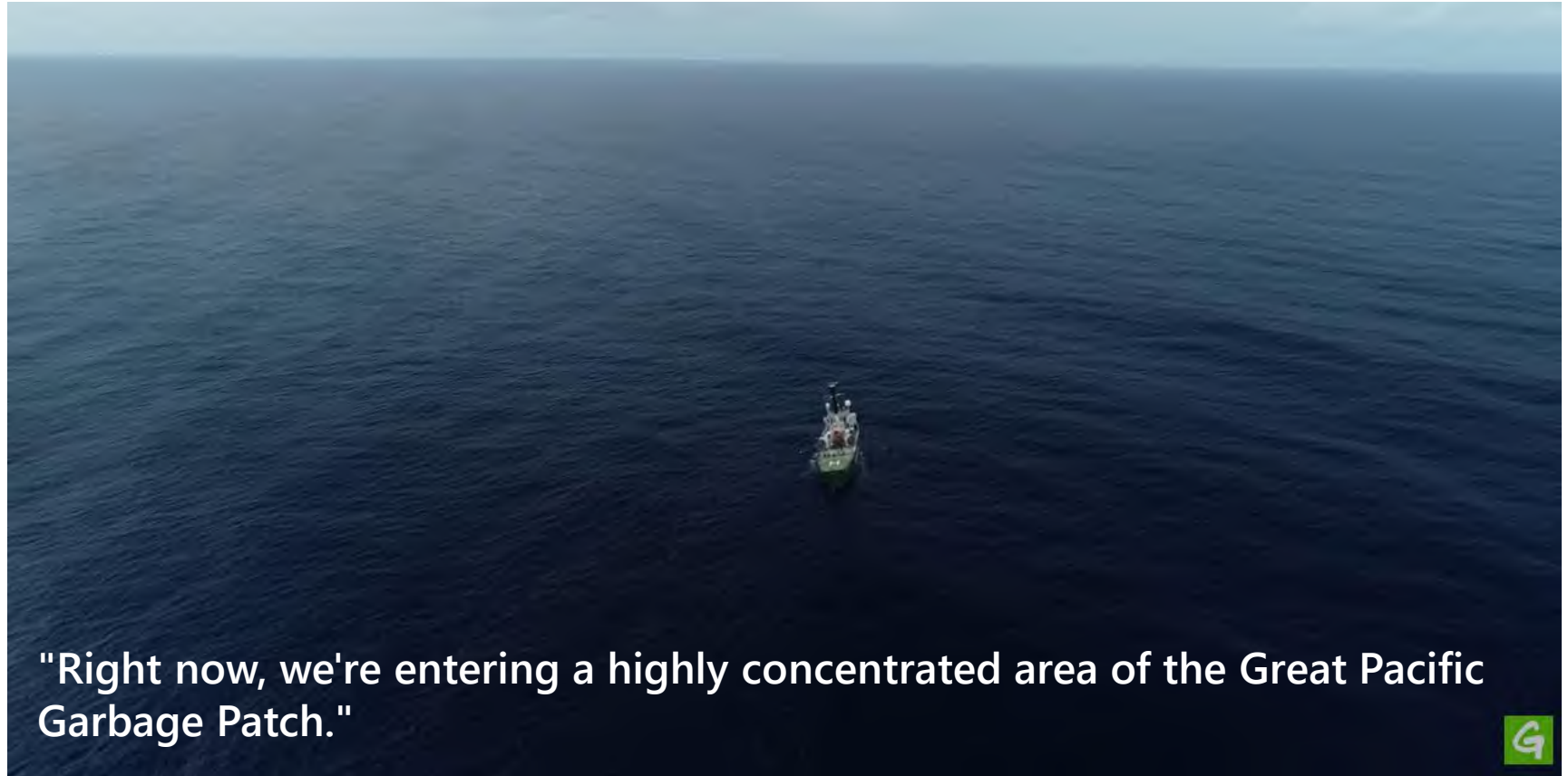
Caption:
A Part of the Great Pacific Garbage Patch

Article text:
"these patches are almost entirely made up of tiny bits of plastic, called microplastics."

Hills in background:
Honduras

http://b.parsons.edu/~pany468/parsons/political_website/source2/index.html

GREENPEACE'S ARCTIC SUNRISE IN THE GREAT PACIFIC GARBAGE PATCH



"Right now, we're entering a highly concentrated area of the Great Pacific Garbage Patch."





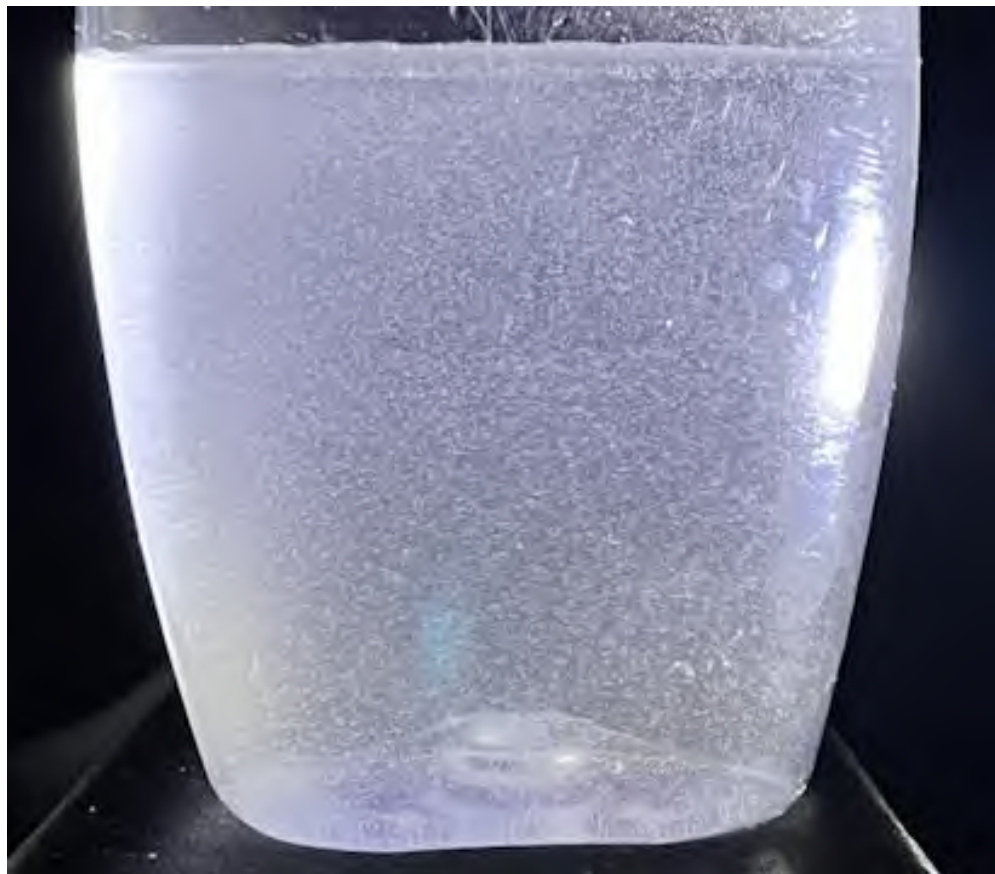
DOW

~31 years



Done.

~5 years





A new study by the University of Newcastle, Australia suggests that an average person could be ingesting approximately 5 grams of plastic every week. The equivalent of a credit card's worth of microplastics. This summary report highlights the key ways plastic gets into our body, and what we can do about it.



It took
you up to
1 WEEK
to eat this
credit card



wwf.panda.org/wwf_news/?348337/Revealed-plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week

per week



whole card = 5 g



per day

$1/7$ card = 710 mg



per meal

1/21 card = 240 mg



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Plastic ingestion by people could be equating to a credit card a week

Wednesday, 12 June 2019

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A new study finds on average people could be ingesting approximately 5 grams of plastic every week, which is the equivalent weight of a credit card.

The analysis *No Plastic in Nature: Assessing Plastic Ingestion from Nature to People* prepared by Dalberg, based on a study commissioned by WWF and carried out by University of Newcastle, Australia, suggests people are consuming about 2000 tiny pieces of plastic every week. That's approximately 21 grams a month, just over 250 grams a year.



Dr Thava Palanisami

The University of Newcastle is the first to combine data from over 50 studies on the ingestion of microplastic by people. The findings are an important step towards understanding the impact of plastic pollution on humans. It also further confirms the urgent need



REUTERS

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World

You may be eating a credit card's worth of plastic each week - study

Reuters

June 11, 2019 9:29 PM EDT · Updated 5 years ago

Aa

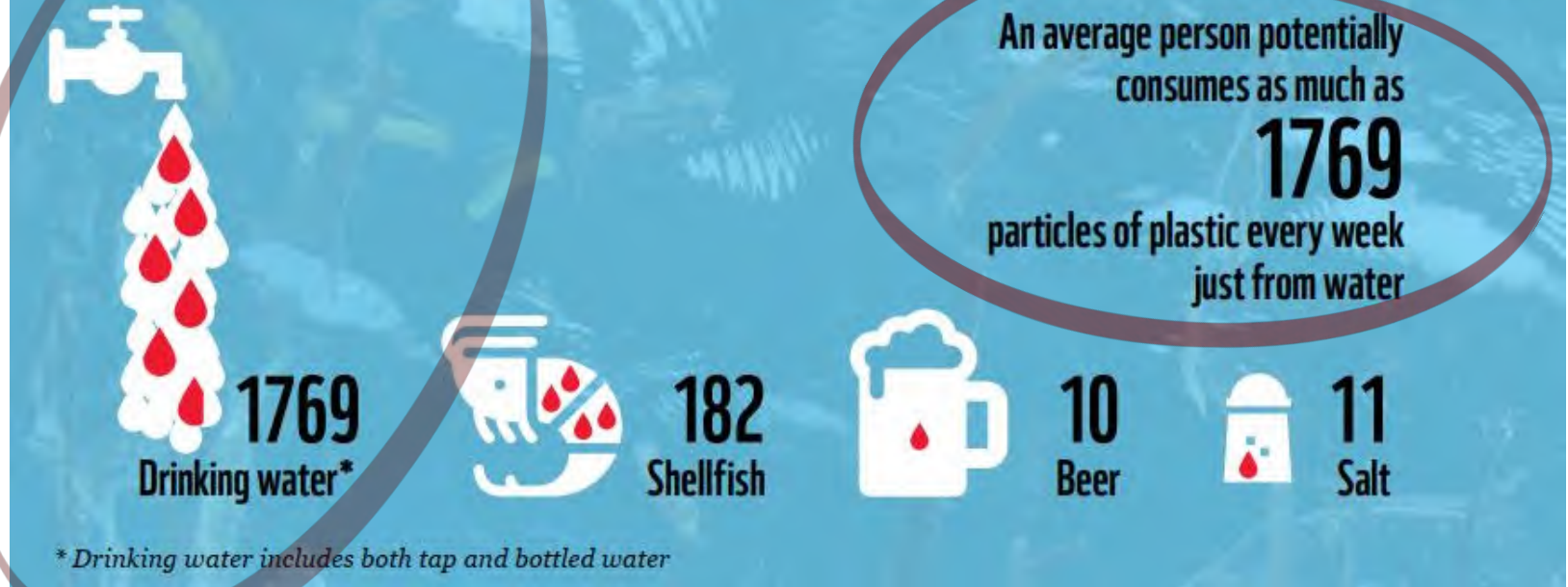


www.reuters.com/article/us-environment-plastic/you-may-be-eating-a-credit-cards-worth-of-plastic-each-week-study-idUSKCN1TD009/



2.5 mg average particle to reach 5 grams.

Figure 2: Estimated microplastics ingested through consumption of common foods and beverages (particles (0-1mm) per week)





Contents lists available at ScienceDirect

Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat

Research paper

Estimation of the mass of microplastics ingested – A pivotal first step towards human health risk assessment

Kala Senathirajah^a, Simon Attwood^b, Geetika Bhagwat^c, Maddison Carbery^c, Scott Wilson^d, Thava Palanisami^{a,*}

^a Global Innovative Centre for Advanced Nanomaterials (GICAN), Faculty of Engineering and Built Environment, The University of Newcastle, Callaghan, NSW 2308, Australia

^b The World Wide Fund for Nature (WWF), 354 Tanglin Road, Singapore, Singapore

^c School of Environmental and Life Sciences, The University of Newcastle, Callaghan, NSW 2308, Australia

^d Department of Environmental Science, Macquarie University, Sydney, Australia

ARTICLE INFO

Keywords:

Exposure pathways
Human health
Ingestion
Microplastics
Plastic pollution
Risk

ABSTRACT

The ubiquitous presence of microplastics in the food web has been established. However, the mass of microplastics exposure to humans is not defined, impeding the human health risk assessment. Our objectives were to extract the data from the available evidence on the number and mass of microplastics from various sources, to determine the uncertainties in the existing data, to set future research directions, and derive a global average rate of microplastic ingestion to assist in the development of human health risk assessments and effective management and policy options. To enable the comparison of microplastics exposure across a range of sources, data extraction and standardization was coupled with the adoption of conservative assumptions. Following the analysis of data from fifty-nine publications, an average mass for individual microplastics in the 0–1 mm size range was calculated. Subsequently, we estimated that globally on average, humans may ingest 0.1–5 g of microplastics weekly through various exposure pathways. This was the first attempt to transform microplastic counts into a mass value relevant to human toxicology. The determination of an ingestion rate is fundamental to assess the human health risks of microplastic ingestion. These findings will contribute to future human health risk assessment frameworks.

“humans may ingest 0.1–5 g of microplastics weekly through various exposure pathways”



Table 6

Summary of the annual average number of microplastics (particles) ingested (particles), and global average rate of microplastics ingested (g) per person per year.

Source of particles	ANMP _{ingested} (particles)	GARMI (0–1 mm) Scenario 1 (g)	GARMI (0–1 mm) Scenario 2 (g)	GARMI (0–1 mm) Scenario 3 (g)
Shellfish	9,445	26.4	0.0	0.0
Salt	565	1.6	7.4	14.2
Beer	523	1.46	0.3	0.5
Drinking water	91,994	257.5	0.0	0.0
Total (per year)	102,527	287.0	7.7	14.7
TOTAL (PER WEEK)	1,972	5.5	0.1	0.3

3 mg/particle



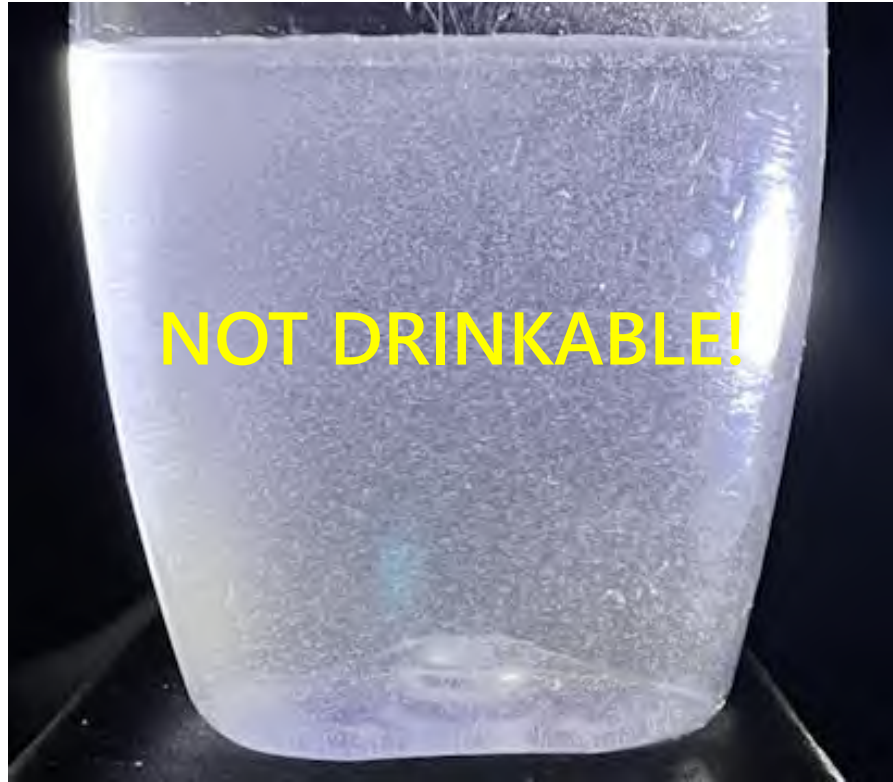
For PET, 1.6 mm
diameter particle

Average 2.5 mg particles.

Plastic microparticles,
0.65 grams consisting of
523 particles, in a liter of
water equaling the
concentration in order to
ingest 5 grams per week.
Such a high
concentration is easily
seen both in water and
upon drying. The particles
are cut from 1.5 mm
plastic monofilament.



HOMEMADE MICROPARTICLE SUSPENSION



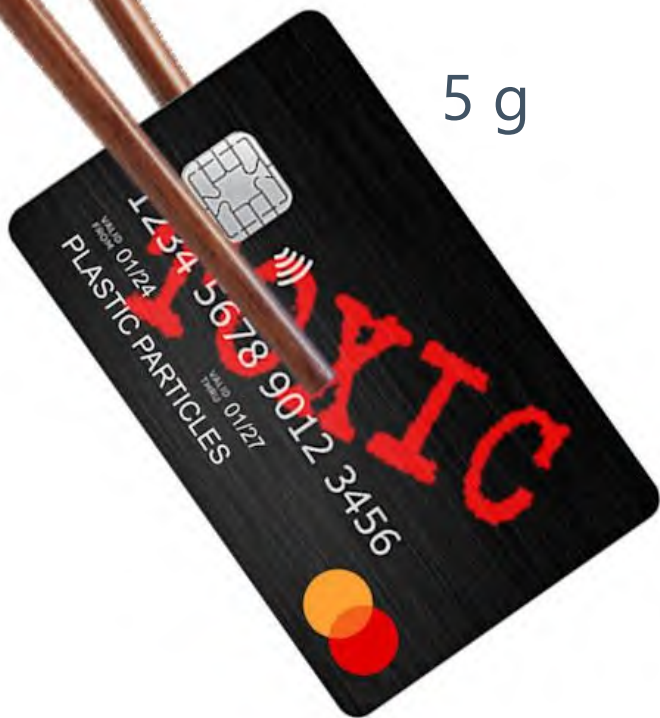
measured <0.05 g/L



Table 6

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Total (per year)	102,527	287.0	7.7	14.7
TOTAL (PER WEEK)	1,972	5.5	0.1	0.3



5 g

one model

0.1 g



0.02 credit cards worth

another model

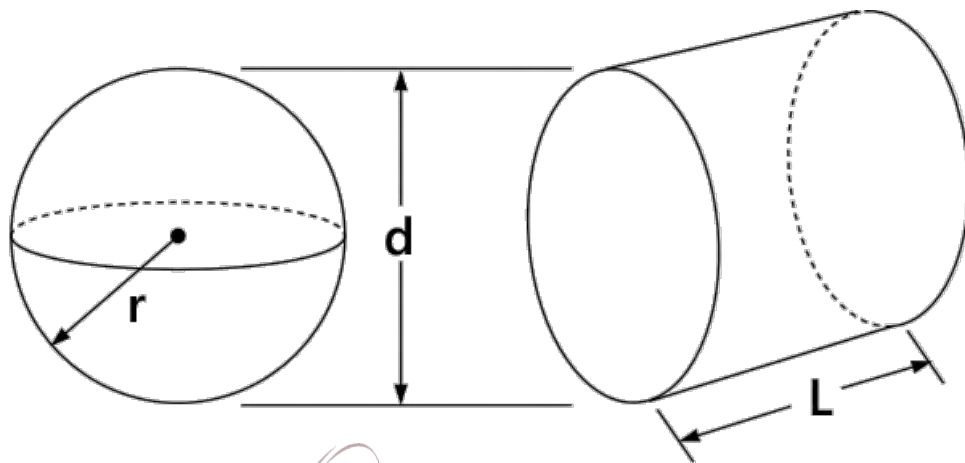


an average person could
be ingesting approximately 5
grams of plastic every
week.

wwfint.awsassets.panda.org/downloads/plastic_ingestion_web_spreads.pdf



GUESSING PARTICLE MASS



$$m = \rho V = \frac{\pi \rho d^3}{6}$$

$$m = \frac{\pi \rho d^2 L}{4}$$

$$\text{let } A = \frac{L}{d}$$

$$m = \frac{\pi \rho d^3 A}{4}$$

polymer	density(g/cc)
PE	0.92-0.97
PP	0.88-0.91
PET	1.30-1.40



Lifetime Accumulation of Microplastic in Children and Adults

Nur Hazimah Mohamed Nor,* Merel Kooi, Noël J. Diepens, and Albert A. Koelmans



Cite This: *Environ. Sci. Technol.* 2021, 55, 5084–5096



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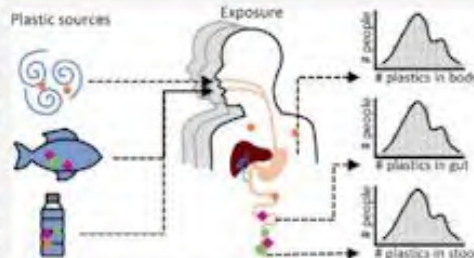


Article Recommendations



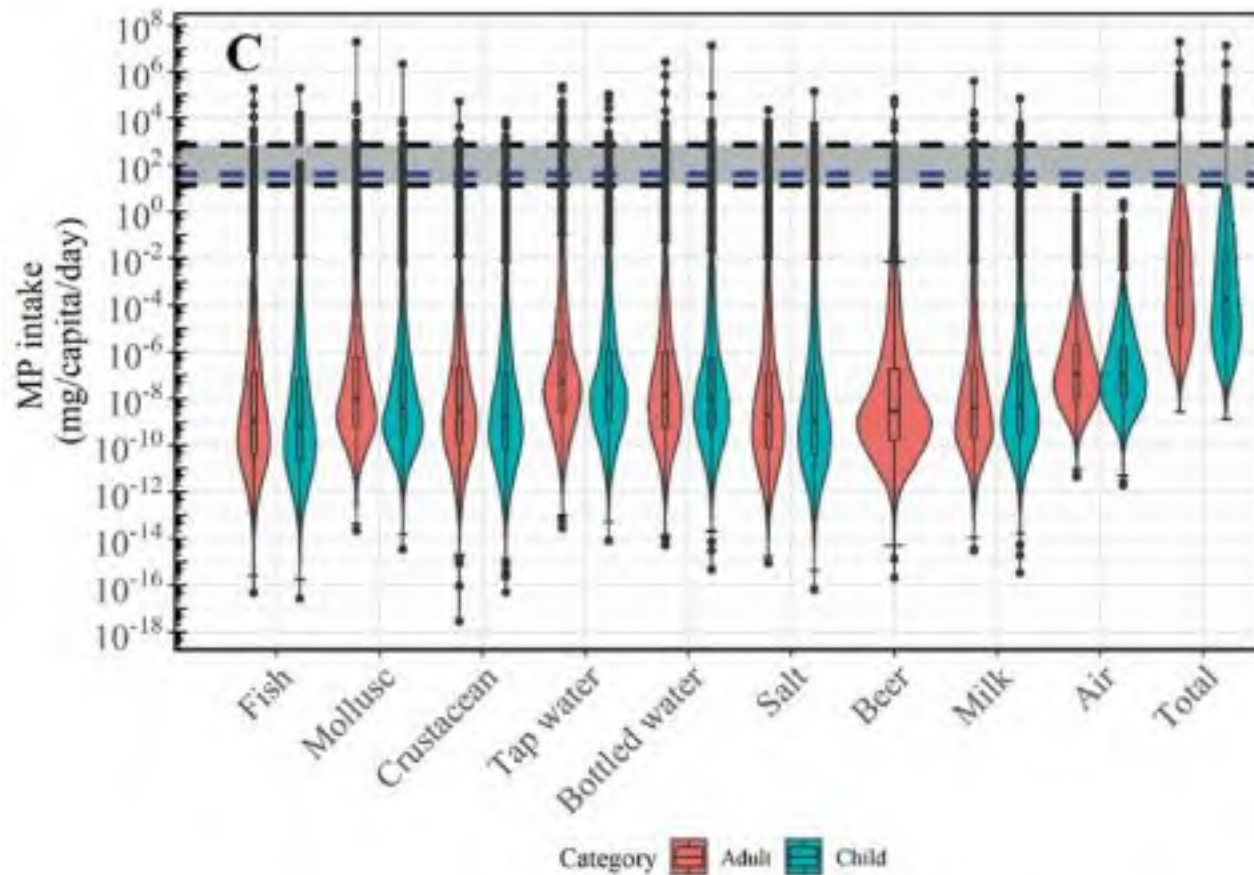
Supporting Information

ABSTRACT: Human exposure to microplastic is recognized as a global problem, but the uncertainty, variability, and lifetime accumulation are unresolved. We provide a probabilistic lifetime exposure model for children and adults, which accounts for intake via eight food types and inhalation, intestinal absorption, biliary excretion, and plastic-associated chemical exposure via a physiologically based pharmacokinetic submodel. The model probabilistically simulates microplastic concentrations in the gut, body tissue, and stool, the latter allowing validation against empirical data. Rescaling methods were used to ensure comparability between microplastic abundance data. Microplastic (1–5000 μm) median intake rates are 553 particles/capita/day (184 ng/capita/day) and 883 particles/capita/day (583 ng/capita/day) for children and adults, respectively. This intake can irreversibly accumulate to 8.32×10^3 (90% CI, 7.08×10^3 – 1.91×10^4) particles/capita or 6.4 (90% CI, 0.1 – 2.31×10^3) ng/capita for children until age 18, and up to 5.01×10^4 (90% CI, 5.25×10^3 – 9.33×10^4) particles/capita or 40.7 (90% CI, 0.8 – 9.85×10^3) ng/capita for adults until age 70 in the body tissue for 1–10 μm particles. Simulated microplastic concentrations in stool agree with empirical data. Chemical absorption from food and ingested microplastic of the nine intake media based on biphasic, reversible, and size-specific sorption kinetics, reveals that the contribution of microplastics to total chemical intake is small. The as-yet-unknown contributions of other food types are discussed in light of future research needs.



883 particles per person per day

583 ng/person/day





Bert Koelmans makes point that a week's ingestion is like a grain of salt between chopsticks – mere micrograms.



To Waste or Not to Waste: Questioning Potential Health Risks of Micro- and Nanoplastics with a Focus on Their Ingestion and Potential Carcinogenicity

Elisabeth S. Gruber¹ · Vanessa Stadlbauer^{2,3} · Verena Pichler⁴ · Katharina Resch-Fauster⁵ · Andrea Todorovic⁵ · Thomas C. Meisel⁶ · Sibylle Trawoeger⁷ · Oldamur Hollóczy⁸ · Suzanne D. Turner^{9,10} · Wolfgang Wadsak^{3,11} · A. Dick Vethaak^{12,13} · Lukas Kenner^{3,14,15,16} 

Received: 8 October 2021 / Revised: 30 December 2021 / Accepted: 11 February 2022 / Published online: 22 March 2022
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Abstract

Micro- and nanoplastics (MNPs) are recognized as emerging contaminants, especially in food, with unknown health significance. MNPs passing through the gastrointestinal tract have been brought in context with disruption of the gut microbiome. Several molecular mechanisms have been described to facilitate tissue uptake of MNPs, which then are involved in local inflammatory and immune responses. Furthermore, MNPs can act as potential transporters (“vectors”) of contaminants and as chemosensitizers for toxic substances (“Trojan Horse effect”). In this review, we summarize current multidisciplinary knowledge of ingested MNPs and their potential adverse health effects. We discuss new insights into analytical and molecular modeling tools to help us better understand the local deposition and uptake of MNPs that might drive carcinogenic signaling. We present bioethical insights to basically re-consider the “culture of consumerism.” Finally, we map out prominent research questions in accordance with the Sustainable Development Goals of the United Nations.

Keywords Microplastic · Nanoplastic · Carcinogenesis · Human health · Bioethics issue



“Translated into more imaginable numbers, on average we ingest five grams of MPs per week per person (roughly corresponding to the mass of a credit card).”





MEDICAL UNIVERSITY
OF VIENNA

DEUTSCH

Menu

Health risk due to micro- and nanoplastics in food

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< [All News](#)

2022-03-24 — MEDICINE & SCIENCE



(Vienna,
24-03-2022) Five
grams of plastic
particles on aver-
age enter the hu-
man gastrointesti-
nal tract per person

Five grams
of plastic particles
on average enter
the human
gastrointestinal
tract per person
per week

www.meduniwien.ac.at/web/en/ueber-uns/news/default-0f889c8985-1/gesundheitsrisiko-durch-mikro-und-nanoplastik-in-lebensmitteln/



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from research organizations

Health risk due to micro- and nanoplastics in food

Date: March 24, 2022

Source: Medical University of Vienna

Summary: Five grams of plastic particles on average enter the human gastrointestinal tract per person per week. This is roughly equivalent to the weight of a credit card. Whether ingested micro- and nanoplastics pose a health risk is being investigated in numerous studies but is largely unknown to date. A research team has now summarized the current state of scientific knowledge.



Five grams
of plastic particles
on average enter
the human
gastrointestinal
tract per person
per week





NEW YORK POST

READ THE
LATEST ON **Page Six**



HEALTH

You're eating a credit card's worth of plastic a week — and it's killing your gut

By **Brooke Kato**

Published March 30, 2022 | Updated March 30, 2022, 4:47 p.m. ET



Newsweek 90

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Food

Drink

Water

Science

scientific research

Junk Food and Tainted Water: People Ingest a Credit Card Worth of Nanoplastics Weekly, Study Says

Mar 31, 2022 at 5:09 PM EDT

Bottled water or tap?

How you answer that question could have some major implications for your long-term health, a new study into the health effects of ingested plastic particles shows.

That study also contained this startling fact: People are eating the equivalent of one plastic credit card every week in their diet. The plastic particles enter the human food chain through plastic waste contained in fish, sea salt and drinking water, the study shows.

Scientists say such nanoplastics disrupt the human gut bacteria and can lead to killer diseases like cancer and diabetes.

www.newsweek.com/junk-food-tainted-water-people-ingest-credit-card-worth-nanoplastics-weekly-study-says-1693970



TastingTable.

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COOK

You Probably Eat A Credit Card's Worth Of Plastic Every Week



BY GILLIE HOUSTON / UPDATED: OCT. 19, 2022 6:53 PM EST

www.tastingtable.com/1062298/you-probably-eat-a-credit-cards-worth-of-plastic-every-week/

November 2022

Journal of Hazardous Materials Letters 3 (2022) 100071

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journal homepage: www.sciencedirect.com/journal/journal-of-hazardous-materials-letters

ELSEVIER



Ingested microplastics: Do humans eat one credit card per week?

Martin Pletz

Designing Plastics and Composite Materials, Department of Polymer Engineering and Science, Montanuniversität Leoben, Austria

ARTICLE INFO

Keywords:

Microplastics
Size distribution
Ingestion
Human health

ABSTRACT

Ingested Microplastic (MP) particles can harm the human body. Estimations of the total mass of ingested MP particles correspond to 50 plastic bags per year (Bai et al., 2022), one credit card per week (Gruber et al., 2022), or a median value of 4.1 $\mu\text{g}/\text{week}$ for adults (Mohamed Nor et al., 2021). The first two estimations are based on an analysis (Senathirajah et al., 2021) that predicts a total ingested mass of MP particles $m_{\text{I,MP}}$ of 0.1–5 g/week. This work revisits and evaluates this calculation and compares its results and methods to Mohamed Nor et al. (2021). Senathirajah combines data of averaged MP particle masses $\bar{m}_{\text{MP}}$ from papers that reported MP particle sizes and MP particle counts n_{MP} in shellfish, salt, beer, and water based on other papers that detected MP particles. Combined with the estimated weekly consumption of those consumables, they compute $m_{\text{I,MP}}$. This work raises some serious issues of Senathirajah in the way they combine data and they obtained particle sizes. It concludes that Senathirajah overestimates $m_{\text{I,MP}}$ by several orders of magnitude and that $m_{\text{I,MP}}$ can be considered as a rather irrelevant factor for the toxic effects of MP particles on the human body.

a human eats
a credit card
worth of MPs not
every week but
every 23
thousand years.

Sources, consequences, and control of nanoparticles and microplastics in the environment



A. Guhananthan^a, Aswin Kuttykattil^b, Thavamani Palanisami^b and Selvakumar Rajendran^{a,b}

^aDepartment of Nanobiotechnology, PSG Institute of Advanced Studies, Coimbatore, Tamil Nadu, India, ^bEnvironmental Plastic and Innovation Cluster (EPIC), Global Innovation Centre for Advanced Nanomaterials (GICAN), University of Newcastle, Callaghan, NSW, Australia

10.1 Introduction

Nanoparticles (NP) and microplastics (MPs) are the most recent anthropogenic contaminants which pose threat to the environment and health. Both NPs and MPs from various sources interact with water, air, and soil in a complex way affecting aquatic and terrestrial ecosystems (Fred-Ahmadu et al., 2020). Their bioaccumulation leads to, cytotoxicity, genotoxicity, organ failure, and sometimes death in living organisms. Nanoparticles can be classified into different types based on their origin (natural nanoparticles (NNPs) and engineered nanoparticles (ENPs)), dimension, size, and chemical composition (Ealia and Saravanakumar, 2017). Fig. 10.1 illustrates various sources of nanoparticles.



Senathirajah and Palanisami (2019) estimated that on average, humans may consume 5 g of MPs per week





Strategies to Reduce Risk and Mitigate Impacts of Disaster: Increasing Water Quality Resilience from Microplastics in the Water Supply System

Kala Senathirajah* and Thava Palanisami

Cite This: ACS EST Water 2023, 3, 2816–2834

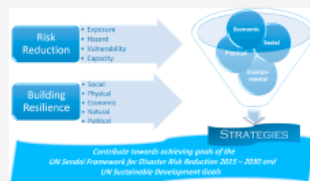
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ABSTRACT: Microplastics contaminating the water supply system qualifies as a disaster. This has major far-reaching implications, posing significant threats to economic growth and human livelihoods, as well as environmental and human health and well-being. Thus, we need to reduce the risk and mitigate against the effects of microplastics to build resilience and ensure continuity and efficiency of water supply system functions. To date, microplastics in the water supply cycle have not been considered in the context of disaster management. Hence, we provide an understanding of the disaster risk that microplastics pose using a conceptual mathematical framework. Additionally, we enhance understanding of the resilience of the social and physical infrastructure by highlighting hazards that people and infrastructure in the community face. Insights of the social, economic, and other human factors that make them vulnerable highlights capacities required to reduce risk and mitigate impacts. By evaluating the social and physical infrastructure resilience to microplastics in the water supply system and recommending multidisciplinary strategies to build resilience over time, we aim to catalyze action to address the problem. This will also contribute toward achieving targets of the Sendai Framework for Disaster Risk Reduction 2015–2030 and UN Sustainable Development Goals.



1. INTRODUCTION

Plastics are versatile, synthetic, widely used, persistent materials found in all aspects of our lives, in all sectors, and as pollution all around the globe. The plastic pollution crisis meets all criteria to qualify as a slow-onset disaster.¹ Microplastics are ubiquitous plastic fragments, spheres, fibers, filaments, and films, viz., plastic particles greater than 100 nm and less than 5 mm in size. Nanoplastics are particles less than 100 nm.² Microplastics have been detected in the air, water, and terrestrial environments, found from Mount Everest to the Marianna trench.³ Microplastics have been found in plants,⁴ animals, and humans,⁵ in human placenta,⁶ lungs, blood, and even breastmilk.⁷ A recent study estimated that we could be ingesting cumulatively 0.1 to 5 g of microplastics a week⁸ from a combination of sources, including from drinking water which is a fundamental need for survival. Microplastics have been detected in water supply sources, tap water, and bottled water around the world.^{9,10}

Microplastics contaminate the water supply system (WSS) due to numerous reasons, including the existing social systems' policies and consumptive behaviors, and limitations in treatment. The fate and transport of microplastics through the water supply cycle (WSC) are varied, and thus the timeframes and implications also range greatly depending on

the entry and exit points. For example, microplastics exiting via ingestion by a human has different implications to microplastics exiting via biosolids application for agriculture, although notably both instances impinge on the health and well-being of humans⁹ and ecosystems.¹⁰ The transport and fate of microplastics are a function of numerous factors including polymer type, size, shape, specific surface area, density, crystallinity, molecular structure, formation of biofilm and additives, among others. These also influence the vulnerability of the WSS and its sensitivity to the microplastic contamination.

Access to safe drinking water and wastewater services (W&WWS) are a human right^{11,12} and are essential to ensure health and well-being, good hygiene practices, economic prosperity, and minimize the spread of water borne diseases.¹³ There are many disruptive events that impact W&WWS. Key to the continuity of service is water quality (WQ). From a

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Revised: August 11, 2023
Accepted: August 14, 2023
Published: August 29, 2023



A recent study estimated that we could be ingesting cumulatively 0.1 to 5 g of microplastics a week



<https://pubs.acs.org/doi/abs/10.1021/acsestwater.3c00206>

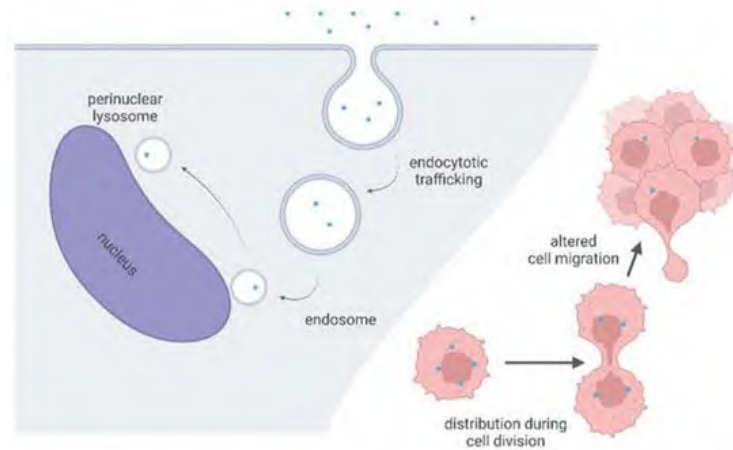


MARCH 6, 2024

Editors' notes

Micro- and nanoplastics in the body are passed on during cancer cell division, finds study

by Medical University of Vienna



Credit: *Chemosphere* (2024). DOI: 10.1016/j.chemosphere.2024.141463

“Plastic particles up to the weight of a credit card (approx. 5 grams) enter the gastrointestinal tract every week.”



Research Paper

Microplastics are detected in human gallstones and have the ability to form large cholesterol-microplastic heteroaggregates

Deyu Zhang^{a,1}, Chang Wu^{a,1}, Yue Liu^{a,1}, Wanshun Li^{a,1}, Shiyu Li^a, Lisi Peng^a, Le Kang^a,
Saif Ullah^c, Zijun Gong^b, Zhaoshen Li^a, Dan Ding^{d,2} , Zhendong Jin^{a,2} ,
Haojie Huang^{a,2}

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<https://doi.org/10.1016/j.jhazmat.2024.133631>

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The World Wildlife Fund reported that adults consume more than 5 g of plastic each week on average.

Does it matter that 5 grams per week is wrong?



Streamed live on Apr 28, 2022

California Attorney General Rob Bonta makes a major announcement on the California Department of Justice's efforts to protect the environment from plastic pollution.

<https://www.youtube.com/watch?v=fhaURS9U04s>



WHO WE ARE

WHAT WE DO



OUR IMPACT

GET INVOLVED



Why UNDP is tackling the developmental dimensions of plastic pollution

The burdens disproportionately affect the vulnerable

JUNE 20, 2024



the average person could be ingesting a credit card worth of plastics, approximately five grams every week.





UN Global Plastics Treaty



<https://yourplasticdiet.org/>

A credit card a week?

On average people could be ingesting around 5 grams of plastic every week, which is the equivalent weight of a credit card. Our study suggests people could be consuming on average over 100,000 microplastics every year. That's approximately 21 grams a month, just over 250 grams a year.

TAKE ACTION!



Picasso, 1955



Microplastics are bad, but ignoring science is worse

www.rdworldonline.com/microplastics-are-bad-but-ignoring-science-is-worse/

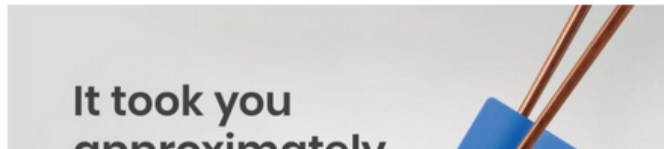
By Mark Jones | March 20, 2024



We all know that 98.6° F is human body temperature ... only it isn't. A new **study** reconfirms something extensively covered during the COVID pandemic: Normal human body temperature falls between 97.3° and 98.2° F — with 97.9° F as today's average.

And 5 grams per week is the amount of plastic every person consumes ... only it isn't. Like outdated body-temperature assertions, this 5-g value (widely reported in many science and news circles) is flawed. The difference is that data manipulation and memes didn't give us the 98.6° F value ... but they did help propel the 5-g-of-plastic assertion. It has shaken my faith in the scientific community.

Now, the world widely accepts the average person consumes 5 g of plastic per week — the weight of a credit card. Thanks to one now-quite-famous picture of a credit card





ELSEVIER

Contents lists available at ScienceDirect

Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat



Research paper

Estimation of the mass of microplastics ingested – A pivotal first step towards human health risk assessment

Kala Senathirajah^a, Simon Attwood^b, Geetika Bhagwat^c, Maddison Carbery^c, Scott Wi Thava Palanisami^{d,*}

^a Global Innovative Centre for Advanced Nanomaterials(GICAN), Faculty of Engineering and Built Environment, The University of Newcastle, Callaghan Australia

^b The World Wide Fund for Nature (WWF), 354 Tanglin Road, Singapore, Singapore

^c School of Environmental and Life Sciences, The University of Newcastle, Callaghan, NSW 2308, Australia

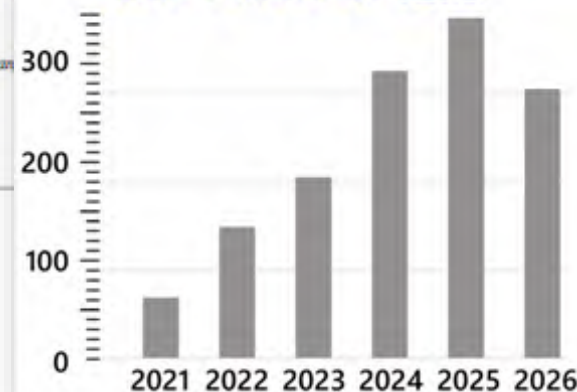
^d Department of Environmental Science, Macquarie University, Sydney, Australia

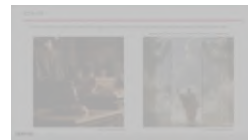


Pletz 105 total citations

<https://doi.org/10.1016/j.jhazmat.2020.124004>

Total Citations: 1278





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FOCUS ON TWO MEMES



https://wwf.panda.org/wwf_news/?348337/Revealed-plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week



PRESS ROOM

First-ever study finds cancer-causing chemicals in black plastic food-contact items sold in the U.S.

October 1, 2024



Highest levels of toxic flame retardants found in a spatula, sushi tray, and beaded necklace—likely the result of dirty plastic recycling

Toxic-Free Future urges the U.S. and states to ban poison plastics and harmful chemical additives through the Global Plastics Treaty and state policy

SEATTLE, WA — A new [peer-reviewed study](#) in *Chemosphere* finds, for the first-time, certain toxic chemicals in black plastic food-contact items sold in the United States. Led by scientists from Toxic-Free Future and Vrije Universiteit Amsterdam, [the testing uncovered](#) high levels of cancer-causing, hormone-disrupting flame retardant chemicals in a variety of household products made with black plastics including food serviceware, kitchen utensils, and toys.

Press Contact

Stephanie Stohler,
ssstohler@toxicfreefuture.org

To receive timely press releases and statements to your inbox, members of the media can request to be added to our press list.

“testing uncovered high levels of cancer-causing, hormone-disrupting flame retardants chemicals in a variety of household products made with black plastics..... Toxic flame retardant chemicals were found in 85% of analyzed products”

Harmful flame retardants (FRs) used in electronics were found in **black plastic household products**—including toys and kitchen utensils—likely due to recycled content.

Presumed FR Source



TBBPA, BDE-209, 2,4,6-TBP, DBDPE, TTBP-TAZ, BDP, RDP, & TPHP are or have been intentionally used in electronics.

FRs Detected

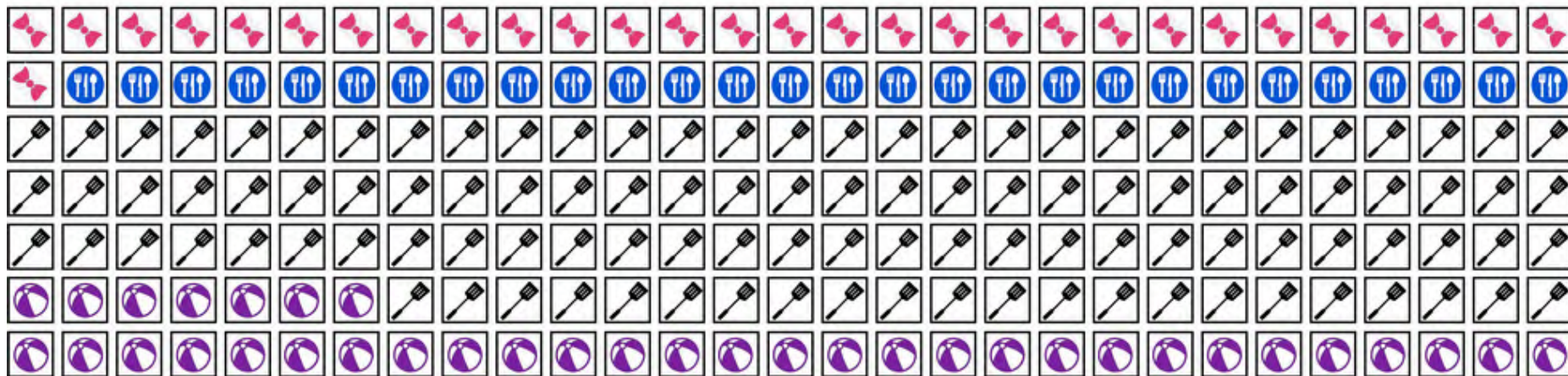


This study found Σ FR concentrations up to 22,790 mg/kg in food serviceware, hair accessories, kitchen utensils, and toys.

- 17 out of 20 products analyzed contained brominated and/or organophosphate FRs.
- Most frequently detected compounds included TBBPA, BDE-209, 2,4,6-TBP, RDP, BDP, and DBDPE.
- Items containing polymers used in electronics had significantly higher FR levels.

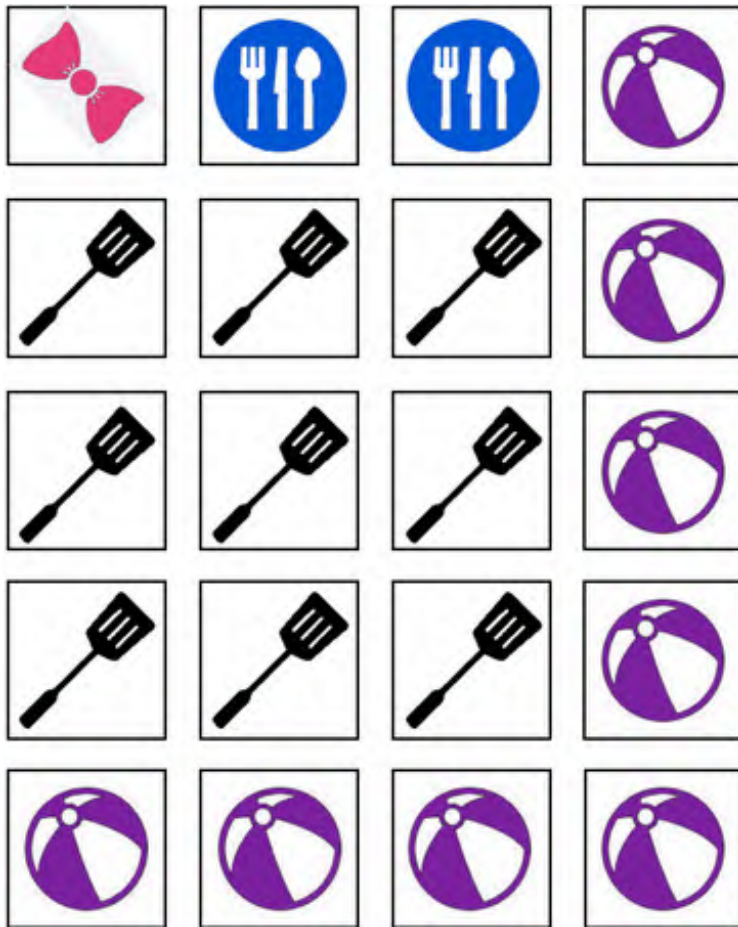
85%



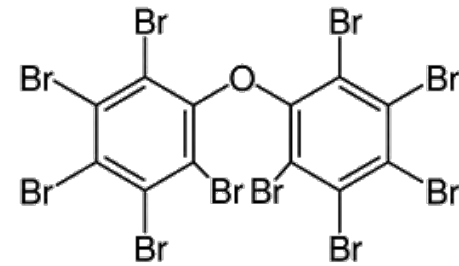
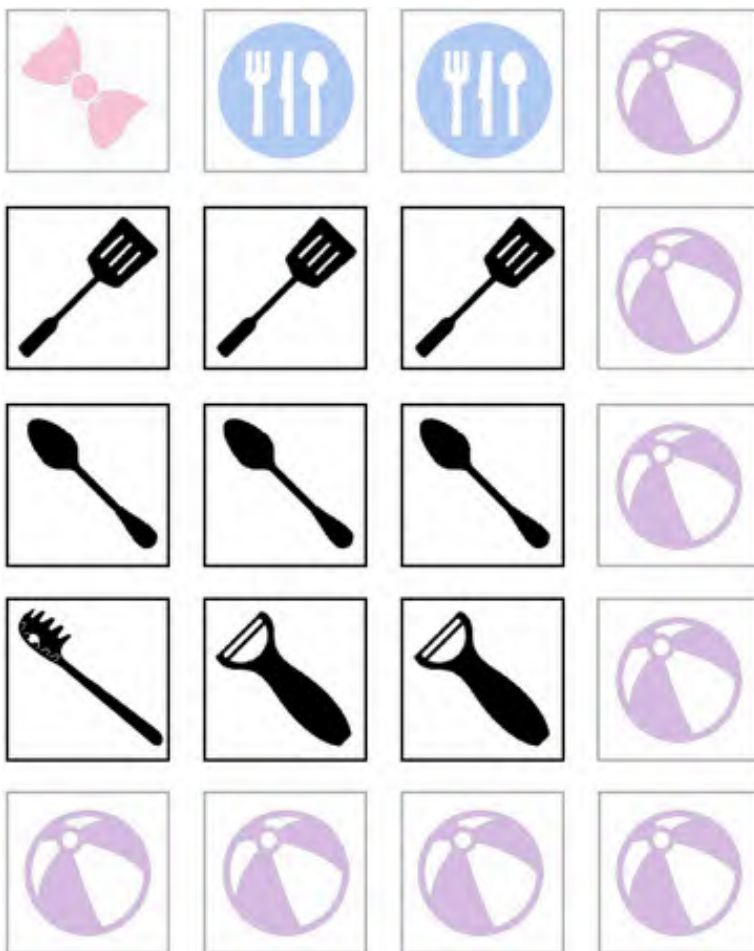


203 total items: 30 hair accessories, 28 food service, 36 toys, 109 kitchen items





Compound-sensitive LC-MS method used to analyze compositions and concentrations present in 20 of the 203 items in the collected cohort, only those with highest Br levels measured by XRF.

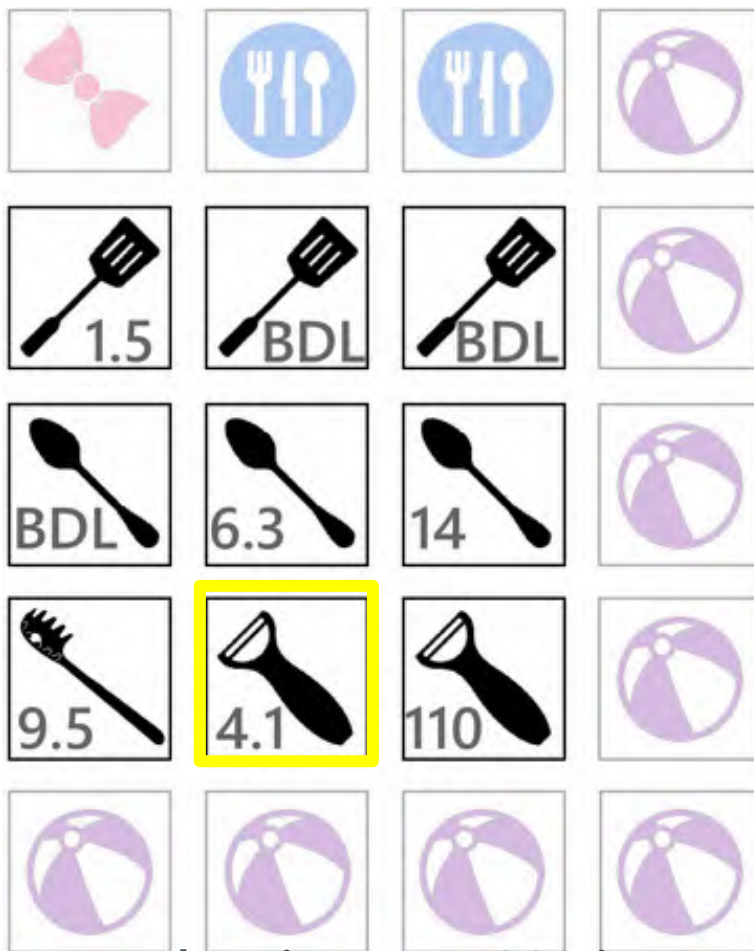


BDE-209

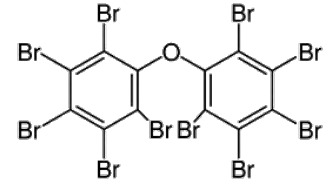
reported median value of
34.7 μ g/day for kitchen items

concluded too close to
42 μ g/day EPA reference dose

but they got it wrong - twice



showing BDE-209 in ug/day



BDE-209

reported median value of
34.7 $\mu\text{g/day}$

actual median 4.1 $\mu\text{g/day}$

average is 16 $\mu\text{g/day}$ (24
ignoring BDL)

reference dose is 420 $\mu\text{g/day}$

concentration

correlation

exposure

correlation from Kuang et al.

$$f(C) = E$$

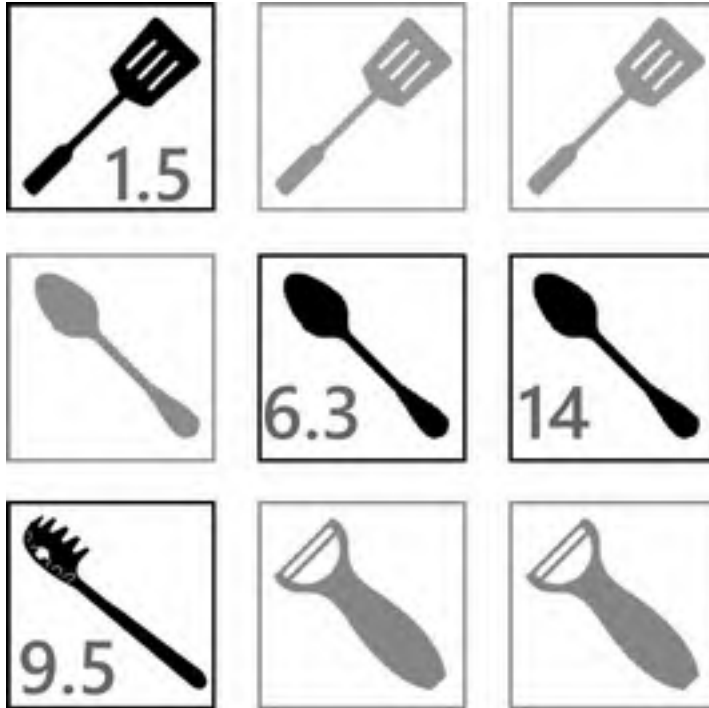
$$E \propto C$$

for immersion in hot oil for 15 minutes

conclude simple touching creates no exposure

Kuang J, Abdallah MA, Harrad S. Brominated flame retardants in black plastic kitchen utensils: Concentrations and human exposure implications. Science of The Total Environment. 2018 Jan 1;610:1138-46. doi.org/10.1016/j.scitotenv.2017.08.173.

author's treatment

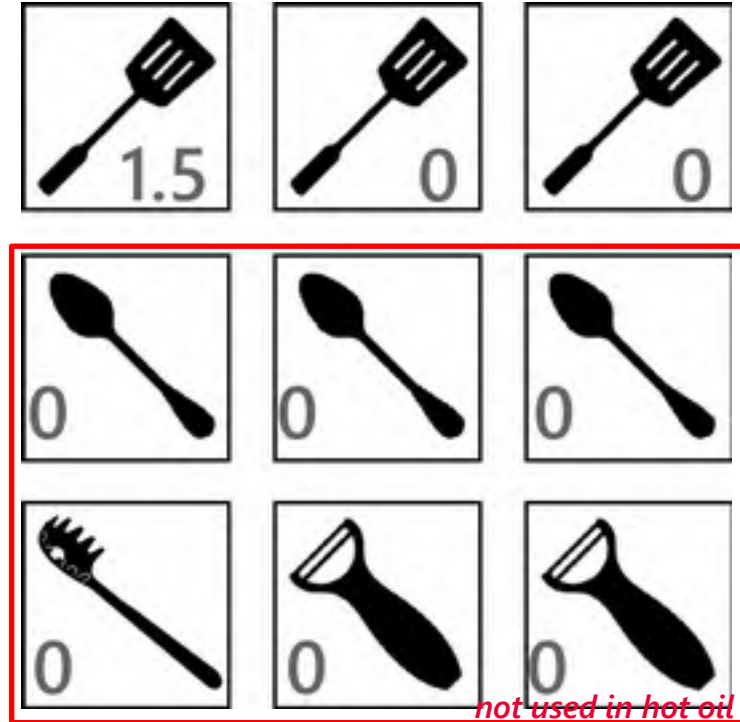


average = 7.9 $\mu\text{g}/\text{day}$ (was 34.7)
= 4.5 $\mu\text{g}/\text{day}$ ex. peelers

showing BDE-209 in $\mu\text{g}/\text{day}$

would be 4.5 excluding only peelers

more correct



0.17 $\mu\text{g}/\text{day}$ = 1.5/9

reference dose is 420 $\mu\text{g}/\text{day}$

In Corrigendum 2, state they only sampled handles.

The KitchenAid spatula shown in the paper has a nylon blade and ABS handle.

average exposure ~ 0



From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling

Megan Liu ^a  , Sicco H. Brandsma ^b, Erika Schreder ^a

<https://doi.org/10.1016/j.chemosphere.2024.143319>

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Refers to

[Response to the letter to the editor](#)

Chemosphere, Volume 385, September 2025, Pages 144547

Megan Liu, Sicco H. Brandsma, Erika Schreder

[Letter to the editor](#)

Chemosphere, Volume 385, September 2025, Pages 144542

Mark E. Jones

Referred to by

[Corrigendum to 'From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling'...](#)

Chemosphere, Available online 3 July 2025, Pages 144552

Megan Liu, Sicco H. Brandsma, Erika Schreder

[Corrigendum to 'From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling'...](#)

Chemosphere, Volume 370, February 2025, Pages 143903

Megan Liu, Sicco H. Brandsma, Erika Schreder



Pull those black plastic spatulas out of the trash

<https://www.rdworldonline.com/pull-those-plastic-spatulas-out-of-the-trash/>

By Mark Jones, Ph.D. | January 23, 2025



2024 was the year of spatulageddon. Plastic spatulas were trashed due to reports of dangers lurking within. The journal article that raised concern contained an error, **an obvious error**. A **correction was made** but there is more to the story.

How a recycling study spawned spatula hysteria

The study causing spatulageddon is **"From e-waste to living space:**



[Adobe Stock]



Viral paper on black plastic kitchen utensils earns second correction

The authors of a paper that went viral with attention-grabbing headlines urging people to throw out their black plastic kitchen tools have corrected the work for a second time.



But a letter accompanying the correction suggests the latest update still fails “to completely correct the math and methodological errors present in the study,” according to **Mark Jones**, an industrial chemist and consultant who has been following the case. “The errors are sufficient to warrant a restating of the abstract, sections of the paper and conclusions, if not a retraction.”





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Norms for conduct that distinguish between acceptable and unacceptable behavior.

Resnik, D.B., "What Is Ethics in Research and Why Is It Important?"



source: midjourney.com



source: midjourney.com



source: [midjourney.com](https://www.midjourney.com)



source: [midjourney.com](https://www.midjourney.com)



Robert Boyle

The Sceptical Chymist (1661)

- 1. Fabricated experiments.
- 2. Uncredited or falsely credited claims.
- 3. Willful obscurity of language.
- 4. Suppressing inconvenient results.

Refinement by Charles Babbage, *Reflections on the Decline of Science in England*, 1830,

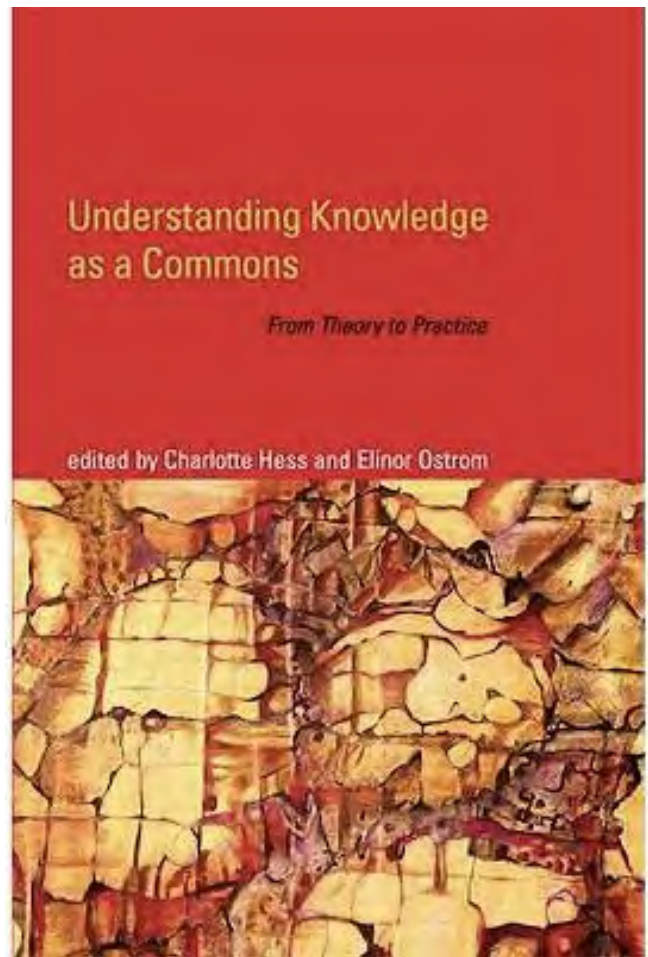
- Hoaxing
- Forging
- Trimming
- Cooking

W. K. CLIFFORD

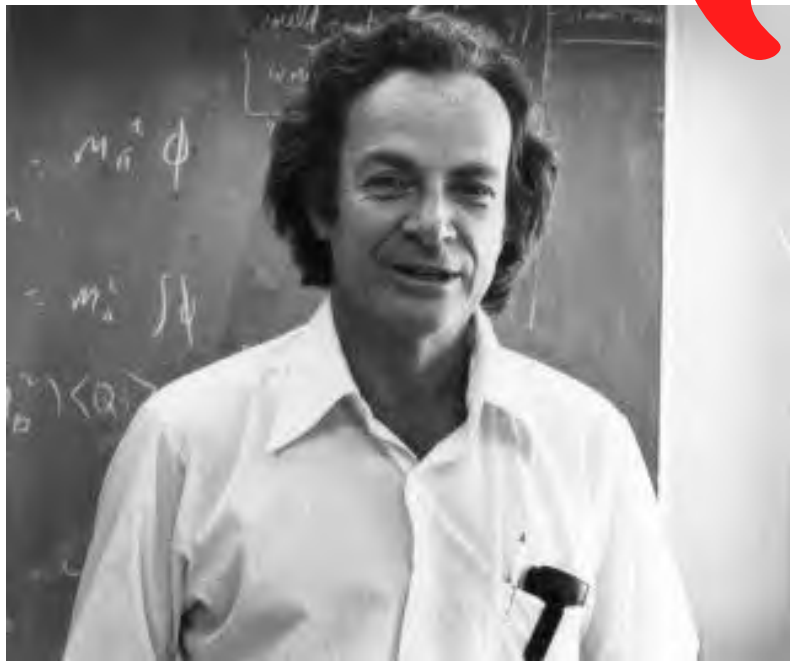
THE ETHICS OF BELIEF



*knowledge
as a
commons*



FEYNMAN WEIGHS IN



Caltech commencement address, 14 June 1974



It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty — a kind of leaning over backwards. For example, if you're doing an experiment, you should report everything that you think might make it invalid — not only what you think is right about it



Making an error is not unethical.

Letting it stand once known?

Depends on who you ask

integrity failure versus competence failure

SOCIETY RULES



*Clause 9: Fellows and Foreign Members shall be fair and objective peer reviewers, maintain confidentiality when requested, **promptly move to correct the literature when errors in their own work are detected**, include all deserving authors on publications, and give appropriate credit to prior work in citations.*



Chemical professionals should seek to advance chemical science while striving for the highest standards of scientific integrity. This includes sharing ideas and information, keeping accurate and complete records, and giving due credit to the contributions of others. Undisclosed conflicts of interest and scientific misconduct, including fabrication, falsification, and plagiarism, are incompatible with this code.

no mention of errors

ORGANIZATION RULES

C O P E

Committee on Publication Ethics is a nonprofit organization whose stated mission is to define best practice in the ethics of scholarly publishing and to assist editors and publishers to achieve this.

*Professional Conduct Guidelines #7: Take action on suspected or reported misconduct **or errors, before or after publication**, by investigating concerns, engaging with relevant parties (including journals, institutions, organisations, and individuals), correcting the literature as needed, and preserving the integrity of the version of record, ensuring any changes to it are made transparently.*



ALLEA serves as the European Federation of Academies of Sciences and Humanities

*The European Code of Conduct for Research Integrity: Authors and publishers promptly issue corrections or retract publications, if necessary, the retraction processes are clear and the reasons stated, and **authors are given credit for issuing corrections post-publication.***

Misconduct does not extend to making mistakes and failing to correct them.

WHO IS RESPONSIBLE FOR CORRECTION

Actor	Duty defined?	Duty triggers on?	Body to enforce it?
Original author	Sometimes yes, mostly no.	Self-detection only	No
Journal	Yes (for FFP but not for error)	Complaint or self-report	Only within its own narrow categories
Field/community	No	N/A	N/A
Society	No	Individual discretion	N/A

FFP: fabrication, falsification, and plagiarism

SAD CONCLUSION

- Gatekeeping power, exercised at the point of submission, is wielded. Curatorial power, exercised on the existing record, is not done (or expected).
- Peer review, editorial rejection, funding review are all forward-facing.
- Retraction and corrections, the backward-facing options, are rare for mistakes and nearly impossible without agreement from the original author(s).
- **We don't recognize knowledge as a commons.**

MORE SAD CONCLUSIONS

- No one likes retractions
 - they don't make money for publishers
 - they are viewed as a black eye for the journal
 - they are viewed negatively so authors don't want them
 - they are unlikely to sway public opinion of meme science
- The number of articles written about the errors pales by comparison to the reporting on the original more sensationalized press release from Toxic-Free Future or WWF/Newcastle.
- Few take action to correct the errors when they are found post-publication.
- Journals paywall corrections and don't link to critical work



creation of Cascatelli is an interesting, very public example of successful product development

memes science is impacting public perception (and is difficult to combat)

- correction in the scientific literature is slow; correcting public perception even slower.
 - retractions don't benefit those directly involved
 - zombie facts persist and persist

what are the costs and ethical implications of being wrong?

- the imperatives to identify flawed studies are weak and largely ineffective
- it is rare for flawed studies to be corrected/retracted



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WHAT CAN AN INDIVIDUAL DO?

- When acting as a peer reviewer
 - Check the methods and the math
 - Don't neglect the background
- If you see obvious errors in published work, there you can take action
- Keep your expectations low

No one likes retractions

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Home / Publications

From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling

Chemosphere (2024) - 4 Comments

doi: 10.1016/j.chemosphere.2024.143319 issn: 0045-6535 pubmed: 39271080 issn: 1879-1298

Megan Liu ✓, Sicco H. Brandsma ✓, Erika Schreder ✓

#1 *Actinopolyspora biskrensis* comment accepted December 2024

Some concerns: <https://nationalpost.com/news/canada/black-plastic>

Correction apparently pending, although I'm not sure I agree with the author's statement:

"However, it is important to note that this does not impact our results," Liu told National Post. "The levels of flame retardants that we found in black plastic household items are still of high concern, and our recommendations remain the same."