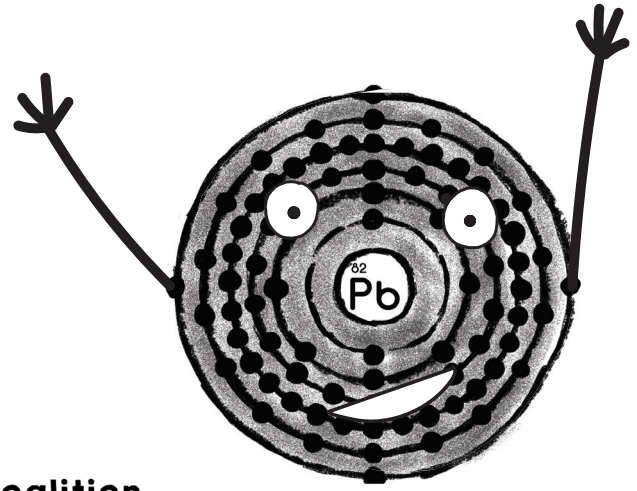
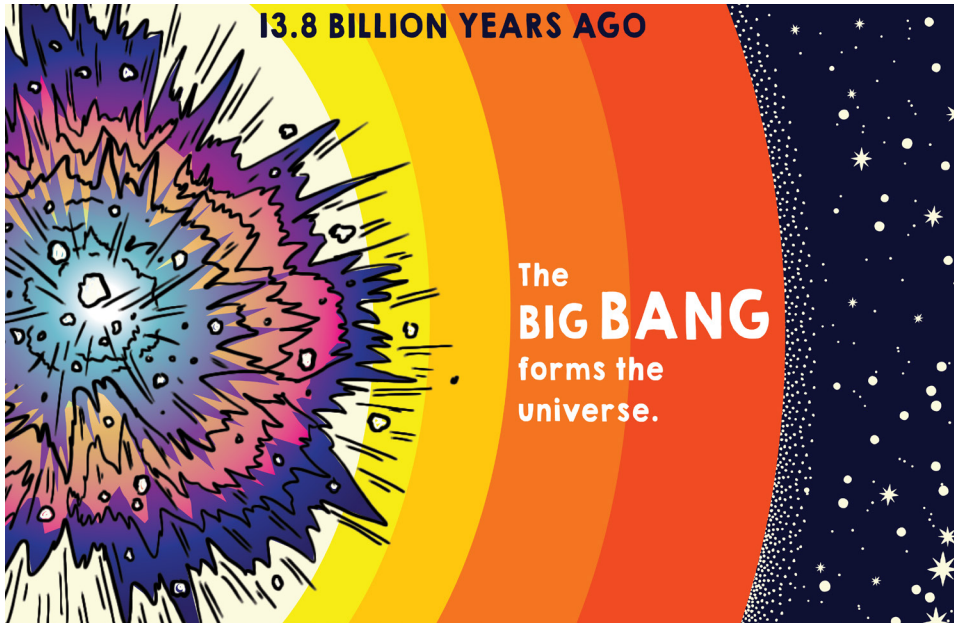
THE LEGACY OF LEAD

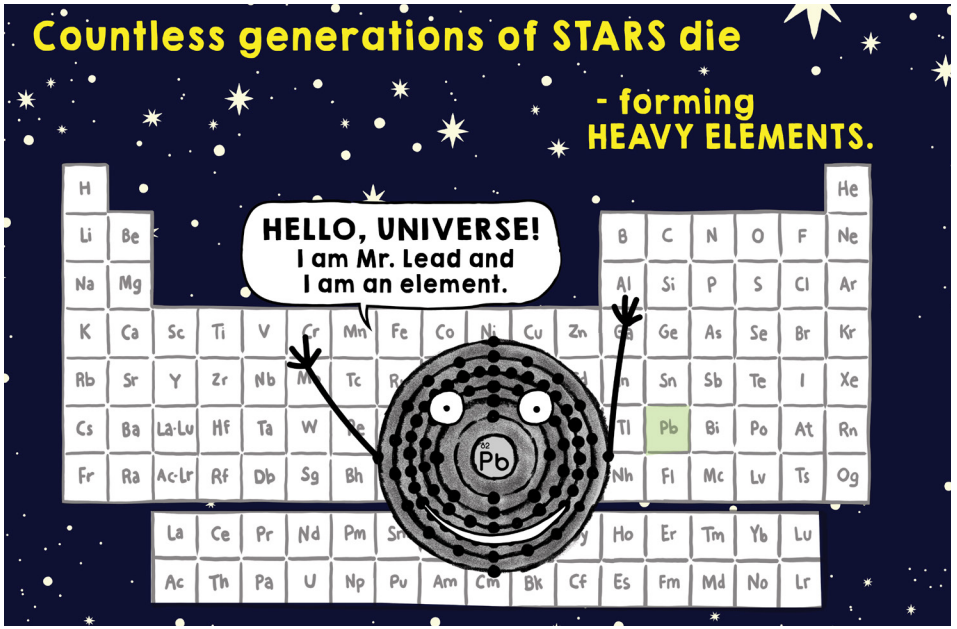
A Bio-Geo-Socio-Chemical Cycle

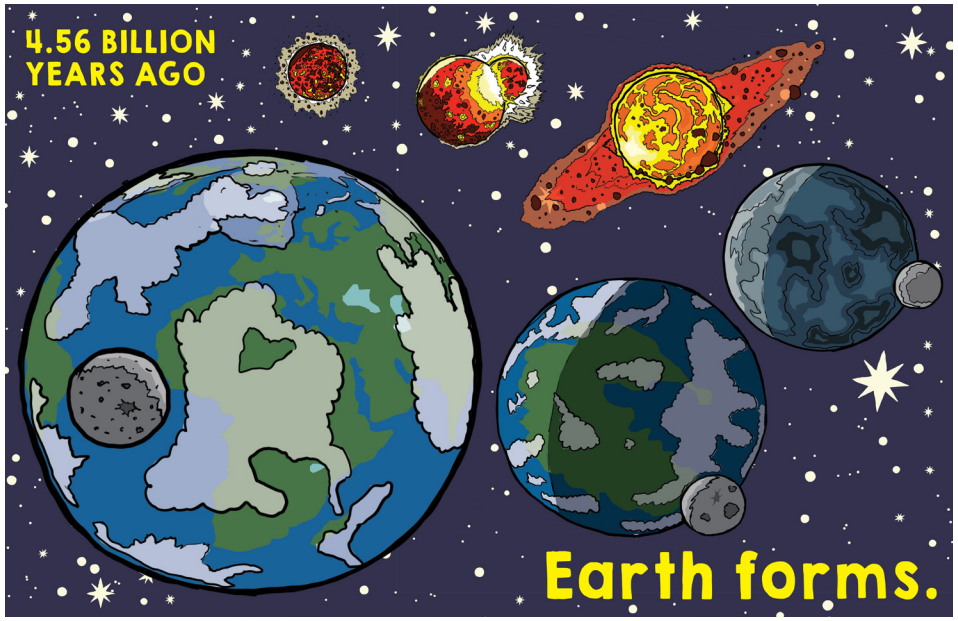


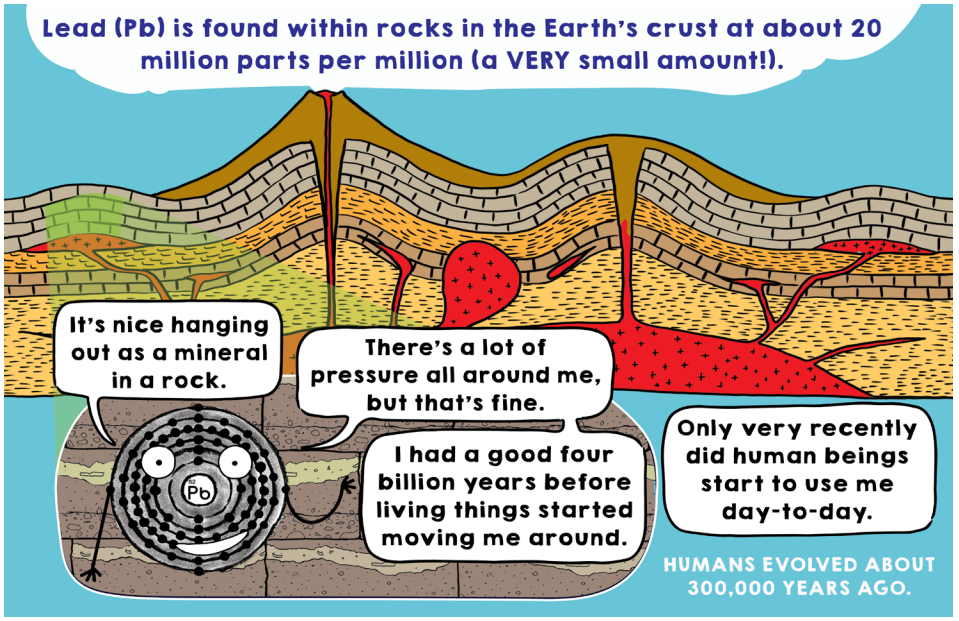
Written by S. Perl Egendorf, Paula Z. Segal and the Legacy Lead Coalition

Illustrated by Emily-Bell Dinan


13.8 BILLION YEARS AGO
The
BIG BANG
forms the
universe.


Countless generations of STARS die
- forming
HEAVY ELEMENTS.
HELLO, UNIVERSE!
I am Mr. Lead and
I am an element.
Pb


4.56 BILLION
YEARS AGO
Earth forms.


Lead (Pb) is found within rocks in the Earth's crust at about 20 million parts per million (a VERY small amount!).
It's nice hanging out as a mineral in a rock.
There's a lot of pressure all around me, but that's fine.
I had a good four billion years before living things started moving me around.
Only very recently did human beings start to use me day-to-day.
Pb
HUMANS EVOLVED ABOUT 300,000 YEARS AGO.

8,000 YEARS AGO

Lead was found in rocks.

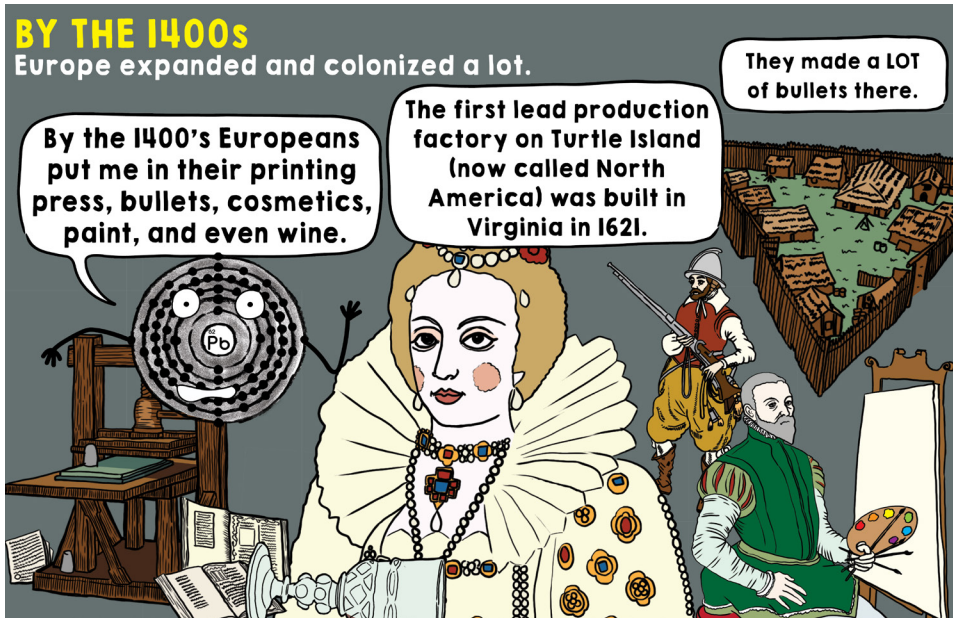
People began mining and smelting lead.

2,000 YEARS AGO

Romans used a tremendous amount of lead.

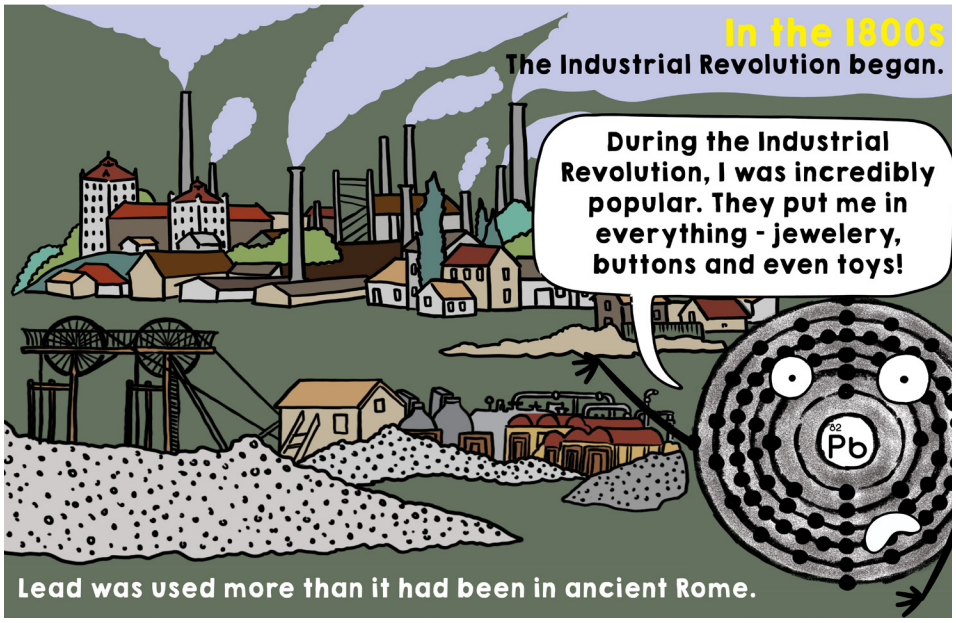
BY THE 1400s

Europe expanded and colonized a lot.

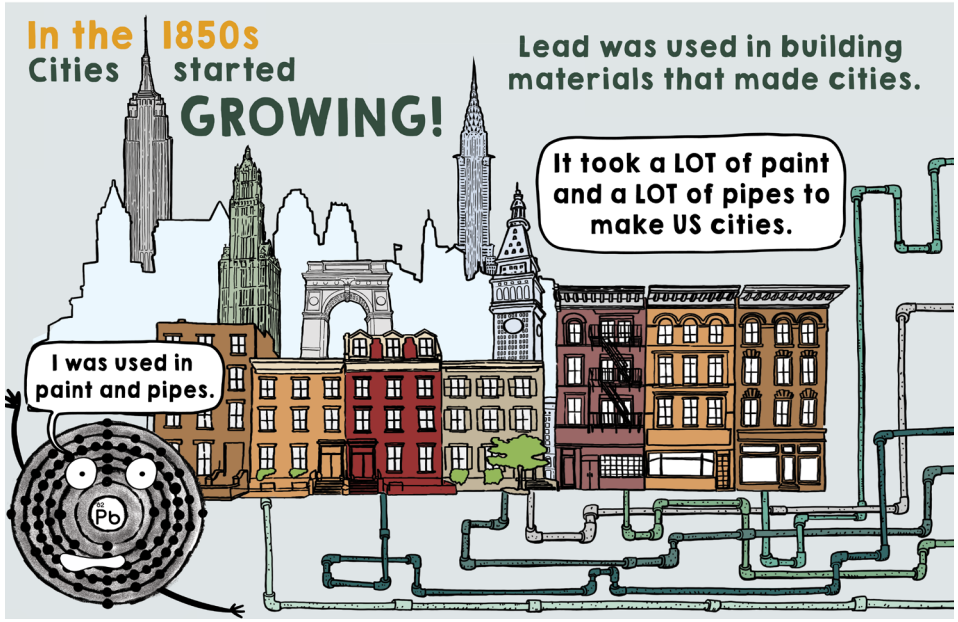


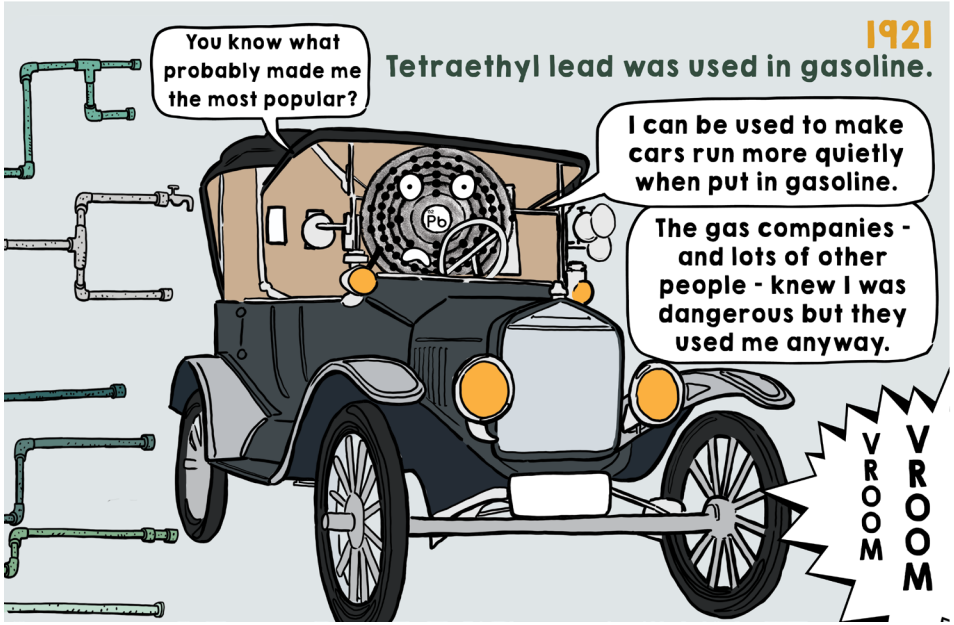
In the 1800s

The Industrial Revolution began.

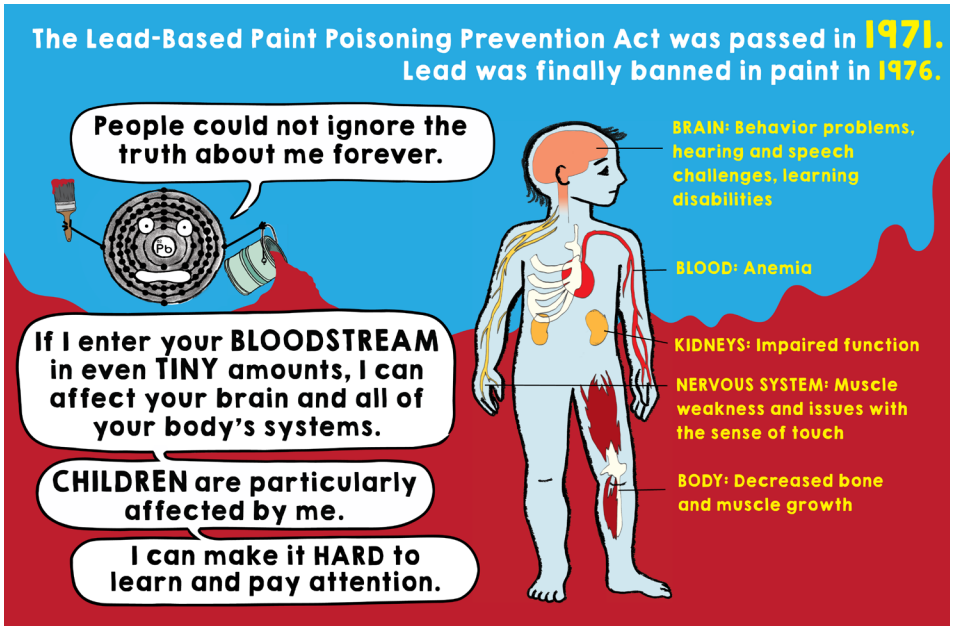


Lead was used more than it had been in ancient Rome.

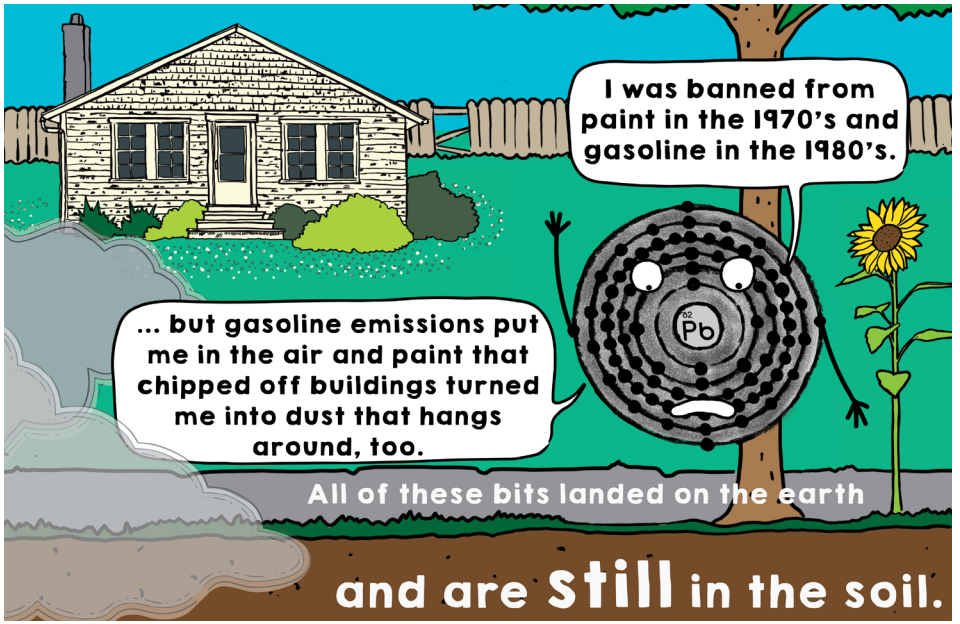

In the Cities 1850s started GROWING!
Lead was used in building materials that made cities.
It took a LOT of paint and a LOT of pipes to make US cities.
I was used in paint and pipes.
Pb

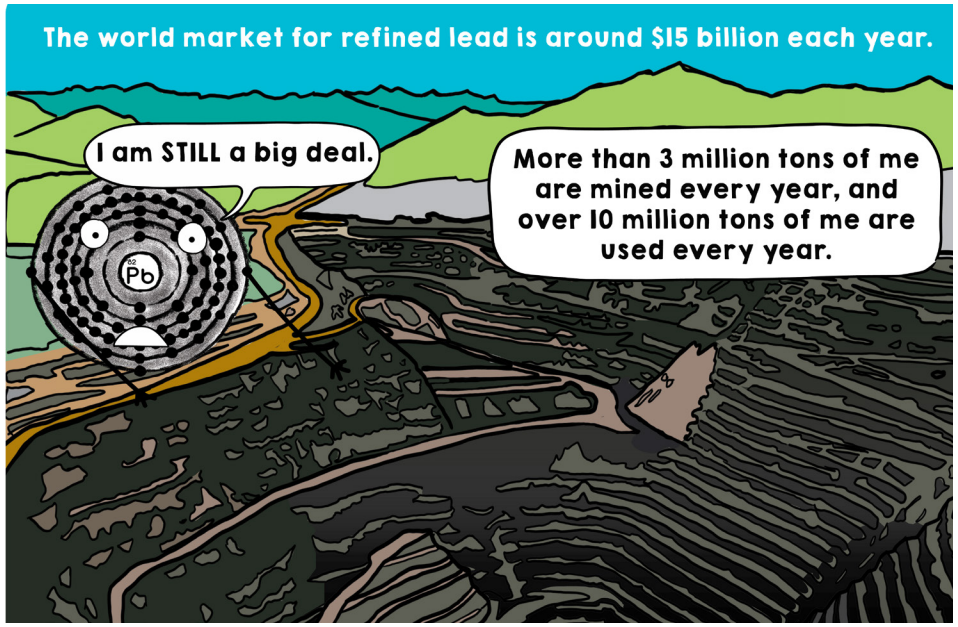

1921
Tetraethyl lead was used in gasoline.
You know what probably made me the most popular?
I can be used to make cars run more quietly when put in gasoline.
The gas companies - and lots of other people - knew I was dangerous but they used me anyway.
Pb
VROOM
VROOM

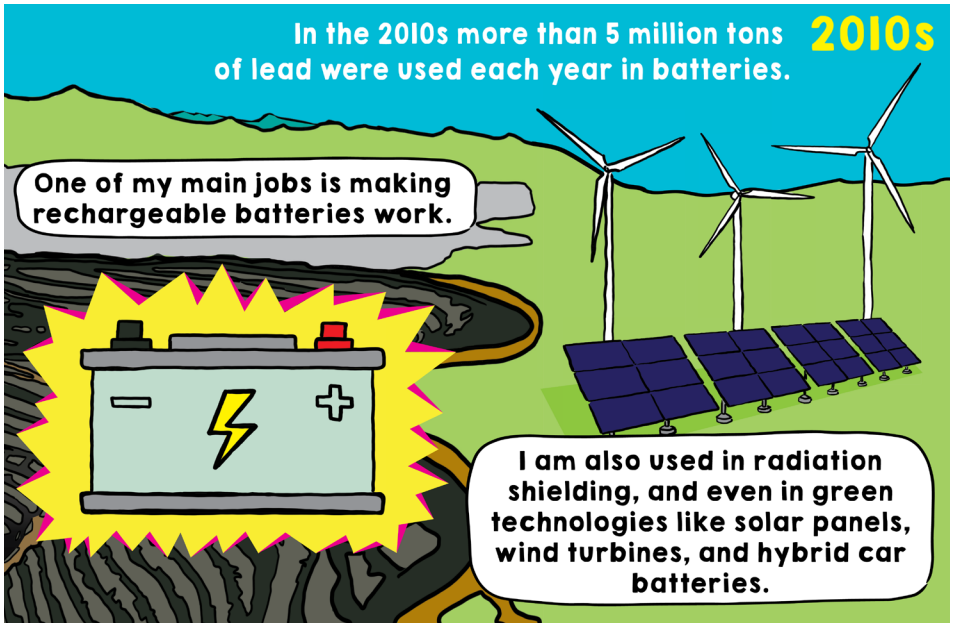

In 1922 over 20 countries (organized together as "the League of Nations") banned lead-based paint. The USA DECLINED to adopt the rule.
Even though I have been great for industry and construction...
I'll be honest with you:
I AM NOT GOOD FOR HUMAN HEALTH.
In fact -- I am TERRIBLE.
Pb

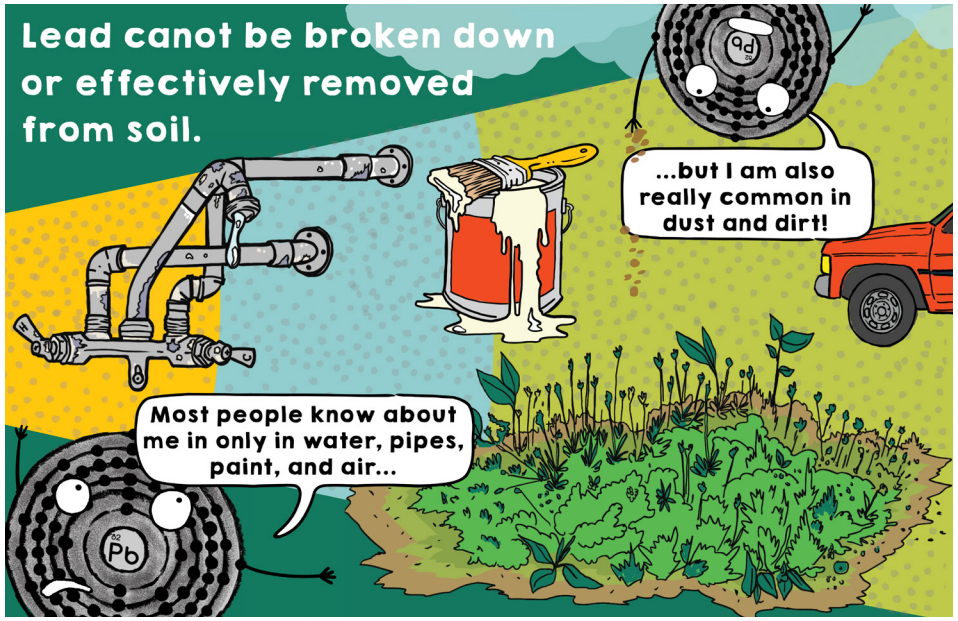

The Lead-Based Paint Poisoning Prevention Act was passed in 1971.
Lead was finally banned in paint in 1976.
People could not ignore the truth about me forever.
If I enter your BLOODSTREAM in even TINY amounts, I can affect your brain and all of your body's systems.
CHILDREN are particularly affected by me.
I can make it HARD to learn and pay attention.
BRAIN: Behavior problems, hearing and speech challenges, learning disabilities
BLOOD: Anemia
KIDNEYS: Impaired function
NERVOUS SYSTEM: Muscle weakness and issues with the sense of touch
BODY: Decreased bone and muscle growth
Pb

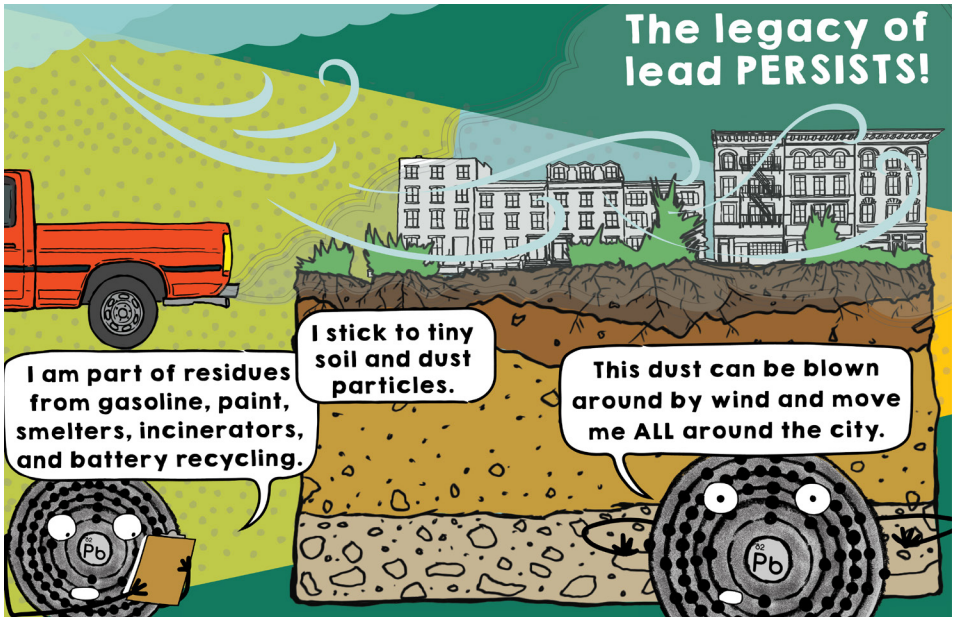

1986
Amendments to the Clean Air Act banned lead in gasoline.
The Act required lead to be phased out of gasoline by the year 2000.

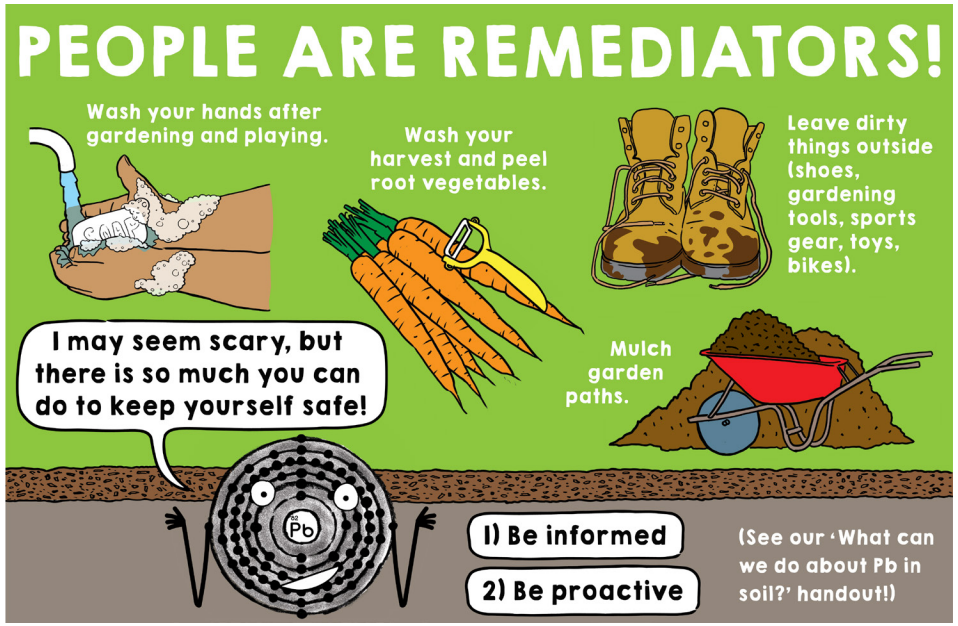

I was banned from paint in the 1970's and gasoline in the 1980's.
... but gasoline emissions put me in the air and paint that chipped off buildings turned me into dust that hangs around, too.
All of these bits landed on the earth
and are still in the soil.

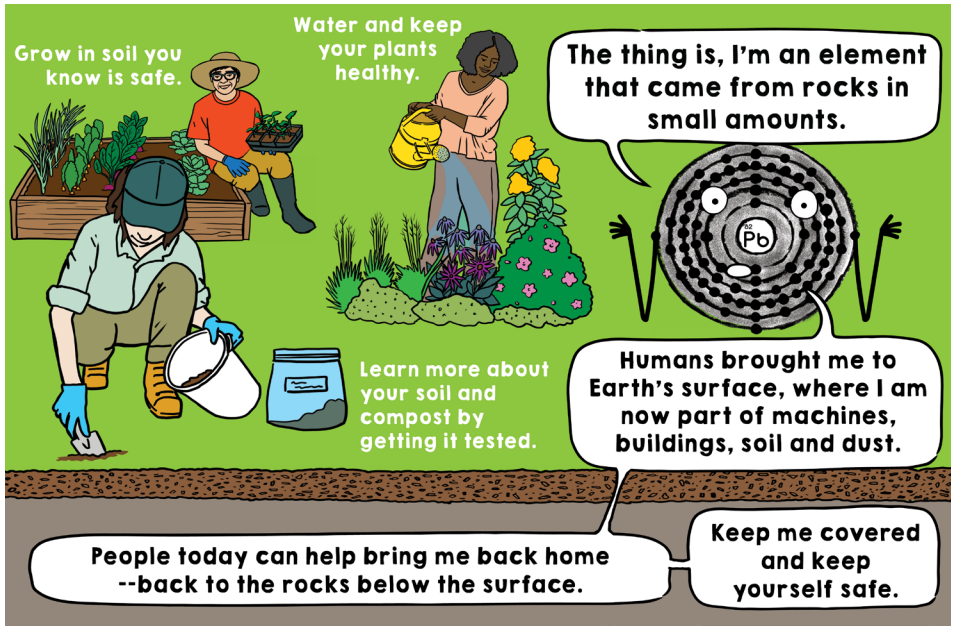

The world market for refined lead is around $15 billion each year.
I am STILL a big deal.
More than 3 million tons of me are mined every year, and over 10 million tons of me are used every year.

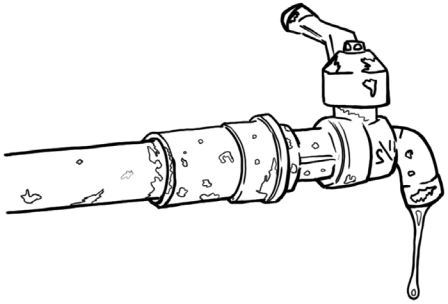

In the 2010s more than 5 million tons of lead were used each year in batteries.
2010s
One of my main jobs is making rechargeable batteries work.
I am also used in radiation shielding, and even in green technologies like solar panels, wind turbines, and hybrid car batteries.


Lead canot be broken down or effectively removed from soil.
...but I am also really common in dust and dirt!
Most people know about me in only in water, pipes, paint, and air...
Pb
Pb


The legacy of lead PERSISTS!
I am part of residues from gasoline, paint, smelters, incinerators, and battery recycling.
I stick to tiny soil and dust particles.
This dust can be blown around by wind and move me ALL around the city.
Pb
Pb


PEOPLE ARE REMEDIATORS!
Wash your hands after gardening and playing.
Wash your harvest and peel root vegetables.
Leave dirty things outside (shoes, gardening tools, sports gear, toys, bikes).
Mulch garden paths.
I may seem scary, but there is so much you can do to keep yourself safe!
Pb
1) Be informed
2) Be proactive
(See our 'What can we do about Pb in soil?' handout!)


Grow in soil you know is safe.
Water and keep your plants healthy.
The thing is, I'm an element that came from rocks in small amounts.
Learn more about your soil and compost by getting it tested.
Humans brought me to Earth's surface, where I am now part of machines, buildings, soil and dust.
People today can help bring me back home --back to the rocks below the surface.
Keep me covered and keep yourself safe.
Pb



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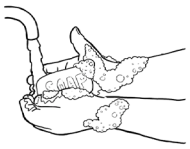
462 Halsey Community Farm, 596 Acres, Bronx Green Up, Brooklyn Botanic Garden, Brooklyn College, Brooklyn Queens Land Trust, City University of New York Advanced Science Research Center, Cornell Cooperative Extension, Columbia University, Common Ground Compost, East New York Farms!, Ecoschools, the Greenpoint Bioremediation Project, GreenThumb, Just Soil, New York Lawyers for Public Interest, New York Restoration Project, Newtown Creek Alliance, North Brooklyn Neighbors, the NYC Compost Project (NYCCP) Hosted by Big Reuse, the NYCCP Hosted by Brooklyn Botanic Garden, the NYCCP Hosted by the Lower East Side Ecology Center, the NYCCP Hosted by Queens Botanical Garden, the NYC Department of Health, the NYC Mayor's Office of Environmental Remediation, the NY State Department of Health, and Smiling Hogshead Ranch

Special thanks to Howard W. Mielke, our "Godfather of Lead in Soil," and to the Cornell Atkinson Center for Sustainability for financial support for this project.

TAKE CARE OF OUR LEGACY LEAD!

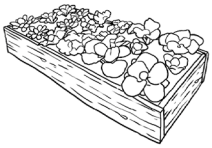


Wash your hands after gardening and playing.

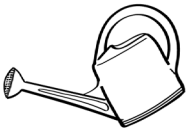
Wash your harvest and peel root vegetables.

Leave dirty things outside (shoes, gardening tools, sports gear, toys, bikes).

Mulch garden paths.



Grow only in soil you know is safe.

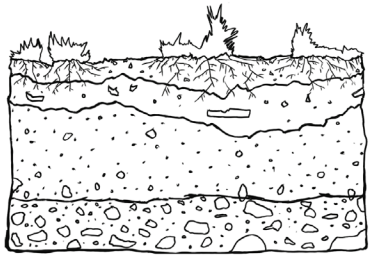


Water and keep plants healthy.

Learn more about your soil and compost by getting it tested.

Thank you for remediating our city!

WHAT CAN WE DO ABOUT LEAD (Pb) IN SOIL?



The Legacy Lead Coalition

Q: Can we dig up and haul out contaminated soil?

YES!

While this is the most effective way to remove contaminated soil, it is expensive, logistically challenging, and places the burden somewhere else (usually a landfill).

Finding new soil to replace excavated soil is also important.

Q: Can we add amendments to soil to make lead less toxic/bioavailable?

YES, BUT THIS CAN BE TRICKY.

Amendments like phosphate and compost can make Pb less toxic, but it is difficult to test for these changes (i.e. expensive and there is no agreed upon testing method).

Phosphate can make other elements like Arsenic more available to plants and people.

Amendments can help improve soil texture and reduce dust.

Q: Can we remove lead from soil? (Can plants help us do this, aka phytoremediation?)

NO, NOT SAFELY

Lead binds tightly to soil particles.

Plants cannot extract lead from soil effectively.

Adding chelating agents can make lead more mobile (but then it leaches to groundwater, creating other issues).

Q: Can we cover contaminated soil to limit exposure?

YES!

Contaminated soil stays down below, and maintaining new soil and establishing plant cover keeps it in place.

Landscape fabric / geotextile can be used as a permeable barrier.

Even without a barrier, the majority of plant roots will not take up Pb from underlying soil.

As long as the new soil is not mixed with the old, exposure is limited.

Information about contaminated soil below should be passed on to future land users.

Monitoring for ongoing contaminant source (dusts blown by the wind, peeling paint) should be continued.

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Mielke (2016). Nature and extent of metal-contaminated soils in urban environments (keynote talk). Environmental Geochemistry and Health, 38(4), 987–999.

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