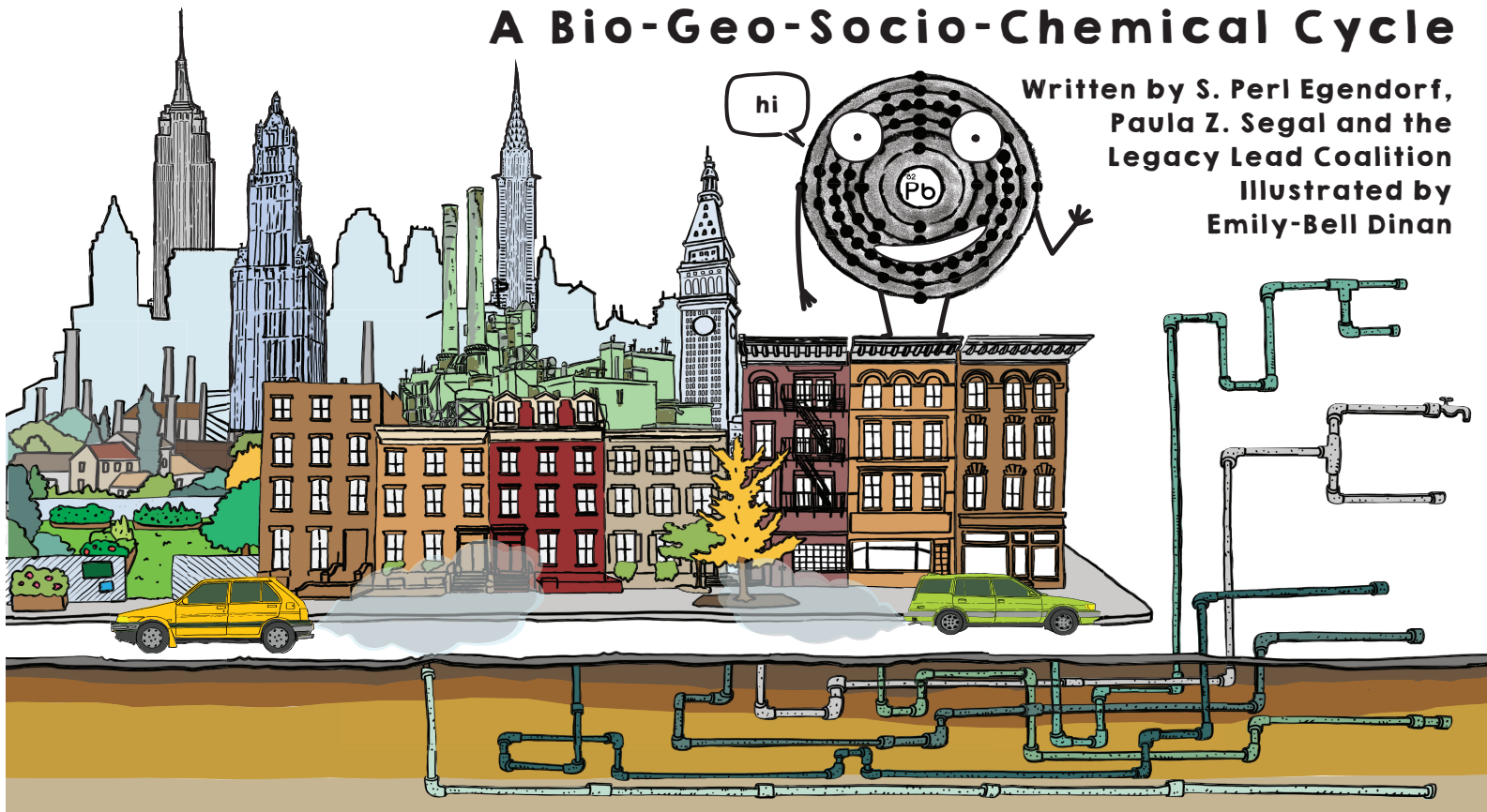


THE LEGACY OF LEAD

A Bio-Geo-Socio-Chemical Cycle

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

Illustrated by
Emily-Bell Dinan

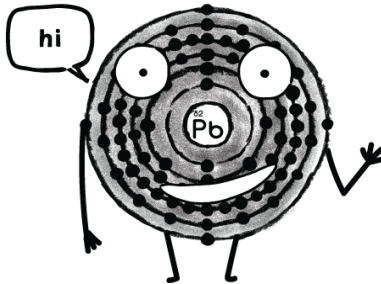


THE LEGACY OF LEAD A Bio-Geo-Socio-Chemical Cycle © 2023

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THE LEGACY OF LEAD

A Bio-Geo-Socio-Chemical Cycle



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

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13.8 BILLION YEARS AGO

The
BIG BANG
forms the
universe.

Countless generations of STARS die

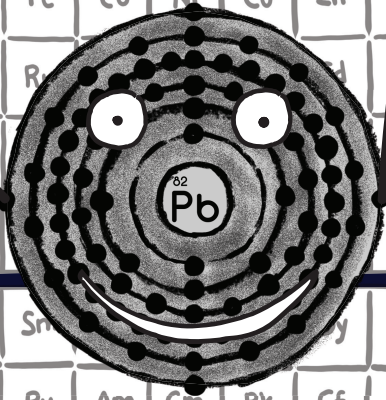
- forming
HEAVY ELEMENTS.

H																	He															
Li	Be																	B	C	N	O	F	Ne									
Na	Mg																	Al	Si	P	S	Cl	Ar									
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr															
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe															
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn															
Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn											
																		Nh	Fl	Mc	Lv	Ts	Og									
																		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tm	Yb	Lu				
																		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

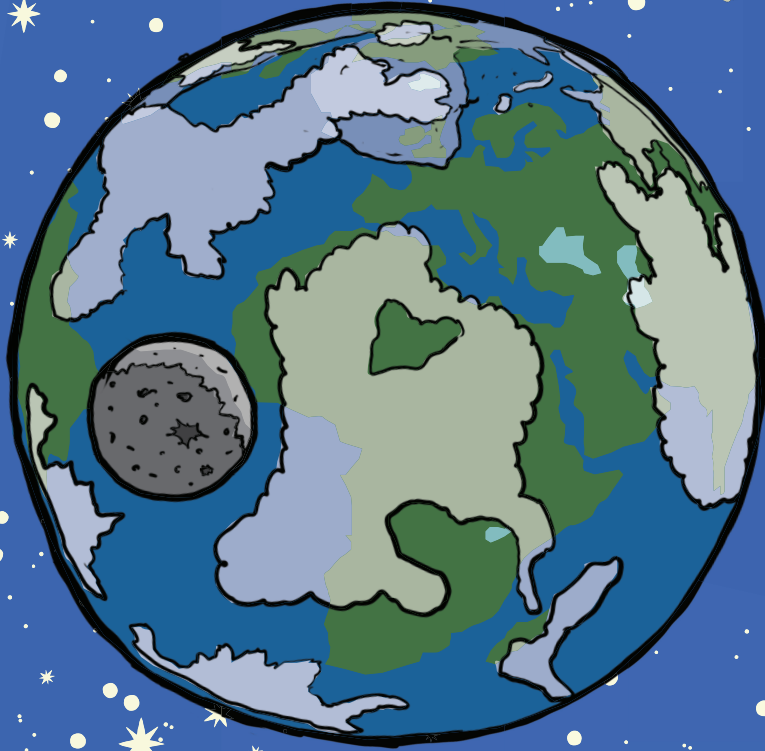
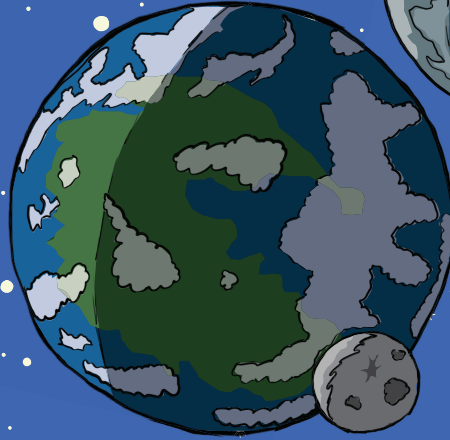
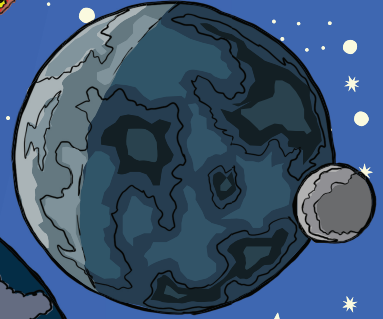
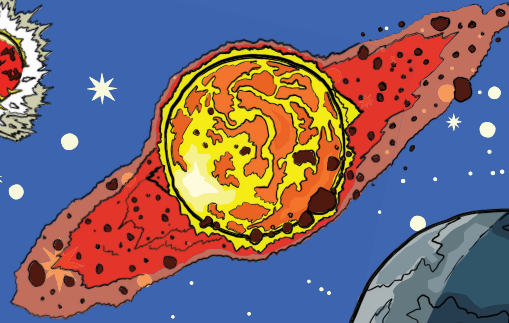
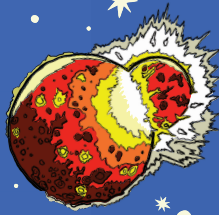
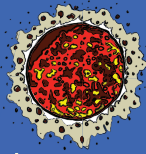
HELLO, UNIVERSE!

I am Mr. Lead and
I am an element.

HELLO, UNIVERSE!
I am Mr. Lead and
I am an element.

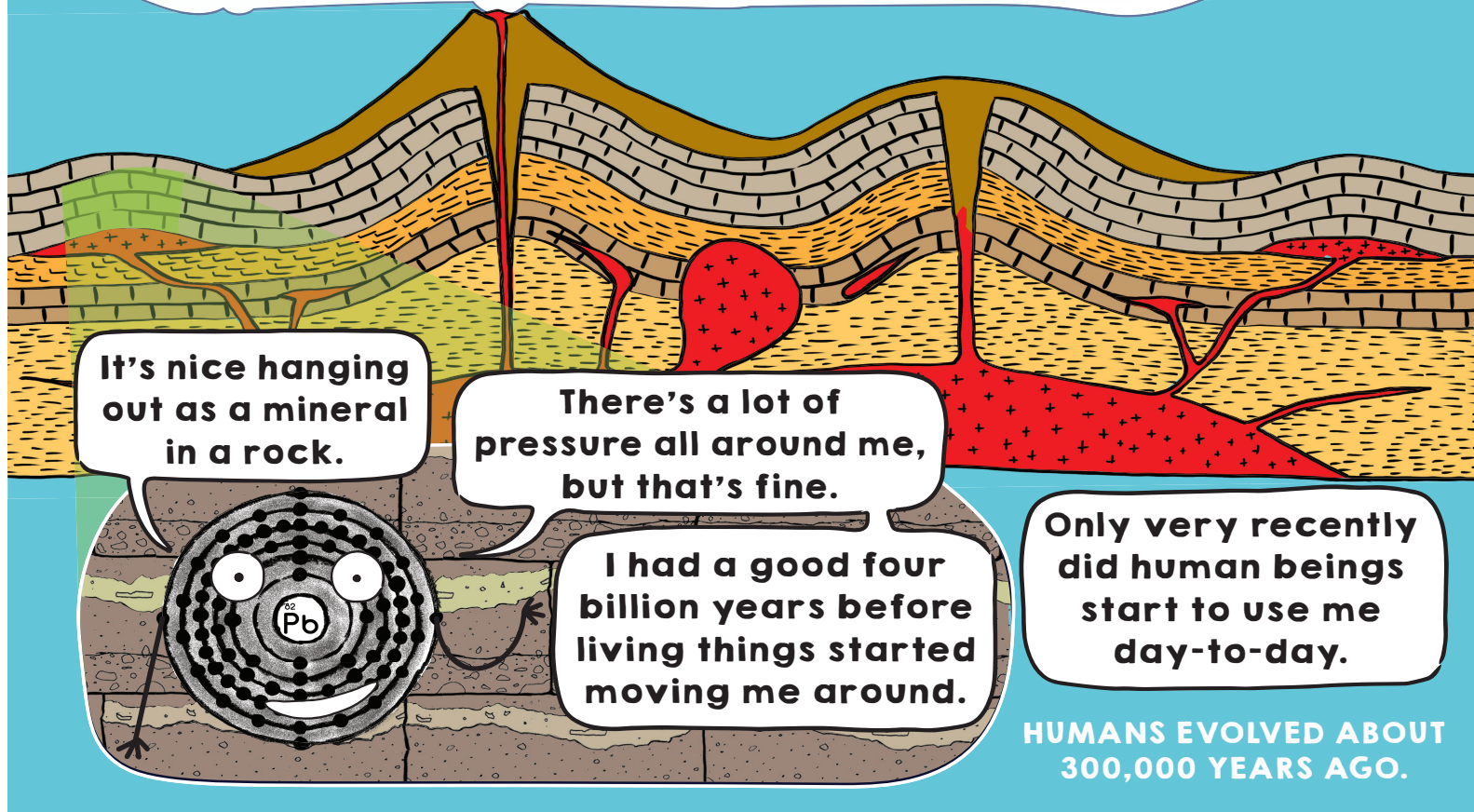


**4.56 BILLION
YEARS AGO**



Earth forms.

Lead (Pb) is found within rocks in the Earth's crust at about 20 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.

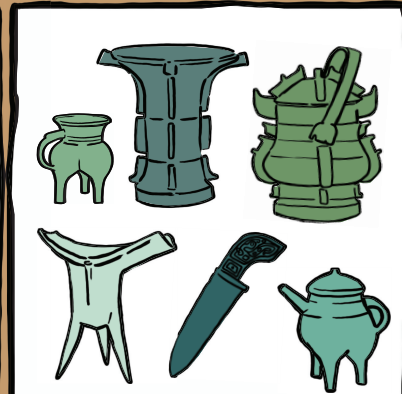
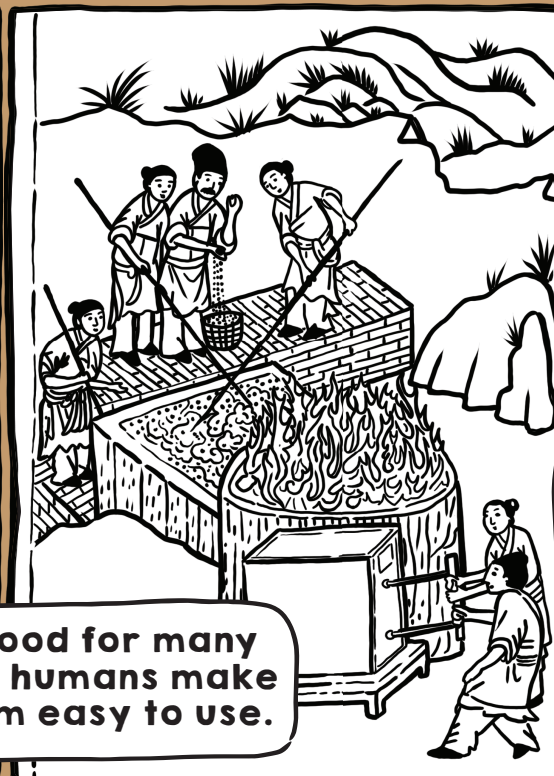
HUMANS EVOLVED ABOUT 300,000 YEARS AGO.

8,000 YEARS AGO

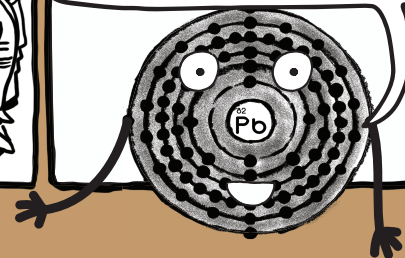
lead was found in rocks.



I'm good for many things humans make and I'm easy to use.



Ancient people realized they could take me out of rocks and put me to work.



People began mining and smelting lead.

2,000 YEARS AGO

Romans used a tremendous amount of lead.



BY THE 1400s

Europe colonized and expanded.

By the 1400's Europeans put me in their printing press, bullets, cosmetics, paint, and even wine.

The first lead production factory on Turtle Island (now called North America) was built in Virginia in 1621.

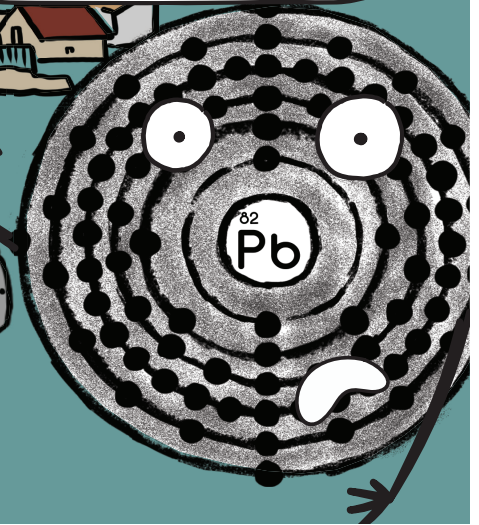
They made a LOT of bullets there.



In the 1800s

The Industrial Revolution began.

During the Industrial Revolution, I was incredibly popular. They put me in everything - jewelry, buttons, and even toys!



Lead was used more than in Ancient Rome.

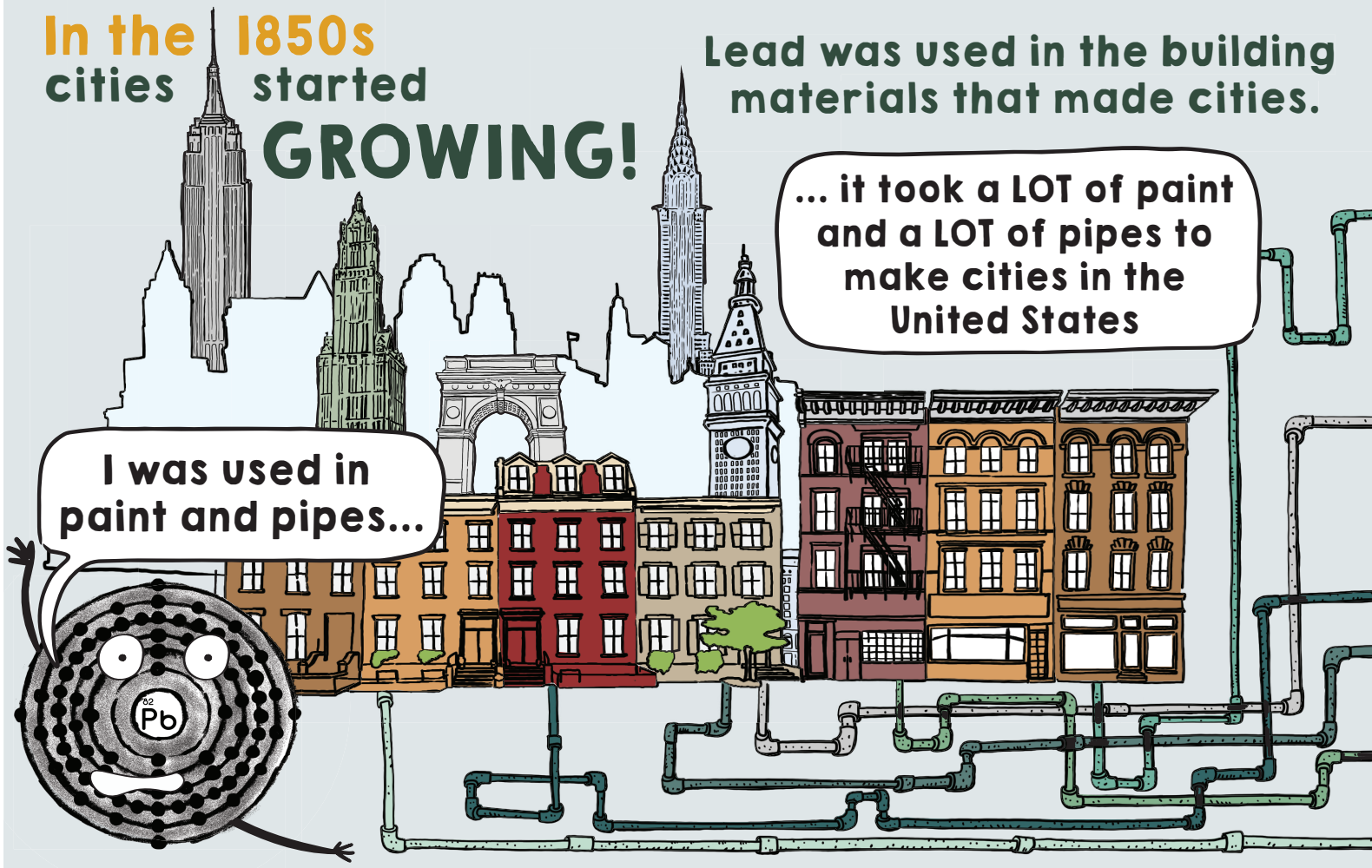
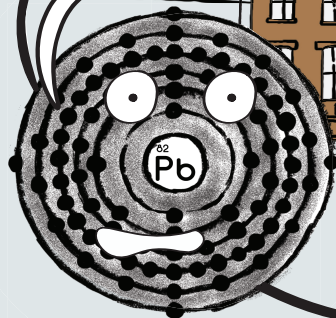
In the 1850s
cities started

GROWING!

Lead was used in the building
materials that made cities.

... it took a LOT of paint
and a LOT of pipes to
make cities in the
United States

I was used in
paint and pipes...



1921

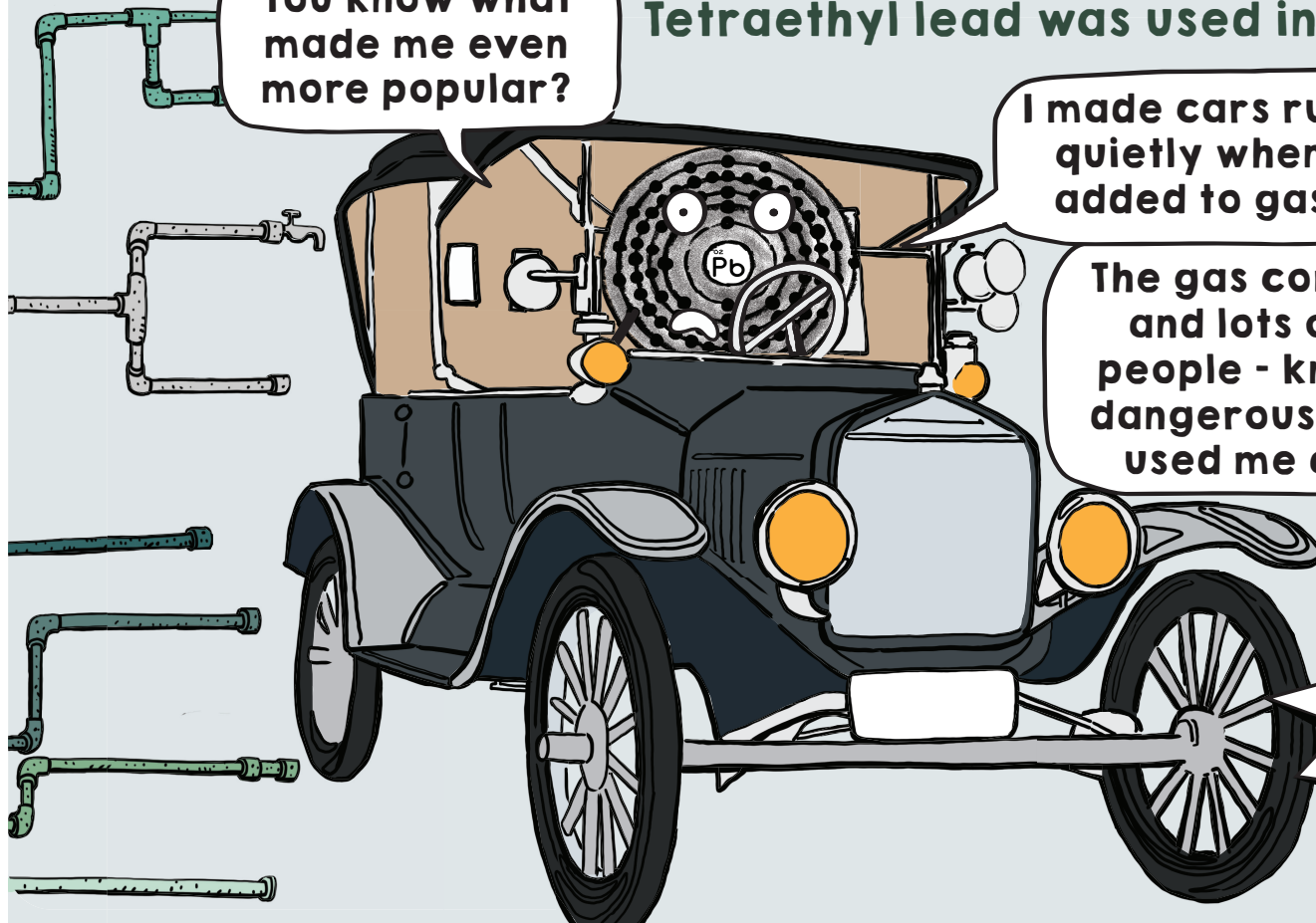
Tetraethyl lead was used in gasoline.

You know what
made me even
more popular?

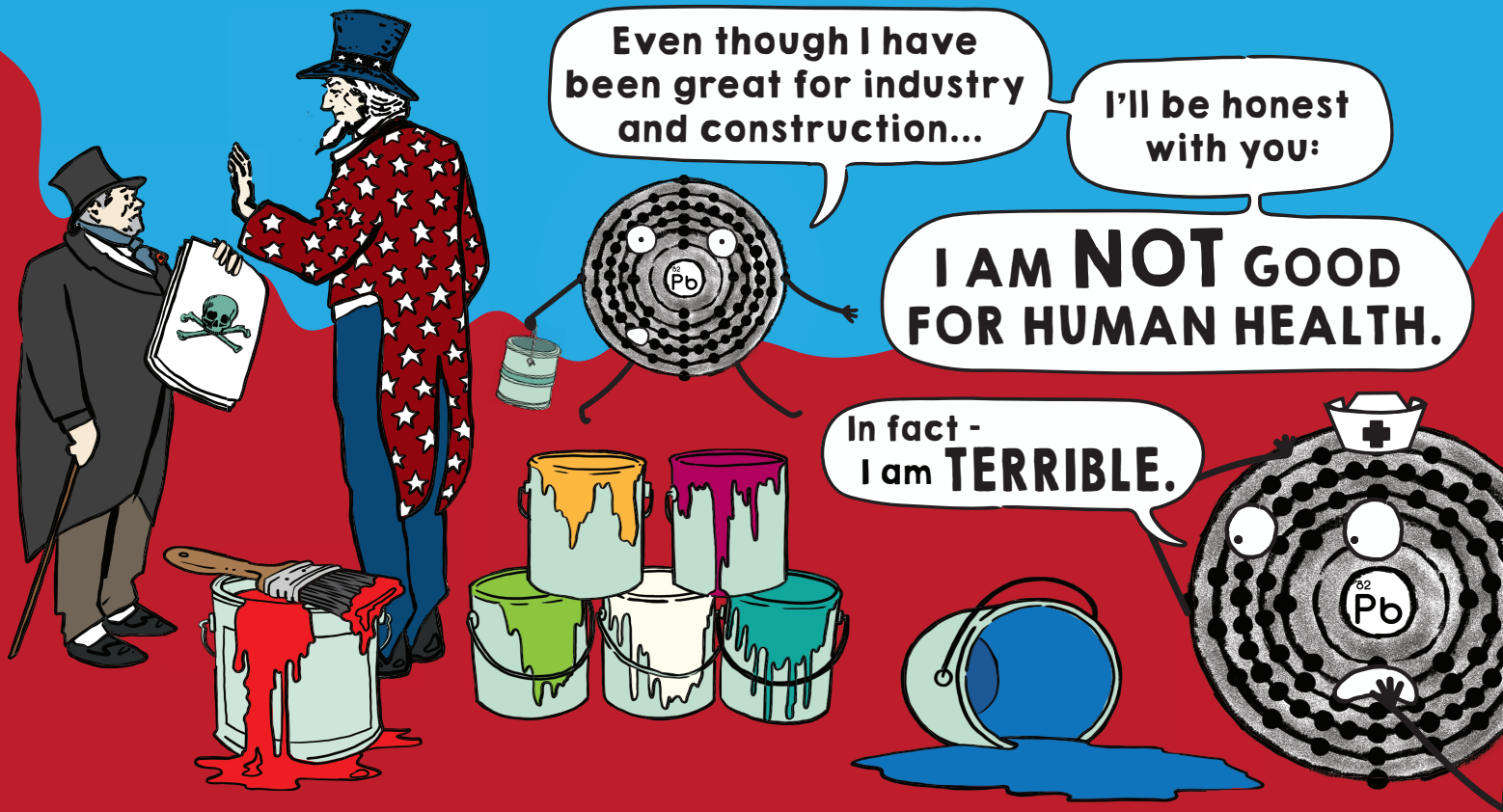
I made cars run more
quietly when I was
added to gasoline.

The gas companies -
and lots of other
people - knew I was
dangerous, but they
used me anyway.

**VROOM
VROOM**

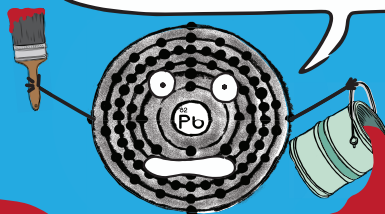


In **1922**, over 20 countries (together as “the League of Nations”) banned lead-based paint. The USA **DECLINED** to adopt the rule.



The Lead-Based Paint Poisoning Prevention Act was passed in **1971**.
Lead was finally banned from paint in **1976**.

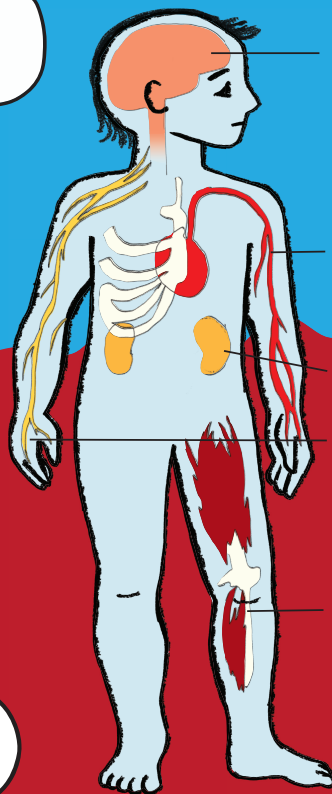
People could not ignore the truth about me forever.



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

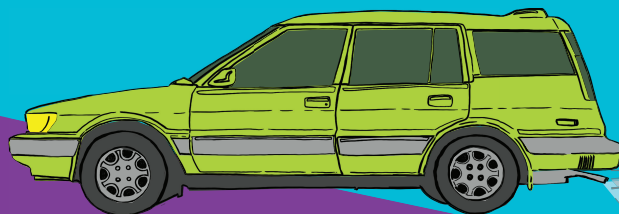
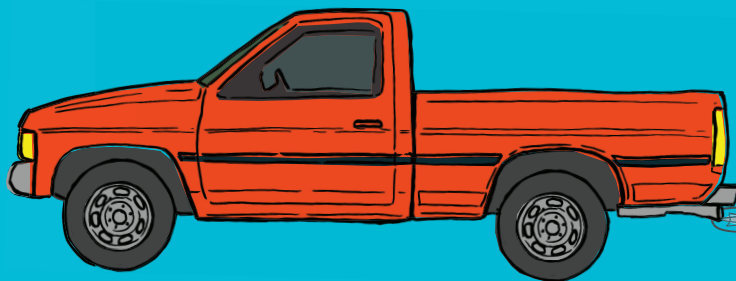
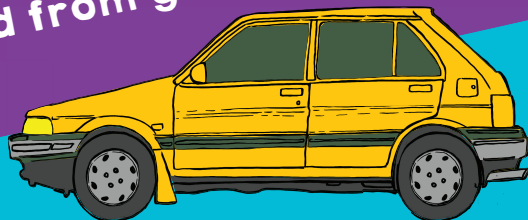
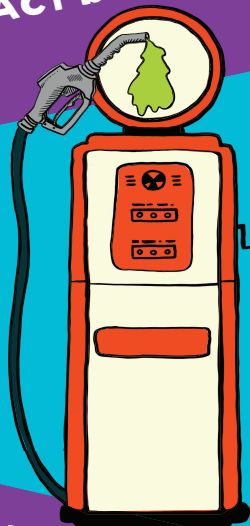
KIDNEYS: Impaired function

NERVOUS SYSTEM: Muscle weakness and issues with the sense of touch

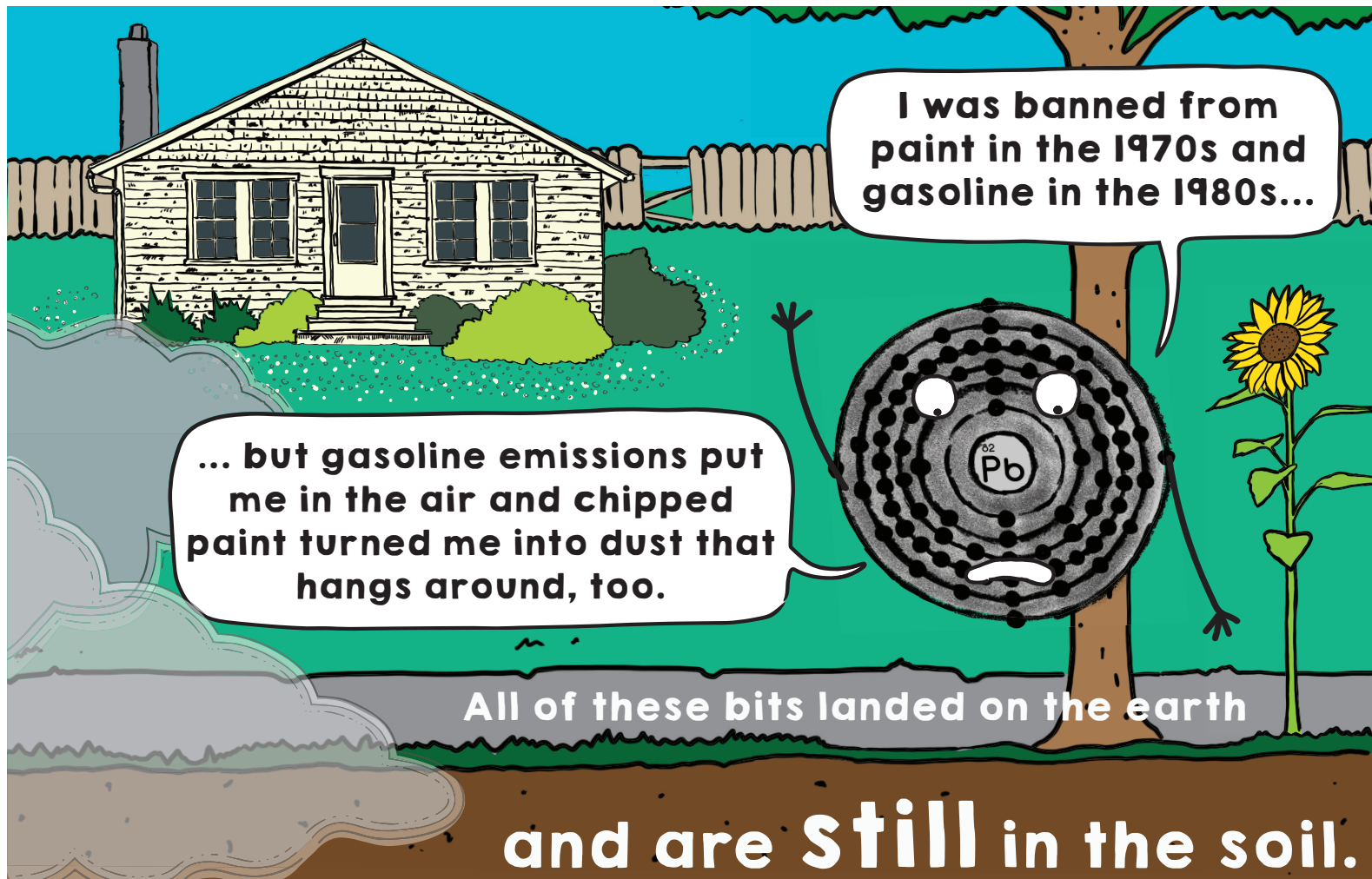
BODY: Decreased bone and muscle growth

1986

Amendments to the Clean Air Act banned lead from gasoline.



The Act required lead to be phased out of gasoline by the year **2000**.



I was banned from paint in the 1970s and gasoline in the 1980s...

... but gasoline emissions put me in the air and chipped paint turned me into dust that hangs around, too.

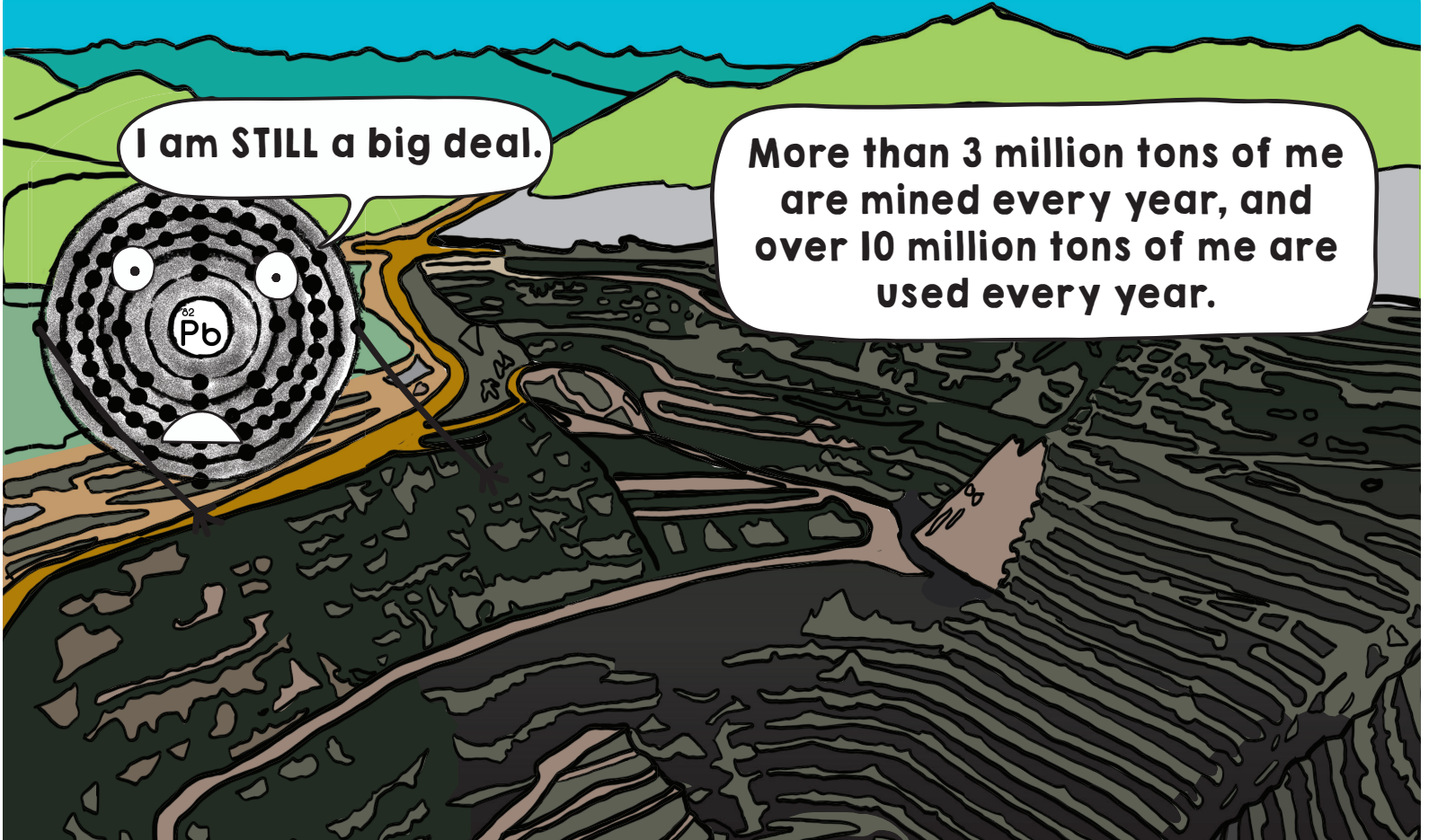
All of these bits landed on the earth

and are **still** in the soil.

The world market for refined lead is around \$15 billion each year.

I am STILL a big deal.

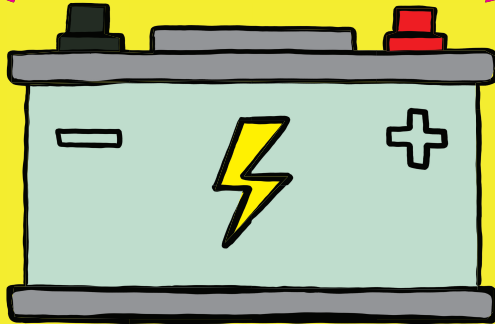
**More than 3 million tons of me
are mined every year, and
over 10 million tons of me are
used every year.**



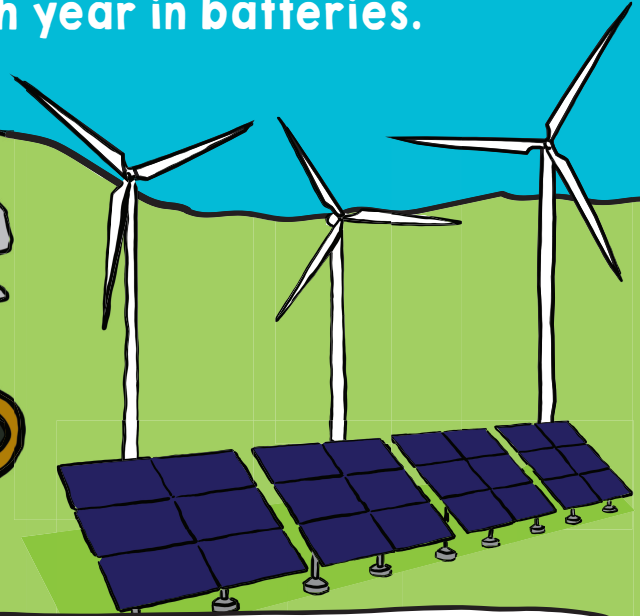
In the 2010s, more than 5 million tons
of lead were used each year in batteries.

2010s

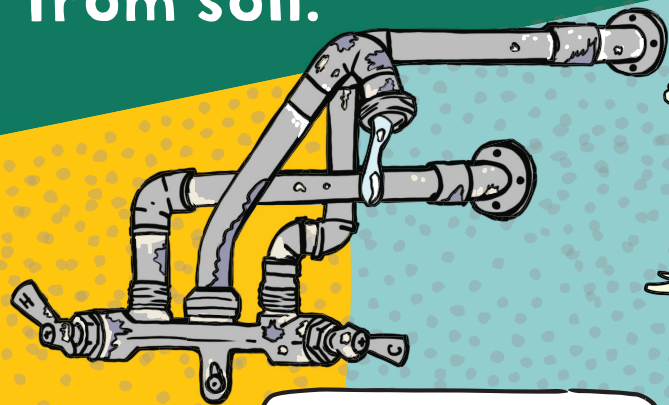
One of my main jobs is making
rechargeable batteries work.



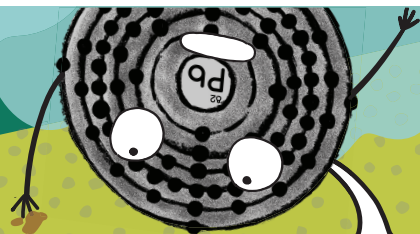
I am also used in radiation
shielding - and even in green
technologies like solar panels,
wind turbines, and hybrid car
batteries.



**Lead cannot be broken down
or effectively removed
from soil.**



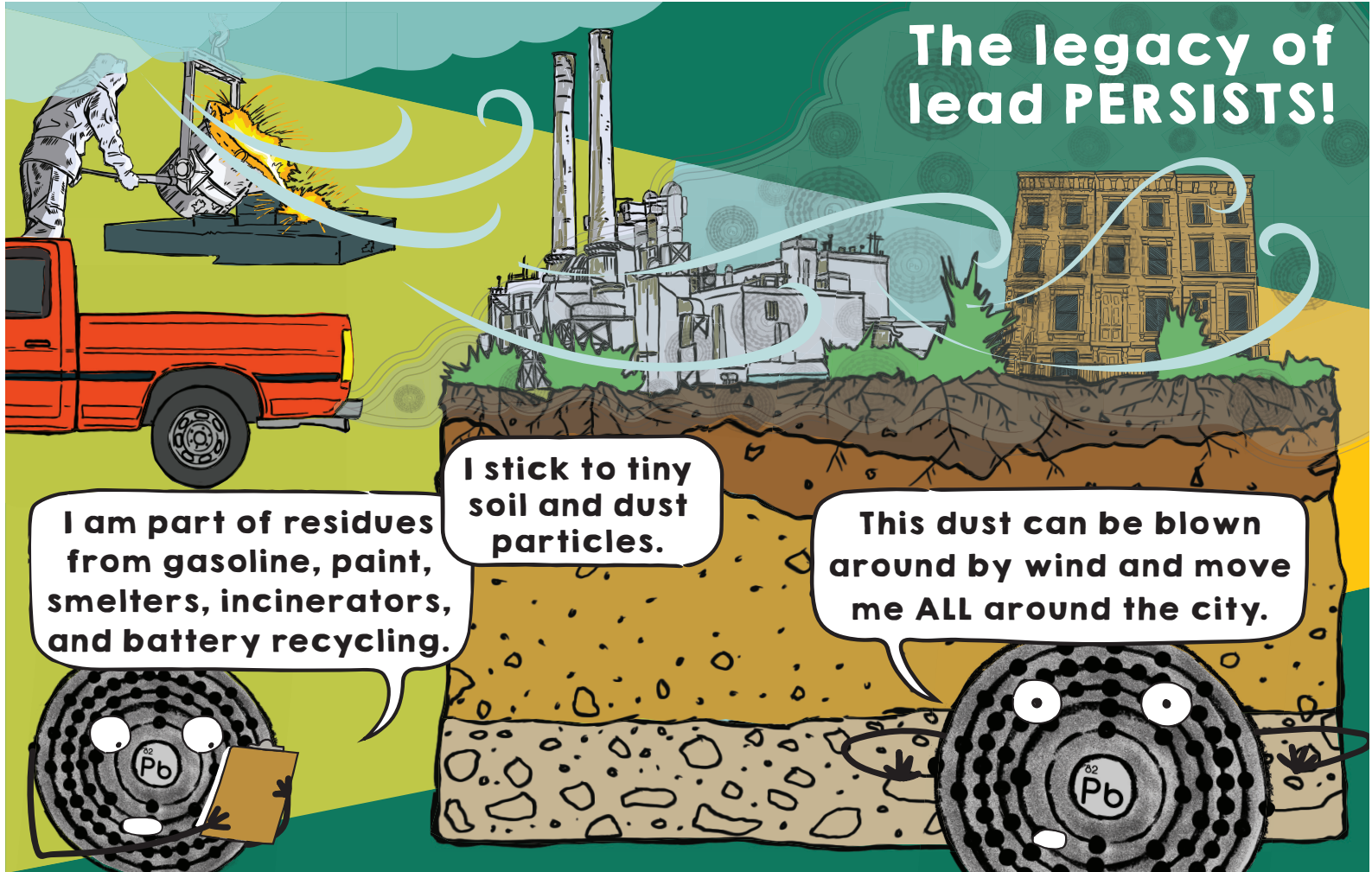
**Most people know
about me in water,
pipes, paint, and
gasoline...**



**...but I am ALSO
really common in
dust and dirt!**



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.

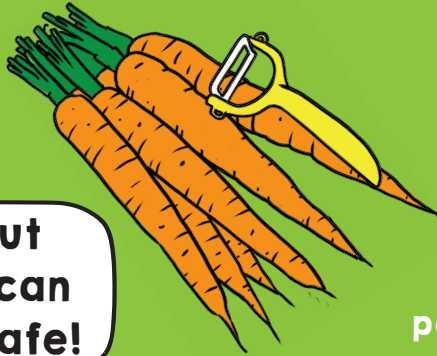
This dust can be blown around by wind and move me ALL around the city.

PEOPLE ARE REMEDIATORS!

Wash your hands after gardening and playing.



Wash your harvest and peel root vegetables.

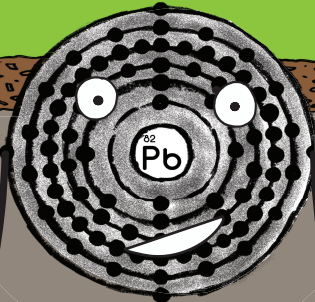


I may seem scary, but there is so much you can do to keep yourself safe!



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

Mulch garden paths.



1) Be informed

2) Be proactive

**Grow in soil you
know is safe.**

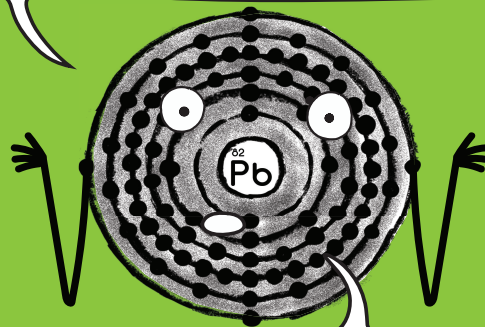


**Water and keep
your plants
healthy.**



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

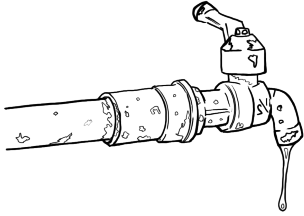
**The thing is, I'm an element
that came from rocks in
small amounts.**



**It was humans who brought
me to the Earth's surface and
put me in 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.**



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Richard G. Newell and Kristian Rogers (2003). The U.S. Experience with the Phasedown of Lead in Gasoline. Resources for the Future. <http://www.rff.org>

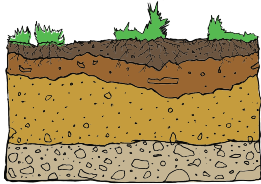
ACKNOWLEDGMENTS

Legacy Lead was made possible by the partnership of community organizations, public agencies, and research institutions:

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.

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



The Legacy Lead Coalition

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

YES, BUT THIS IS 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, which is great!

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 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 cover contaminated soil to limit exposure?

YES!

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

Landscape fabric can be used as a permeable barrier. But even without barriers, 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 should be passed on to future land users.

Monitoring for new contaminant sources (dusts, peeling paint, etc.) should be continued.

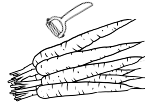
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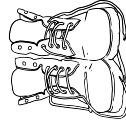
TAKE CARE OF OUR LEGACY LEAD!



Wash your hands after gardening and playing.



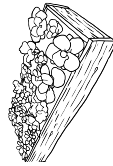
Wash your harvest and peel root vegetables.



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!

