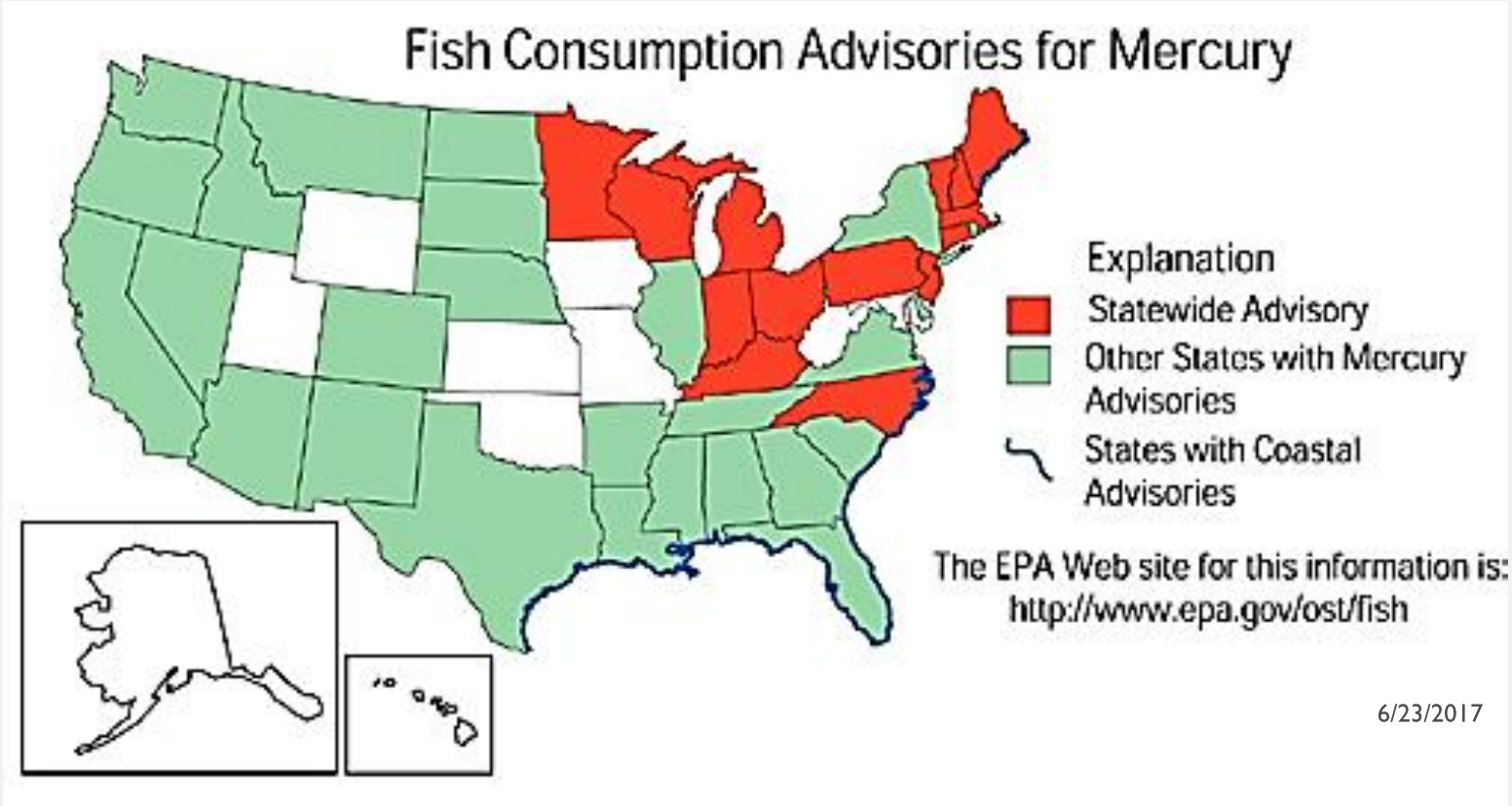
TODAY'S GOALS

- Mercury contamination
  - Why do we care about mercury contamination?
  - How are mercury compounds classified?
  - How does mercury enter our water supply?
  - What happens once the mercury is in the water supply?
  - How does mercury leave our water supply?

- At the end of the lecture, we should be able to understand how mercury affects organisms, ecosystems, and the water cycle.

WHY DO WE CARE ABOUT MERCURY CONTAMINATION?

- Health effects
  - Nervous system
  - Kidneys
- Environmental effects
  - Plants and Bacteria
  - Food chain

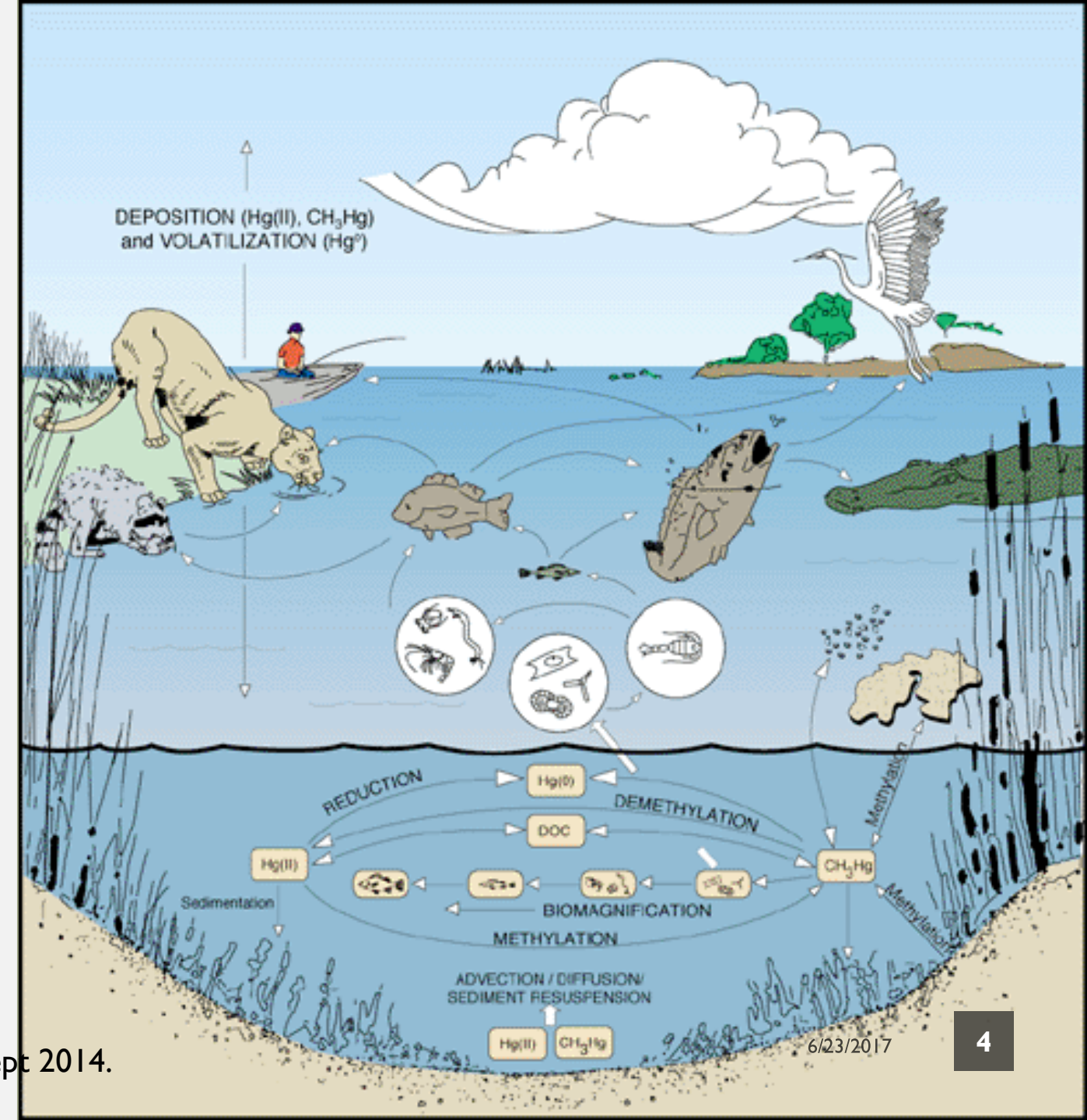


CLASSIFICATION OF MERCURY COMPOUNDS

- Elemental Mercury
  - Hg^0 - elemental
  - Hg_2^{2+} - monovalent
  - Hg^{2+} - divalent
- Inorganic mercury
  - $HgCl_2$, Hg_2Cl_2, HgS, $HgC_4H_6O_4$
- Methylmercury
  - CH_3Hg^+
  - Easily forms complexes with anions, such as Cl^-, OH^-, NO_3^-
  - Thiols

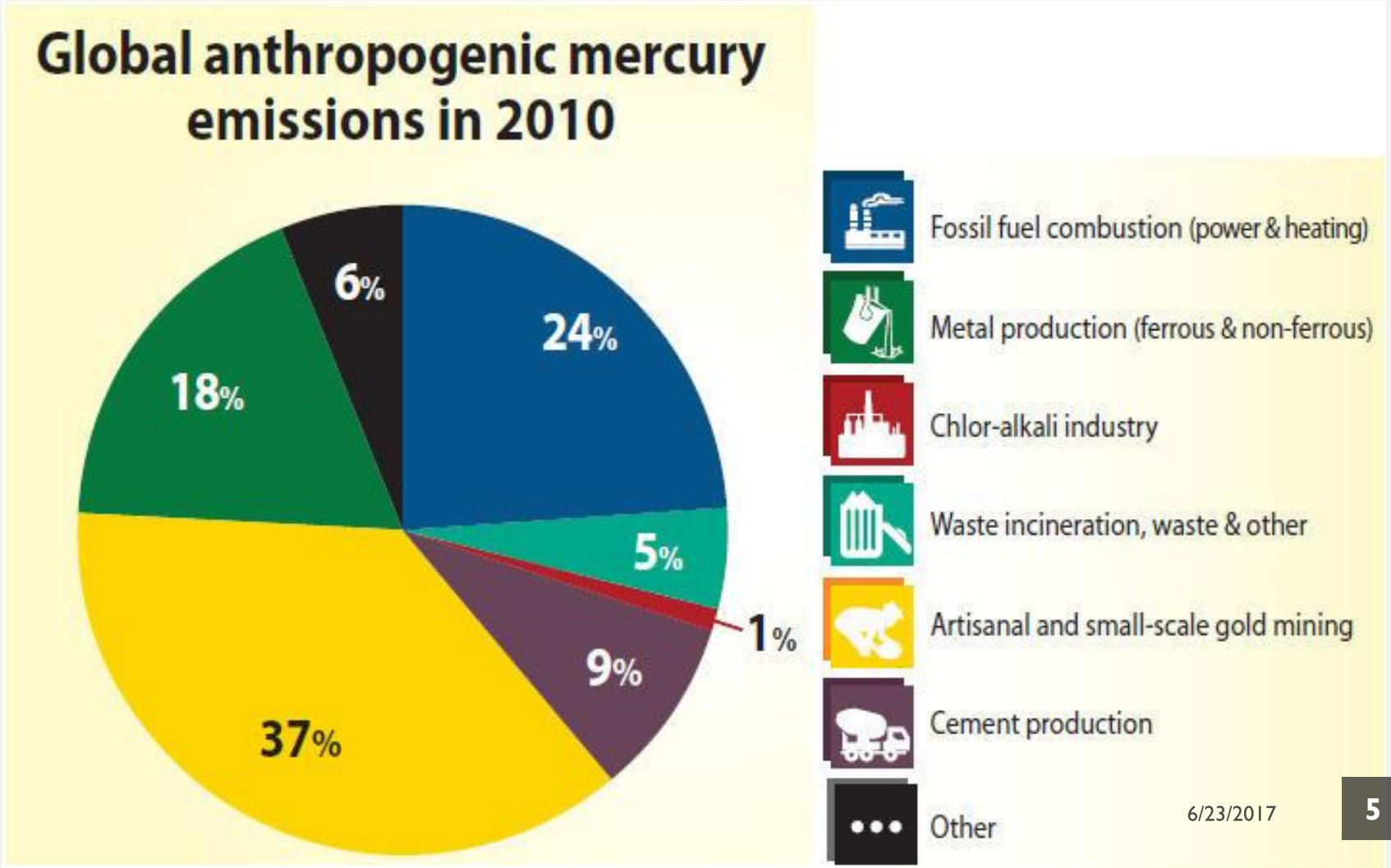
Yin, R., et al. (2010). Applied Geochemistry **25**(10): 1467-1477.

THE MERCURY CYCLE



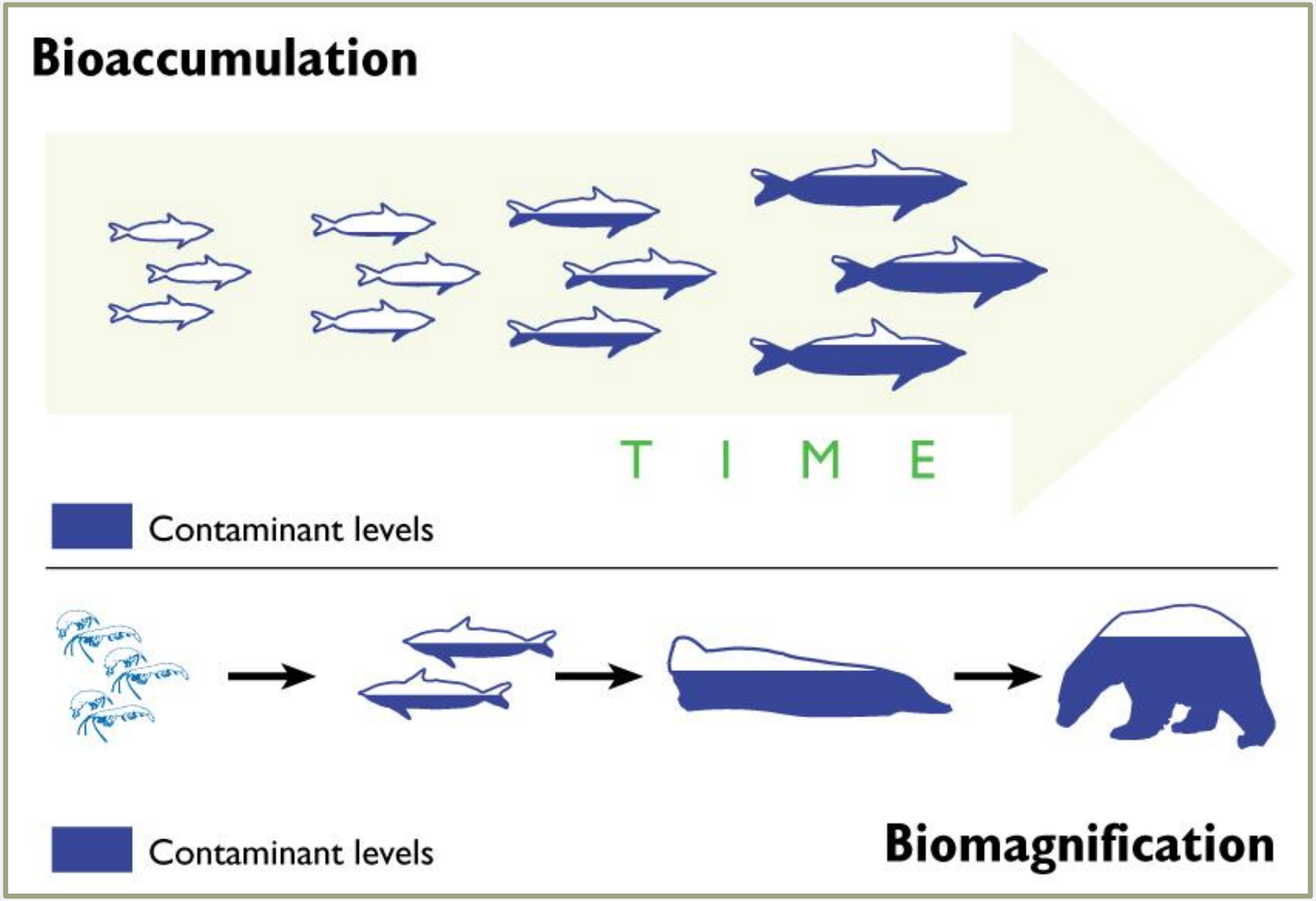
www.usgs.gov. Accessed Sept 2014.

HOW DOES MERCURY ENTER OUR WATER SUPPLY?



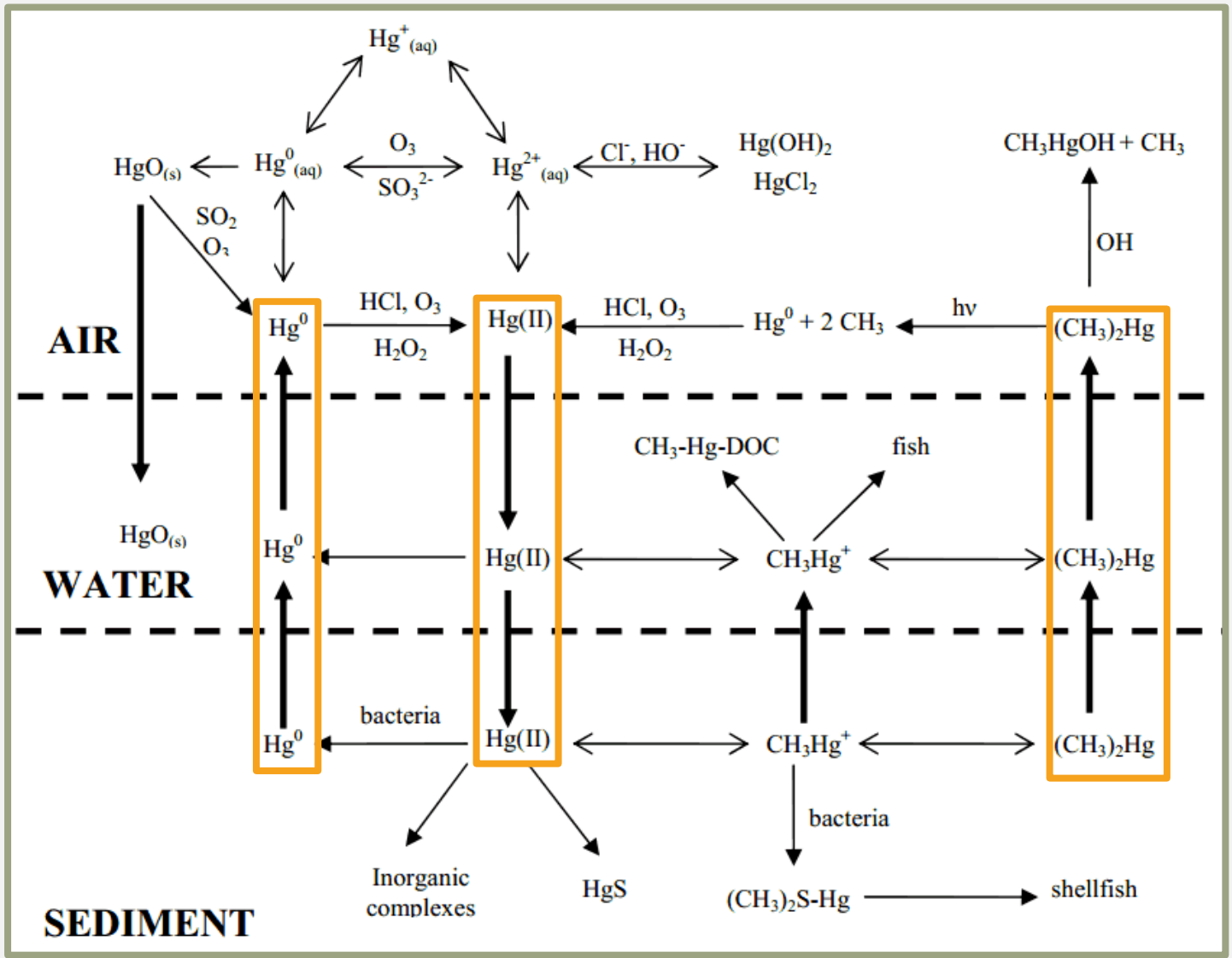
www.epa.gov/mercury.Accessed Sept 2014.

WHAT HAPPENS ONCE THE MERCURY HAS ENTERED THE WATER SUPPLY?



Julie van der Hoop, MIT, 2013

CHEMICAL REACTIONS - PHASES



Farina, M., et al. (2011). *Life Sciences* **89**(15-16): 555-563.

$Hg^{2+} + OH^- \leftrightarrow Hg(OH)^+$

$Hg^{2+} + Cl^- \leftrightarrow HgCl^+$

$CH_3HgCl(g) \leftrightarrow CH_3HgCl(aq)$

$(CH_3Hg)_2S \rightarrow (CH_3)_2Hg + HgS$

$(CH_3)_2Hg + H^+ \rightarrow CH_4 + CH_3Hg^+$

$Hg(OH)_2(g) \leftrightarrow Hg(OH)_2(aq)$

$Hg(CH_3)_2(g) \leftrightarrow Hg(CH_3)_2(aq)$

$Hg^0(g) \leftrightarrow Hg^0(aq)$

$(CH_3)_2Hg \rightarrow CH_3Hg + CH_3$

$Hg^{2+} + 4\ Cl^- \leftrightarrow HgCl_4^{2-}$

$Hg^{2+} + 3\ Cl^- \leftrightarrow HgCl_3^-$

$Hg^{2+} + C_2O_4^{2-} \leftrightarrow HgC_2O_4$

$Hg^{2+} + 2\ Cl^- \leftrightarrow HgCl_2$

$2CH_3Hg^+ + HS^- \rightarrow (CH_3Hg)2S + H^+$

$Hg^{2+} + 2\ OH^- \leftrightarrow Hg(OH)_2$

$Hg^{2+} + 2\ SO_3^{2-} \leftrightarrow Hg(SO_3)_2^{2-}$

$4CH_3Hg^+ + 2H_2O + 4H^+ \rightarrow 3CH_4 + CO_2 + 4Hg^{2+} + 4H_2$

$CH_3Hg \rightarrow Hg + CH_3$

$HgCl_2(g) \leftrightarrow HgCl_2(aq)$

$Hg^{2+} + SO_3^{2-} \leftrightarrow HgSO_3$

CHEMICAL REACTIONS

Environment

$$Hg^0 + CH_4 \leftrightarrow HgCH_3^- + H^+$$

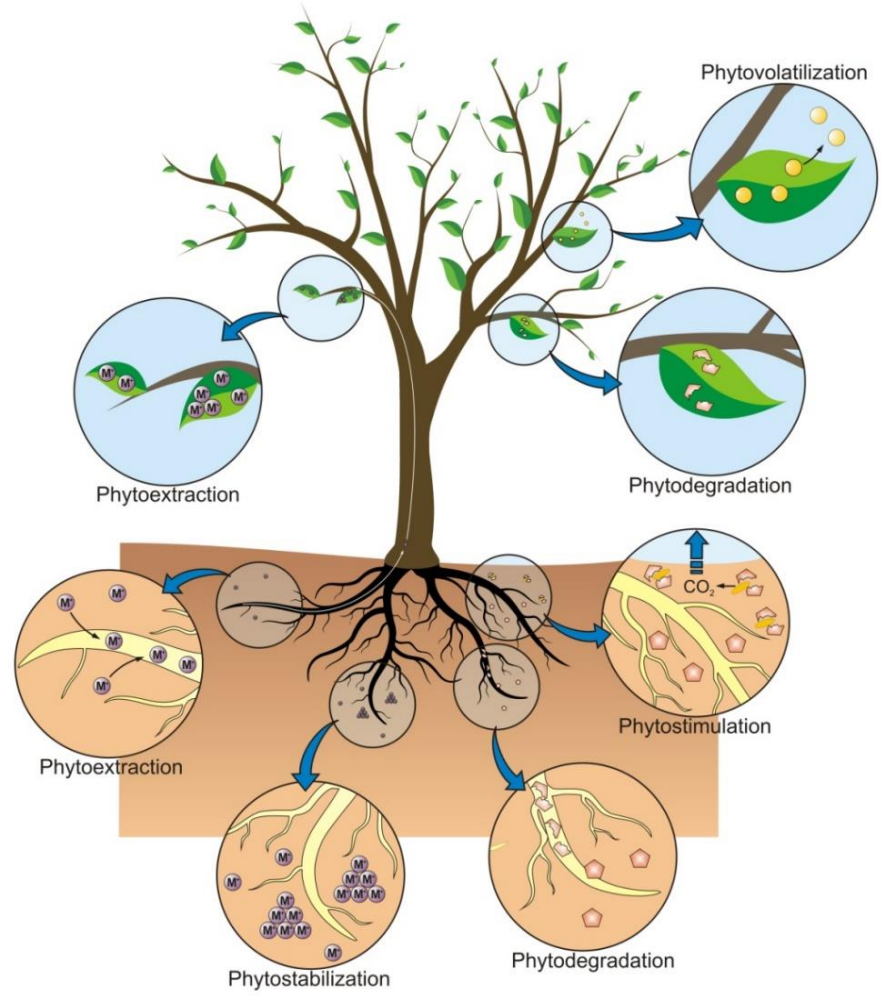
$$HgCH_3^+ + CH_4 \leftrightarrow Hg(CH_3)_2 + H^+$$

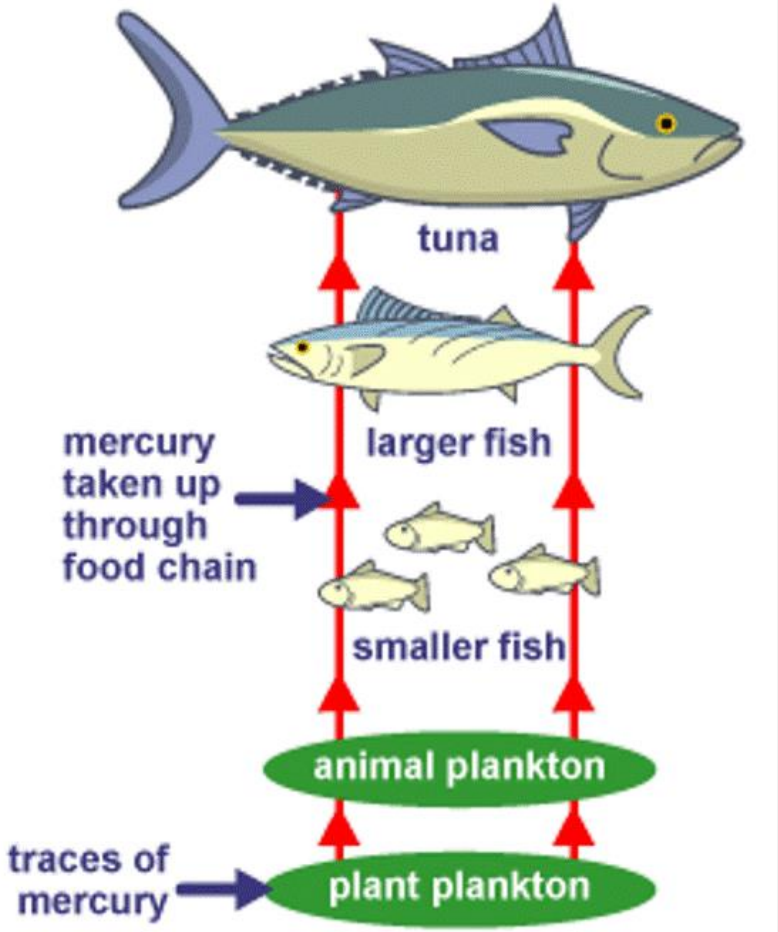
Body

$$Hg(CH_3)_2 \xrightarrow{h\nu} Hg^0 + 2CH_4$$

$$2CH_3Hg^+ + HS^- \rightarrow (CH_3Hg)_2S + H^+$$

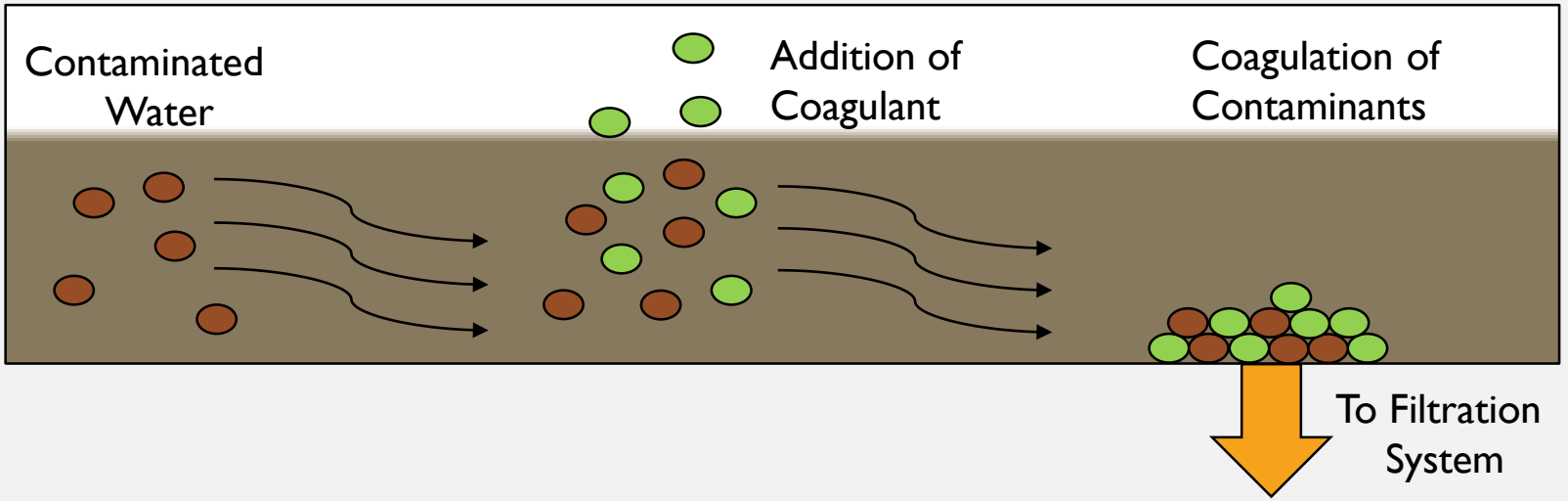
HOW DOES MERCURY EXIT THE WATER SUPPLY? ABSORPTION BY PLANTS/ANIMALS





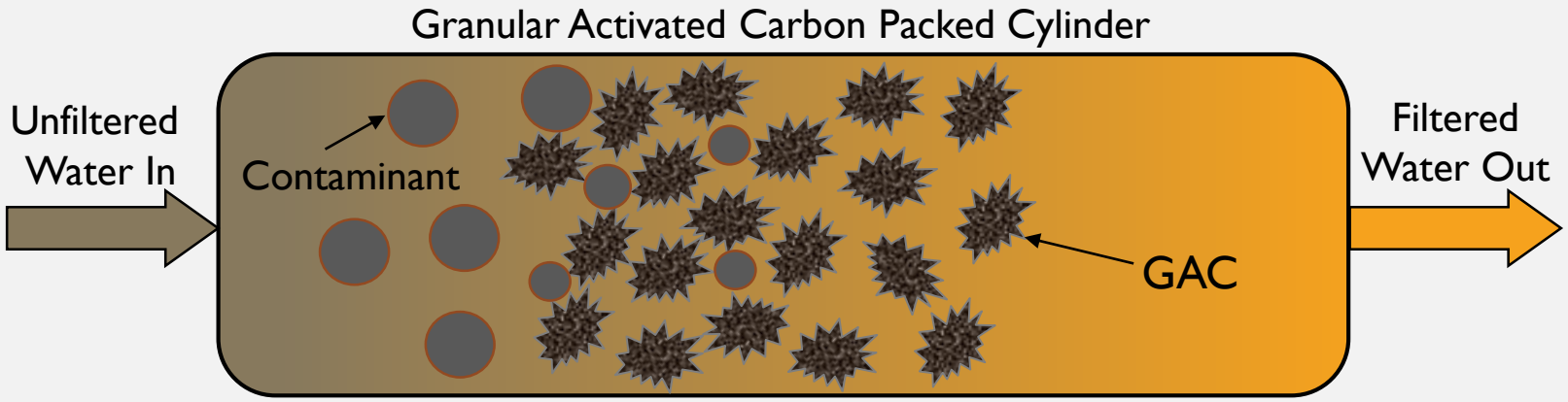
HOW DOES MERCURY EXIT THE WATER SUPPLY? REMOVAL FROM DRINKING WATER

- Coagulation/Filtration methods use metal salts that bind to metals, including mercury, allowing for it to be filtered out of the water.
- Coagulant Formulas: FeCl3, Fe2(SO4)3, AlnCl(3n-m)(OH)m



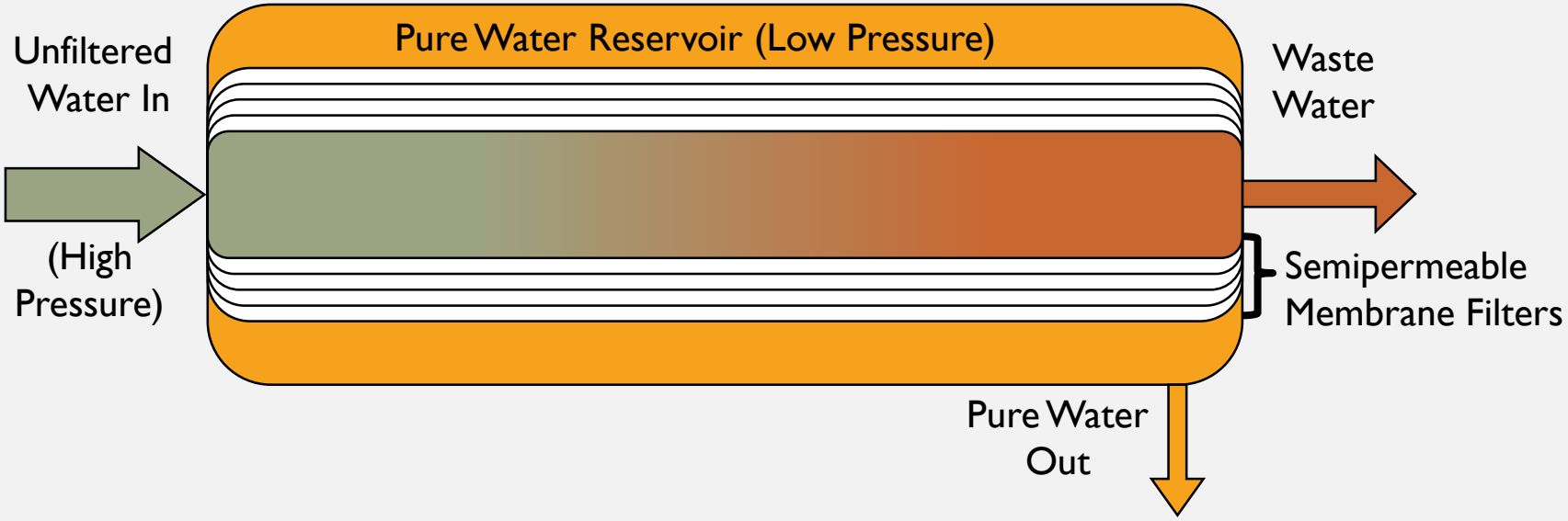
HOW DOES MERCURY EXIT THE WATER SUPPLY? REMOVAL FROM DRINKING WATER

- Granular Activated Carbon is a highly porous carbon structure usually derived from plant material.

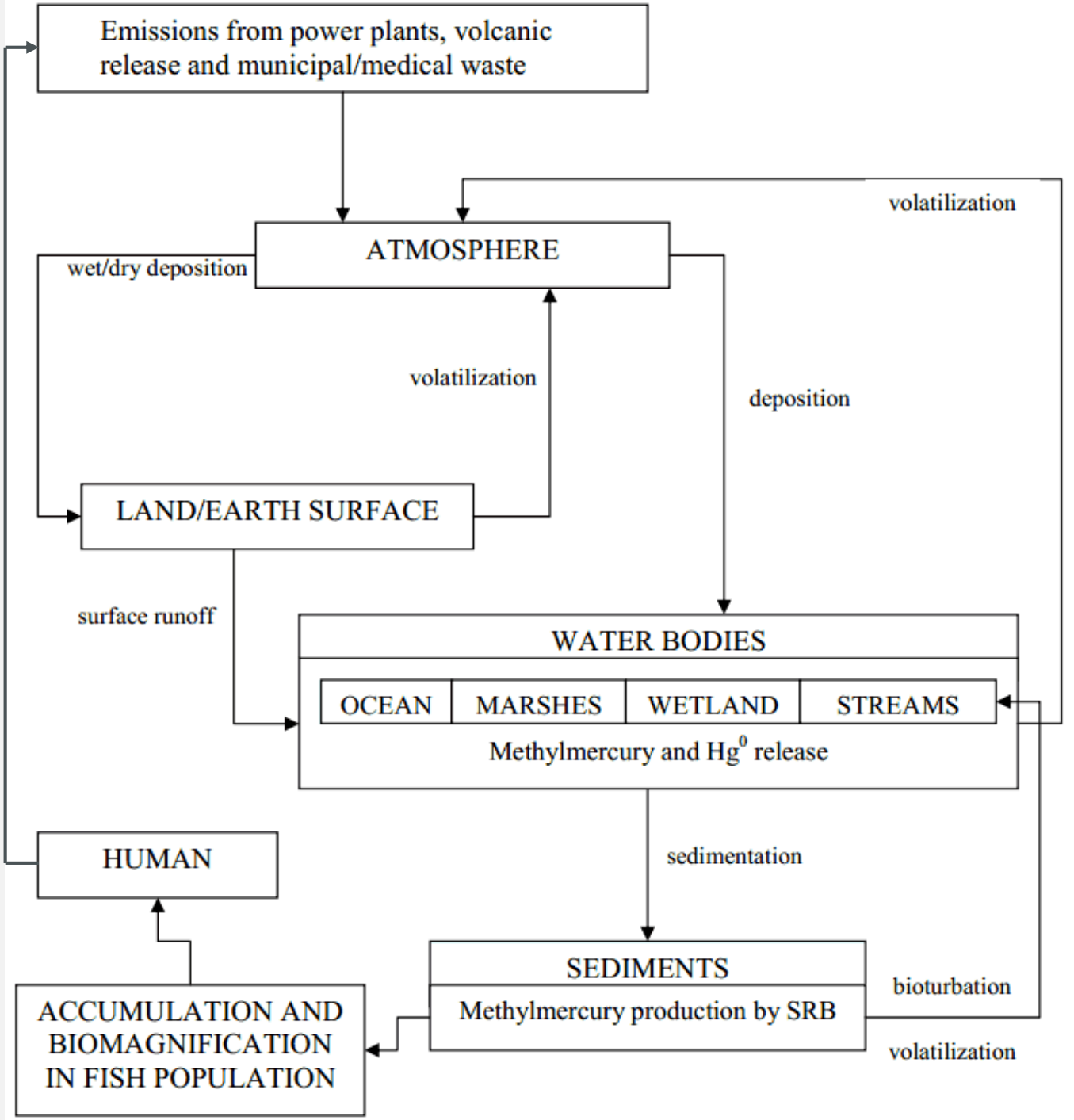


HOW DOES MERCURY EXIT THE WATER SUPPLY? REMOVAL FROM DRINKING WATER

- Osmosis is the spontaneous net movement of solvent molecules through semipermeable membrane into a region of higher solute concentration



CONCLUSION


Emissions from power plants, volcanic release and municipal/medical waste
volatilization
ATMOSPHERE
wet/dry deposition
volatilization
deposition
LAND/EARTH SURFACE
surface runoff
WATER BODIES
OCEAN
MARSHES
WETLAND
STREAMS
Methylmercury and Hg^0 release
HUMAN
sedimentation
SEDIMENTS
Methylmercury production by SRB
bioturbation
volatilization
ACCUMULATION AND BIOMAGNIFICATION IN FISH POPULATION