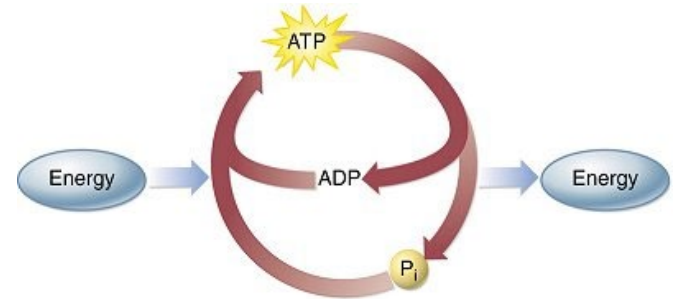Phosphorus
15
P
30.974

A Valuable Nutrient: Integral to Food Security

Tom Kaszas, P.Eng – *Director, Partnerships Branch,*
Ministry of Environment and Climate Change (MOECC)

Ontario

Importance of Phosphorus

One of three macro nutrients:
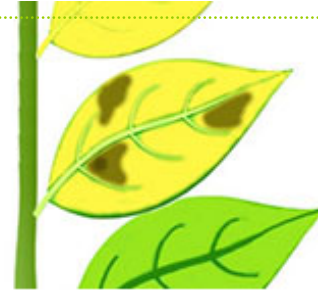
- Nitrogen
- Phosphorus
- Potassium

Present in all living things – vital component of DNA and RNA

Defining metabolic pathway of all life on earth (ATP cycle)

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Importance of Phosphorus

- ## Important for plant growth:
  - Photosynthesis
  - root development
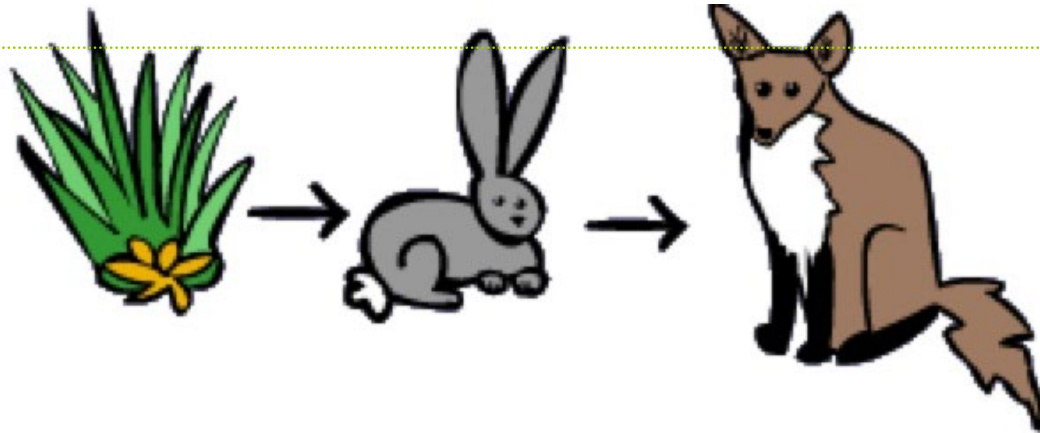 - flower formation and seed production
  - resistance to plant diseases

Phosphate deficiency
Yellowing and death patchs on older leaves. The leaves die and falls off rather quickly.
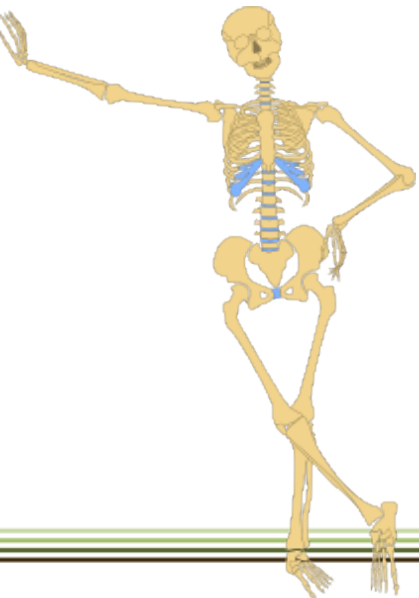
- ## Important for Animals
  - 2nd most abundant mineral in the body (3% of body mass)
  - 80% is in skeleton and Teeth
  - Role in Brain health and hormone Regulation

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Sources of Phosphorus

Animals get their P from eating plants or by eating other animals that eat plants
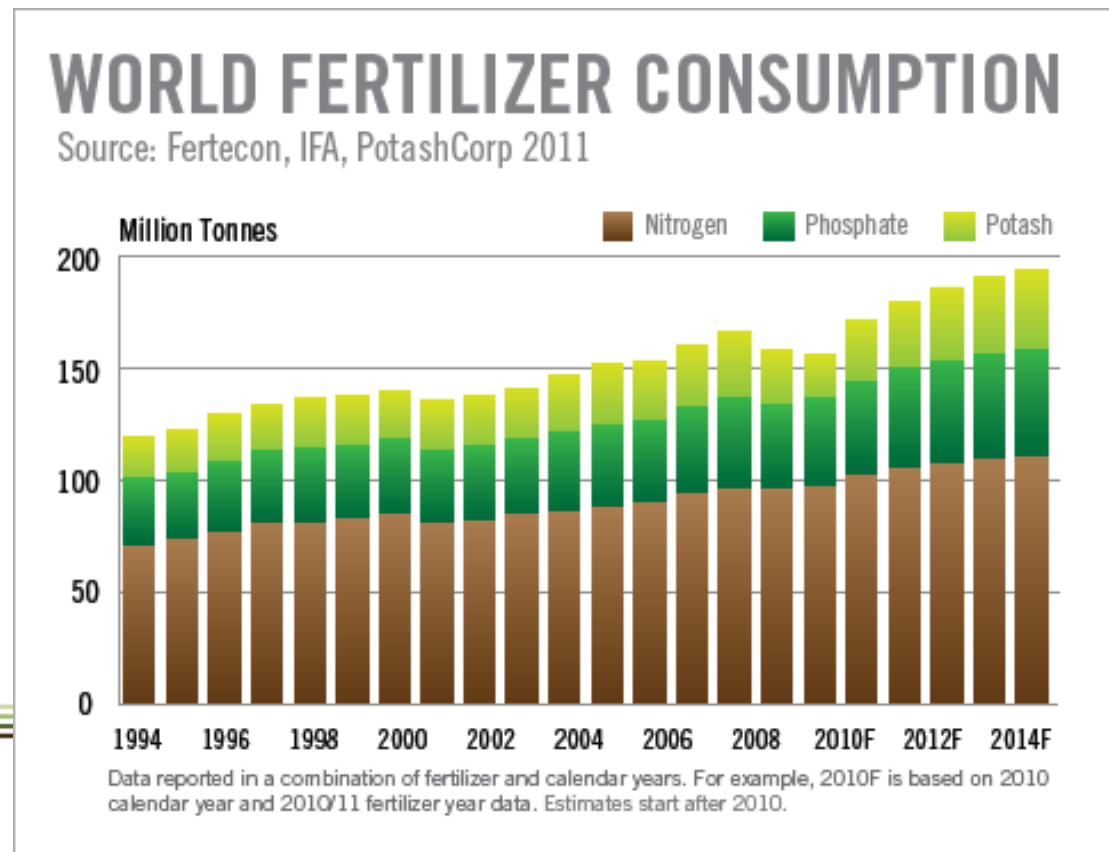
Plants get their Phosphorus from the soil.

P is naturally occurring in the soil

- highly variable but may not be in a readily available form or may not be optimal for the crops we wish to grow.
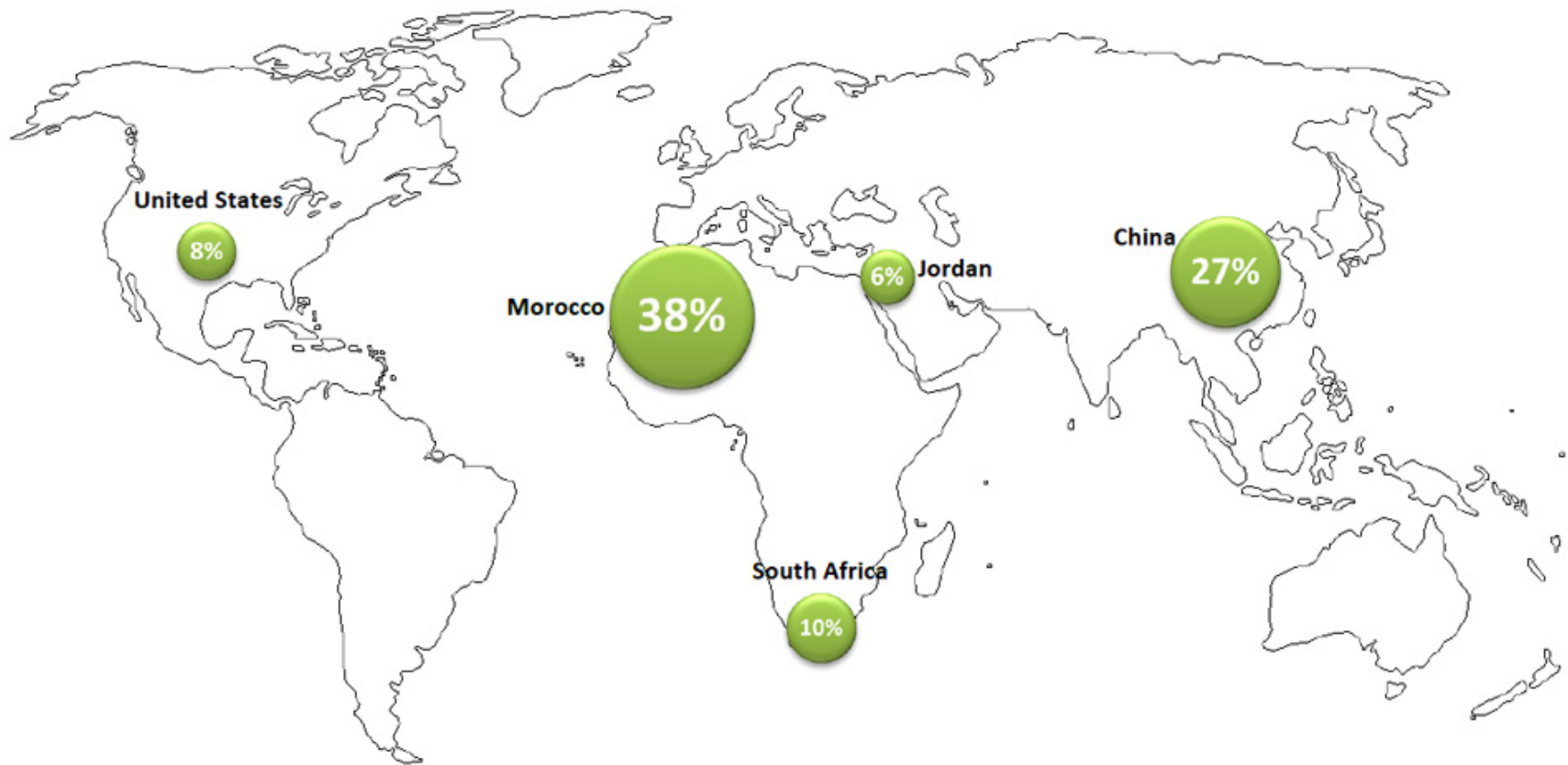- depleted through continuous removal of biomass as in agriculture

Crop production enhanced by commercial fertilizer application

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Commercial Fertilizer

As need for food production increases with increasing population so does the demand for fertilizer.

WORLD FERTILIZER CONSUMPTION

Source: Fertecon, IFA, PotashCorp 2011

Legend: Nitrogen, Phosphate, Potash

Million Tonnes (y-axis: 0, 50, 100, 150, 200)

x-axis: 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010F, 2012F, 2014F

Data reported in a combination of fertilizer and calendar years. For example, 2010F is based on 2010 calendar year and 2010/11 fertilizer year data. Estimates start after 2010.

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Global distribution of phosphate reserves

United States — 8%

Morocco — 38%

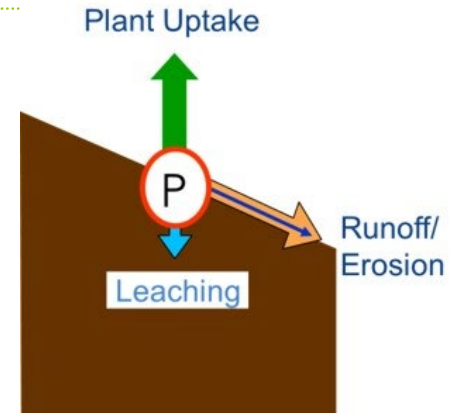Jordan — 6%

China — 27%

South Africa — 10%

Source: 2009 USGS

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P Leakage from the Agri-Food System

P migrates from the food system

- Removed with the crop
- Metabolized by humans (and animals) and not returned to farmland – lost to wastewater treatment
- Surface water run off and water erosion
- Also migrates with soil loss (wind erosion)

Credit: Amy Shober, University of Delaware

- Deposited in Water Bodies
  - not particularly useful there
  - for all intents and purposes permanently lost from system

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Opportunities for Intervention

Lots of opportunity to change the way we manage P in the Agri-food system to minimize this leakage.

- Nutrient Management (targeted application) (reduce use)

- Cropping practice changes (reduce runoff and erosion)

- Recovery from WWRF residuals and discharges (return removed P)

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Non-Agricultural Opportunities

Recovery from already impacted waterbodies

- George Barley Water Prize
- X Prize type of competition ($19M total)
- Potential Cold Weather Component of Challenge is "Made in Ontario" – Demo's are underway now!

Enhanced recovery from WWRF facilities

- Technology Change – New Tech
- Change in Philosophical Approach?
  (prevention – substitution, point source capture)

Food For Thought?
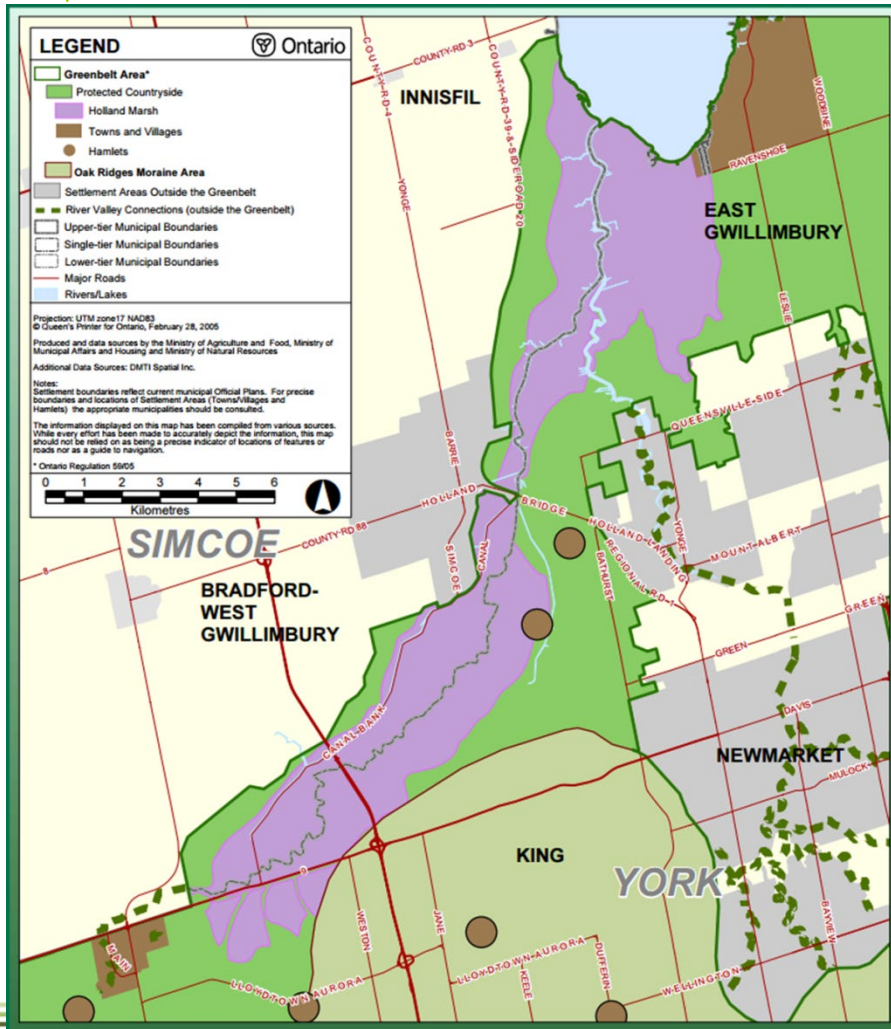
Upper York Sewage Solutions – New Quaternary Treatment System designed to accommodate growth in East Gwillimbury, Aurora and New Market

- Membrane Filtration of WWRF effluent
- Highly purified water stream (permeate) – industrial uses and discharge to Lake Simcoe.
- Concentrated N and P rich stream (retentate) – initially to be conveyed to Duffins Creek WRRF
- 80 km away on Lake Ontario!
- A deployable Technology Solution does not exist.

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Let's Dream Big

- This is the fourth workshop I have attended on this subject, 2014,2015, 2016, 2018….

- Sadly (at least for me) my remarks from the 2015 session are still largely applicable.

- All of us are responsible to make this happen.

- There may be no I in TEAM, but there is an M and an E. So if you are wondering who should do this think to yourself "ME"

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Let's Dream Big

- We will need to feed 10 Billion people

- The concept of a water constrained future is well understood and readily appreciated.

- No One is talking about a phosphorus constrained future.

- We are not talking about the food security risk we face due to our need to rely on imported Phosphorus fertilizers in Canada.

- Change attitudes to conserve this valuable resource.

- Close the loop.

- We need a technological and attitudinal change to the way we manage this non-renewable resource.

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