

# Why Phosphorus?

William “Breck” Bowden  
Patrick Professor of Watershed Science and Planning

*Rubenstein School of Environment  
and Natural Resources  
University of Vermont*

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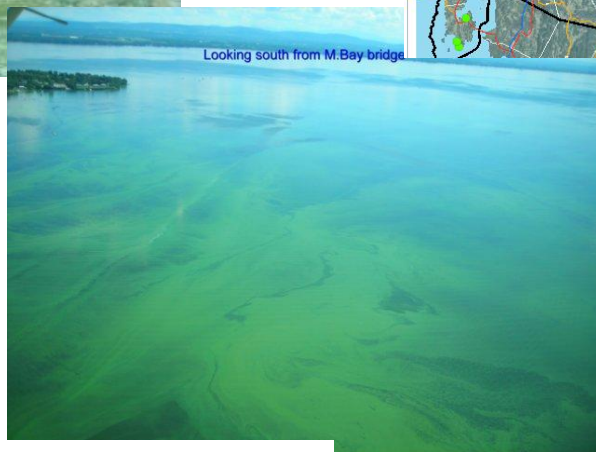
2 February 2017



# Specific Concern: Cyanobacteria



Credit: CLF (2011)



### Vermont Blue Green Algae Tracker

Select Lake/Region ▾

Select Monitoring Town ▾

**Blue-Green Algae Testing Results**

- High Alert
- Low Alert
- Generally Safe

VERMONT  
DEPARTMENT OF HEALTH  
VT Environmental  
Public Health Tracking

Site	Site Name	Date	Test Type	Status
64	Treadswell Bay, Beekmantown NY	10/6/2015	Visual	<a href="#">Generally Safe</a>
	offshore, vicinity of town park	10/6/2015	Visual	<a href="#">High Alert</a>
182	South Alburch - Squires Bay	10/4/2015	Visual	<a href="#">Generally Safe</a>
166	Lake Carmi, Dewing Road	9/30/2015	Visual	<a href="#">Generally Safe</a>

Toxic?

## Lake Champlain property values hurt by algae

GEORGIA, VT.  
| ASSOCIATED PRESS JULY 25, 2015  
Boston-Globe (July 2015)

Water pollution related to toxic algae blooms in Lake Champlain is reducing the values of some lakefront properties in the town of Georgia. **The town's contracted assessor reduced the value of 34 homes along the lakefront on Ferrand Road by a total of \$1.7 million**, the St. Albans Messenger reported. Potentially toxic algae blooms have led to numerous warnings from the health department, and

Credit: LCBP  
Larry Dupont

## SCIENTIFIC AMERICAN™

### Are Algae Blooms Linked to Lou Gehrig's Disease?

Medical researchers are now uncovering clues that appear to link some cases of ALS to people's proximity to lakes and coastal waters

By Lindsey Konkel and Environmental Health News | December 11, 2014

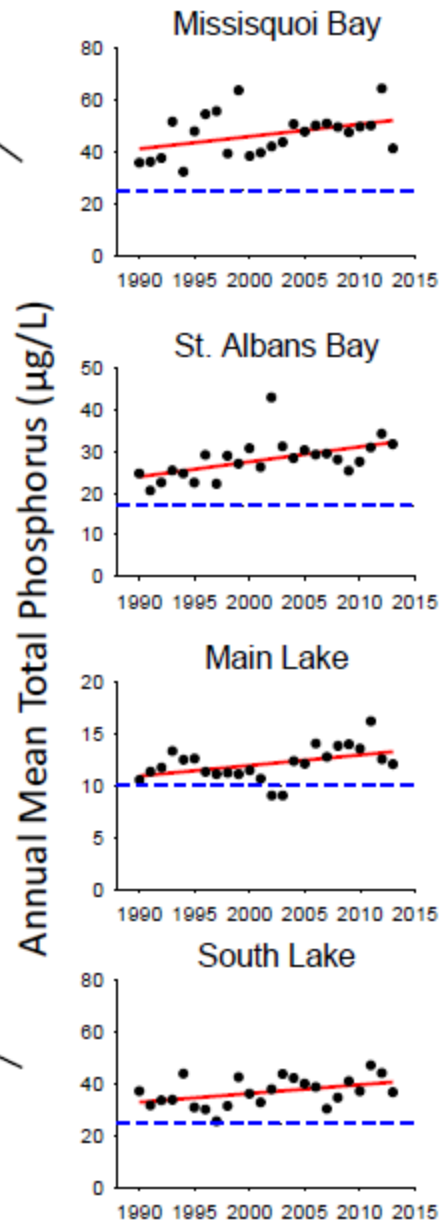
For 28 years, Bill Gilmore lived in a New Hampshire beach town, where he surfed and kayaked. "I've been in water my whole life," he said. "Before the ocean, it was lakes. I've been a water rat since I was four."

Now Gilmore can no longer swim, fish or surf, let alone button a shirt or lift a fork to his mouth. Earlier this year, he was diagnosed with Amyotrophic lateral sclerosis (ALS), or Lou Gehrig's disease.



In New England, medical researchers are now uncovering clues that appear to link some cases of the lethal neurological disease to people's proximity to lakes and coastal waters.  
Credit: Jeff Reutter / Ohio Sea Grant via Flickr

# The Problem



— Trend line  
- - - Water quality standard

## Lessons learned from the past 20 years

Phosphorus levels in the lake are above the allowable standards.

Vermont has taken many important actions, especially in the last 10 years.

Cleaning up the lake ecosystem is complex and recovery will take time.

We need to do a lot more.

# Two Big Ideas

- The Limiting Nutrient Concept
- Competitive Advantage

# The Periodic Chart of Elements

1 H																	2 He									
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne									
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar									
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr									
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe									
55 Cs	56 Ba											72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra											104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu										
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr										

C – Carbon  
N – Nitrogen  
P – Phosphorus

# Two Ecological Assertions

Organisms are not a random assortment of elements.

Organisms need a specific “balance” of elements to remain healthy.

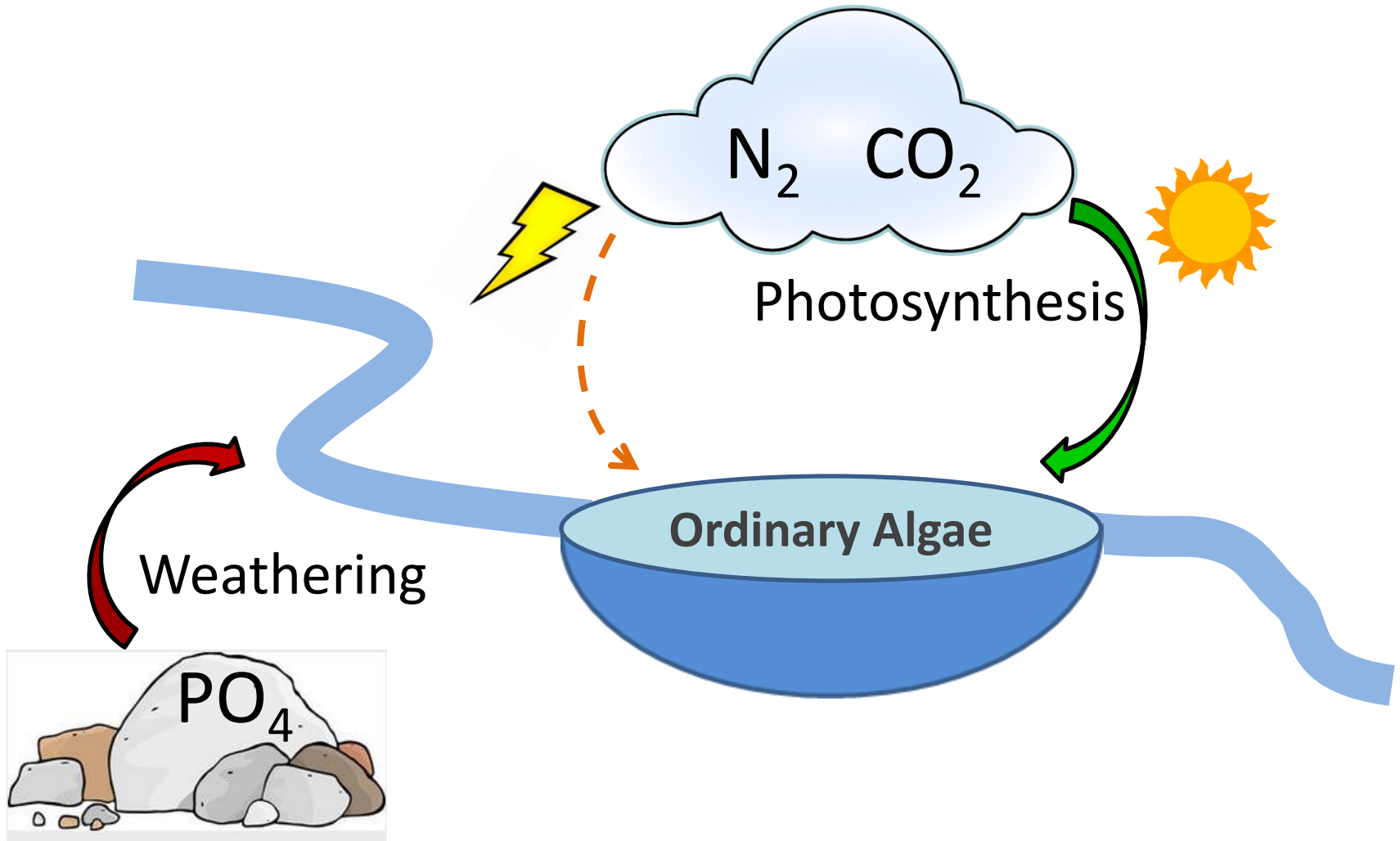
(The Concept: Ecological “Stoichiometry”)



So what?



# Supply & Demand in Ecosystems



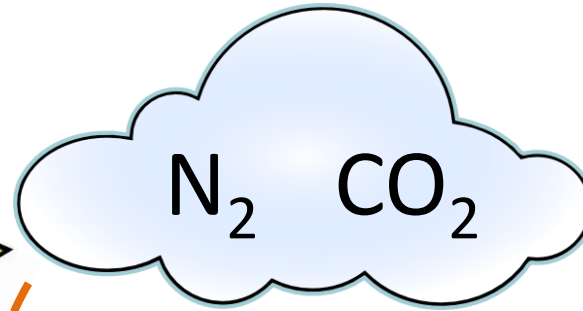
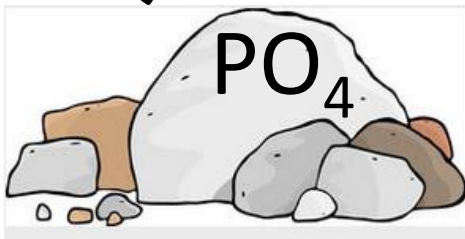
# Supply & Demand in Ecosystems



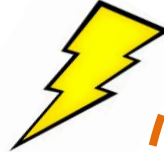
Runoff



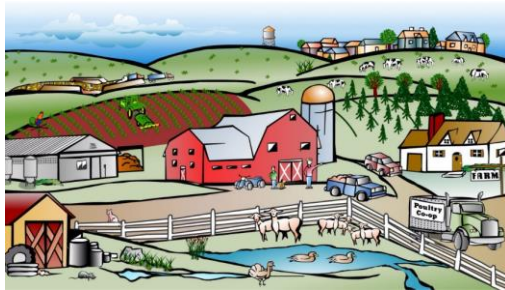
Weathering



Photosynthesis



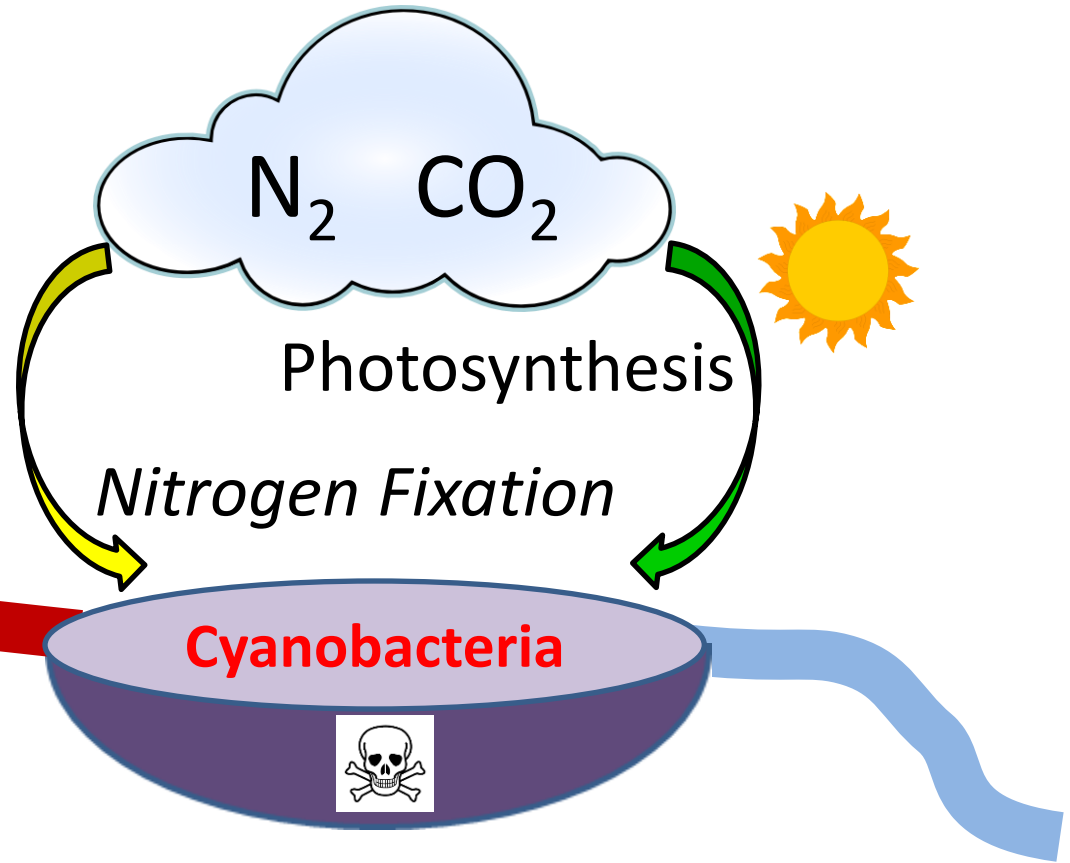
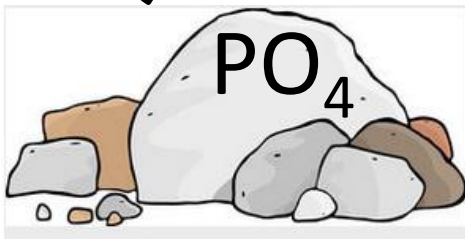
# Supply & Demand in Ecosystems



Runoff



Weathering



**Cyanobacteria**

Nitrogen fixation gives cyanobacteria a competitive advantage over ordinary algae.

# Take-Home Messages

- Organisms (and ecosystems) require a specific balance of elements to remain healthy.
- A scarcity of one element can “limit” the production of the entire system *even when all other elements are in abundance*.
- Organisms that can overcome the scarcity of the limiting element have a competitive advantage.

# Thank you!

Breck Bowden

[Breck.Bowden@uvm.edu](mailto:Breck.Bowden@uvm.edu)

802-238-0929

*Rubenstein School of Environment  
and Natural Resources*

