

## Section 01: The Issue Harmful Algal Blooms

### The Toledo Water Crisis

HAB is short for \_\_\_\_\_ **Harmful Algae Bloom** \_\_\_\_\_ .

In 2014 **\_400,000\_** people were without drinking water for 3 days, because of the HAB's in Lake Erie.

### Doug Wagner Interview

The process to clean the water from start to finish is approximately **\_\_\_18\_\_\_** hours.

The toxin that shut down the water supply was **\_\_\_microcystin\_\_\_**.

The city of Toledo demand was unusually **\_\_\_high\_\_\_** during that time of year, and the water was moving through the treatment plant more quickly not allowing the **\_\_\_treatment\_\_\_** time to work.

They decided to add **\_\_\_ozone\_\_\_** to the process after the Toledo shutdown.

### Lake Erie History

Which Great Lake is most shallow? **\_\_\_\_\_Lake Erie\_\_\_\_\_**

List ways humans have impacted Lake Erie and what impact they have had: **Students can list several answers about the land being developed causing changes that impacted the lake.**

Three invasive species that have entered Lake Erie are: **lamprey, zebra mussels and alewife**

How do farmers scientifically know which fertilizers to use and how much to apply to their field? **\_\_\_soil testing\_\_\_**

What is 4R Nutrients Stewardship? **Right rate, Right source, Right time, Right place.**

### Review

What is one of the challenges facing Lake Erie today?

Who or what is affected by this challenge?

## Section 2: Science of Harmful Algal Blooms

### H2Know Podcast: Part 1

What type of algae is responsible for the algae bloom? **cyanobacteria**\_\_\_\_\_

Algae is important to the water to produce \_\_\_\_\_ **oxygen** \_\_\_\_\_.

What are the 2 components needed for algae bloom to occur?

1. **warm temperatures**
2. **the presence of nitrogen and phosphorus**

### Algal Bloom Images

What do you notice is similar in each photo? \_\_\_\_\_  
\_\_\_\_\_

Why is knowing the depth of the lake important? \_\_\_\_\_  
\_\_\_\_\_

### H2Know Podcast: Part 2

What was the main cause of the algae bloom in the 40's, 50's 60's and 70's?

**Detergent, sewer treatment, runoff**\_\_\_\_\_

The increase in the bloom since the early 90's is from \_\_\_\_\_ **dissolved phosphorus.** \_\_\_\_\_

Who does Dr. Chaffin say will need to help stop the blooms? **Everyone** \_\_\_\_\_

### Review

What makes Lake Erie an ideal environment for HABs?

What are the primary nutrients that create an algae bloom?



## Section 3: Western Lake Erie Basin Watershed Dynamics

### Watershed Lesson

A watershed is a land area that drains into a specific \_\_\_\_\_ **stream** \_\_\_\_\_,  
\_\_\_\_\_ **river** \_\_\_\_\_, \_\_\_\_\_ **lake** \_\_\_\_\_ or \_\_\_\_\_ **other body of water** \_\_\_\_\_.

If a watershed is in an urban area, the impacts come from \_\_\_\_\_ **traffic streets** \_\_\_\_\_, \_\_\_\_\_ **lawn care** \_\_\_\_\_  
and \_\_\_\_\_ **industrial sites** \_\_\_\_\_.

If a watershed is in an rural area, the impacts come from \_\_\_\_\_ **manure** \_\_\_\_\_, \_\_\_\_\_ **septic** \_\_\_\_\_  
and \_\_\_\_\_ **farming** \_\_\_\_\_.

Which area has the highest amount of runoff? **Urban**, Suburban or Rural (circle one)

Topography is the **shape** of the ground surface.

What impact does topography have on runoff? \_\_\_\_\_  
\_\_\_\_\_

### Review

In the example, what direction is the water flowing?

How can you tell?

What other substances may travel with the water as it moves through the watershed?

## Section 4: Agricultural Research and Management Practices

### Overview of the 4R Nutrient Stewardship

What are the 4R's of nutrient stewardship?

(right source, right rate, right time, and right place)

Right Source -

Right Rate-

Right Time-

Right Place-

Farmers are NOT losing a lot of nutrients they are only losing on average 2-3 %.

That means farmers have a 95 % efficiency rate.

### 4R Farmers and The Lake

4R hand out

Fertilizers replenish soil nutrient supplies depleted by the crop. Within the watershed, crop harvest removes more phosphorus than is being applied as fertilizer and manure.

### Agricultural Use of Fertilizer and the 4R Strategies

What are the 3 Macronutrients? nitrogen, phosphorus and potassium

Throughout the video, the word "stewardship" is used. What are some ways that farmers are "stewards"? \_\_\_\_\_

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## International Perspectives on Agriculture Use of Fertilizers and 4R strategies

Ontario has a goal to reduce phosphorus loss by 40% by 2025. What approach is referenced in their action plan? \_\_\_\_ **4R** \_\_\_\_

What are 2 other major sources of runoff?

1. \_\_\_\_ **distraiges from sewer treatment plants** \_\_\_\_
2. \_\_\_\_ **urban stormwater runoff** \_\_\_\_

## Scientific Perspective on Phosphorus and Water Quality

Why do farmers use subsurface drainage in the fields? \_\_\_\_ **To help drain excess water from the field in heavy soil conditions.** \_\_\_\_

Producers are now using \_\_\_\_ **less** \_\_\_\_ phosphorus than in the past.

## Using Science to Meet Sustainability

Research is key to understanding the water quality and farm impacts of implementing 4R practices. Continued \_\_\_\_ **research** \_\_\_\_ initiatives will help uncover the best management practices and generate new tools to meet important goals for \_\_\_\_ **reducing** \_\_\_\_ nutrient loading.

## How Edge-of-Field Research Quantifies the Impact of Management Practices

What is Kevin King's big picture goal in the Edge to Field Research? \_\_\_\_ **To quantify the impact of different agricultural management practices on water quality.** \_\_\_\_

The target is to lose less than \_\_\_\_ **1/4** \_\_\_\_ pound per acre of phosphorus to reduce loss by 40%.

## Managing the Risk of Phosphorus Runoff

What is Dr. Dayton discovering with the research? **Erosion really matters, because of the phosphorus that is traveling with the eroded soil particles.** \_\_\_\_

What are the 3 main things that a farmers has control to reduce runoff and erosion?

1. **Reduce erosion by reducing soil disturbance and keep field cover on the field** \_\_\_\_
2. **Soil test P level- keep within argonomic range** \_\_\_\_
3. **4R practices** \_\_\_\_

## Consumers and Phosphorus

Phosphorus is one of the most common elements in our environment and is essential to human, animal and plant life.

Phosphorus is present naturally in food, water and even human bodies.

In most areas, a majority of the phosphorus comes from the environment itself and only a fraction, about a third, comes from consumer products.

## Review

What are the 4Rs?

What are some of the management practices that can help reduce nutrient runoff and water contamination?

Besides agriculture practices, what are some of the other contributing factors to HAB?