

# WHAT WE KNOW: Environmental Education and the MWEE

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# OUTLINE

- **Introduction to B-WET & MWEEs**
- **Review of watershed education & related research** (Zint 2010)
- **Results from evaluation of Chesapeake Bay MWEEs**  
(Kraemer, Zint & Kirwan, 2007)
- **So what? Implications for MWEEs**

## *TIME???*

- **Introduction to B-WET's evaluation system**  
(Zint & Kraemer, In Process)
- **Watershed outreach guide – behavior change strategies**  
( Kelly et al., 2011)



# *B-WET National*

- National Program implemented by local NOAA offices
- **Mission:** To promote environmental literacy in society: citizens exhibit behaviors that protect and restore watersheds and related ocean, coastal and Great Lakes ecosystems.
- Chesapeake Bay, California, Hawai'i, Pacific Northwest, New England, Gulf of Mexico, Great Lakes
- Variations on a theme:
  - *All programs focus on meaningful watershed experiences*
  - *Specific implementation tailored to local needs*
  - *Build upon established NOAA presence*



## **STUDENT “minimum” MWEE**

- ❖ **3 Implementation Phases:**
  - **Preparation – question/problem/issue**
  - **Action – min 2 outdoor experiences or multi-day, action related to environmental change/study**
  - **Reflection – emphasis on analysis/ assessment/ communication**
  
- ❖ **Aligned with standards**
  
- ❖ **Employing NOAA sciences (e.g., data, personnel)**
  
- ❖ **Hands on, focused on question/issue/project-oriented**



## **TEACHERS/PROFESSIONAL DEVELOPMENT “minimum”**

- ❖ **3-day professional development including outdoors**
- ❖ **Adequate reflection/follow up/support**
- ❖ **Incentives (stipends, continuing credits)**



# What does research tell us?



# There is a need for watershed education!

## U.S. adults and children are not “watershed literate”

	Adults	Children
Don't know what watershed is	44%	74%
Watershed=wetlands	65%	59%
Don't know where water drains	26%	54%
Don't know non-point source pollution	86%	85%
Don't know threats of land use/development/sprawl	65%	-

(Penn, 2001a,b)



# Potential Benefits of Watershed Education

## Students:

- ✓ **Improved understanding of watersheds** (Endreny, 2010)
- ✓ **Enhanced environmental attitudes and behaviors** (Bodzin, 2008)
- ✓ **Increased advocacy for the environment** (Stapp, 2000)
- ✓ **Strengthened civic responsibility** (Eflin & Shaeffer, 2006)

## Teachers:

- ✓ **Improved understanding of watersheds** (Shepardson et al., 2002)



# Instructional Practices linked to these benefits

- ❖ **(long term) place-based, hands-on science inquiry**  
(Bodzin, 2008; Endreny, 2010; Patterson & Harbor, 2005)
- ❖ **outdoor learning experiences** (Bodzin, 2008)
- ❖ **demonstrations/models that make invisible parts of watershed systems visible** (Covitt, et al., 2009)
- ❖ **instructional technologies (e.g. web-based GIS maps and Google Earth)** (Bodzin, 2008)
- ❖ **service learning** (Eflin & Sheaffer, 2006)



# **Is SCIENCE INQUIRY more effective in fostering student understanding of science concepts than more passive techniques?**

- ❖ **Review of 138 studies (1984-2002) (Minner et al., 2010)**
- ❖ **Authors did not find “overwhelming positive” evidence (p. 493)**
- ❖ **But “a clear and consistent trend” (p. 493) when students are engaged in thinking about and drawing conclusions from data i.e., students did not need to be actively involved in collecting data**

# Outdoor Field Work

- ❖ **Review and synthesis of 150 studies (1993-2003)** (Rickinson et al., 2004; Dillon et al., 2006)
  
- ❖ **Potential benefits:**
  - (Higher-order) learning, attitudinal, interpersonal /social outcomes
  - Less evidence for behavioral outcomes (only 2 studies)
  
- ❖ **Practices:**
  - length of the program (i.e., longer, sustained )
  
  - preparatory work : concepts and skills, setting, process
  
  - experience itself
    - amount of structure
    - opportunities to directly interact with environment
    - facilitating and role modeling by educators
    - choice among learning activities
  
  - Follow up work linking outdoor with indoor/classroom-based activities

# Characteristics of environmental education programs that (do not) lead to behavioral outcomes (Zint 2012)

- ❖ Review: 10 behavioral outcome evaluations (1979-2009)
- ❖ Which program characteristics changed participants', their families' and communities' behaviors?

## Option 1?

- ❖ Lack behavioral objectives
- ❖ Focus on general environmental knowledge, attitudes
- ❖ Passive
- ❖ Top down
- ❖ Shorter (i.e., typically a few hours)

## Option 2?

- ❖ Have behavioral objectives
- ❖ Based on behavior theory/model
- ❖ Experiential learning
- ❖ Consider participants' needs and context
- ❖ Longer (i.e., typically 1-2 years)

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## Option 2

- ❖ Have behavioral objectives
- ❖ Based on behavior theory/model (i.e., NOT intuitive ideas)
- ❖ Experiential learning
- ❖ Consider participants' needs and context
- ❖ Longer (i.e., typically 1-2 years)

# Evaluation of Chesapeake Bay Foundation EE Programs (Zint et al., 2002)

	2-week FT	3-day FT	1-day FT	Restoration	Curriculum
Env. sensitivity	✓	✓			
Personal responsibility		✓	✓		
Indiv. locus of control		✓			
Group locus of control	✓	✓	✓		
Knowledge of ecology	✓	✓	✓		
Knowledge of issues	✓	✓	✓	✓	✓
Knowledge of actions	✓	✓	✓		
Skill in actions	✓	✓	✓	✓	
Intention to act	✓		✓	✓	

✓ = Post-test mean was significantly higher ( $p < 0.05$ ) than that of comparison group which did not participate in CBF programs.

# Watershed Related PROFESSIONAL DEVELOPMENT

- + 2 day workshop
- + 2 or 3 week summer institute
- + follow-up workshops during academic year
- + conduct of scientific investigation
- = increased teacher understanding of watershed science concepts/research

(Shepardson et al., 2002)

**Effective GLOBE (inquiry based earth science) implementation (including data reporting) linked to:**

- alignment with learning goals
- planning time for implementation
- technical support

(Penuel et al., 2007)

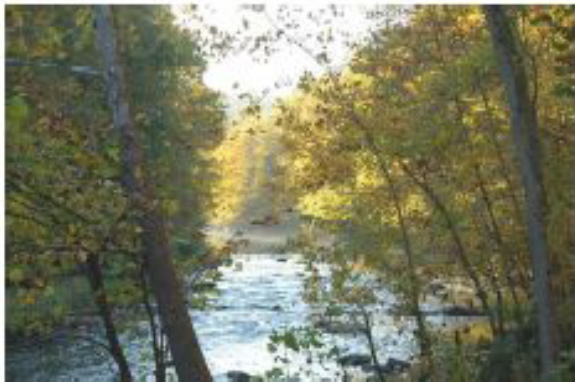
# What PROFESSIONAL DEVELOPMENT practices support teacher learning and change?

**Synthesis** (Fishman & Davis, 2006)

## **Practices:**

- **extended duration (e.g., one study suggests minimum of 30 hours)**
- **emphasizes content, pedagogy, and pedagogical content knowledge**
- **requires teachers to examine/reflect on their own practice**
- **provides opportunities for social support**
- **is closely coupled to what is expected to be taught in the classroom**
- **is structured around (educative) materials and activities that teachers can employ directly in their own classroom practice**
- **situates teachers' learning in representations of practice (i.e., "practice-based")**

An Evaluation of  
National Oceanic and Atmospheric Administration  
Chesapeake Bay Watershed Education and Training Program  
Meaningful Watershed Educational Experiences



Anita M. Kraemer, M.S.  
Evaluations

Michaela T. Zint, Ph.D.  
University of Michigan School of Natural Resources and Environment

Jeffrey L. Kirwan, Ph.D.  
Virginia Tech College of Natural Resources

February 2007

## Methods

### Pre/Post MWEE Questionnaire

- 880 students in 20 MWEE classes
- 465 students in 12 comparison classes

### Post PD Questionnaire

- ~500 teachers

**Analysis: ANCOVA-HLM**

# Evaluation of Chesapeake Bay MWEEs (2007)

<http://chesapeakebay.noaa.gov/bay-watershed-education-and-training-b-wet/evaluation>

## MWEE student outcomes:

- ❖ **Increases in 3 of 8 characteristics associated with environmental stewardship:**

	<b>Effect Sizes</b>
• Knowledge of issues	<b>.60</b>
• Knowledge of actions	<b>.47</b>
• Intention to act	<b>.33</b>

- ❖ **No significant changes in environmental sensitivity, personal responsibility, individual or group efficacy**

# Evaluation of Chesapeake Bay MWEEs (2007)

<http://chesapeakebay.noaa.gov/bay-watershed-education-and-training-b-wet/evaluation>

**MWEE characteristics linked to student stewardship and engagement in learning:**

- Relevance
- Hands-on learning
- Collecting and analyzing data
- Learning outdoors
- Reflection
- Reading and discussing issues
- Participating in action projects



# Evaluation of Chesapeake Bay MWEEs (2007)

<http://chesapeakebay.noaa.gov/bay-watershed-education-and-training-b-wet/evaluation>

## **MWEE professional development teacher outcomes:**

- ❖ **Increased teacher confidence and intentions to incorporate MWEEs**
  - “somewhat” to “very” (4 point scale)
  - “likely” to “very likely” (6 point scale)
  
- ❖ **Greater MWEE implementation ... but not implemented equally**
  - 93% taught about watershed/Bay after PD, including 87% who did not do so before
  - 1/3 of teachers (10% more) taught “complete” MWEEs after PD (i.e., watershed, outdoor learning, issue investigation, action project)
  - 1/4 not teaching outdoors
  - 1/2 not conducting issue research/action projects

# Evaluation of Chesapeake Bay MWEEs (2007)

<http://chesapeakebay.noaa.gov/bay-watershed-education-and-training-b-wet/evaluation>

## **MWEE characteristics associated with gains in teacher confidence and intentions:**

- ❖ **Demonstrating benefits of MWEEs**
  - Academic achievement
  - Environmental awareness/knowledge/actions
  - District/school standards
- ❖ **Providing follow up support**
- ❖ **Conducting environmental action**
- ❖ **Researching environmental issues**
- ❖ **Duration**
- ❖ **Inclusion of:**
  - Hands-on learning
  - Practicing new skills
  - Planning for integration into curriculum



# So what? “Minimum MWEE” should include ...

## STUDENTS

### ❖ 3 Implementation Phases:

- Preparation ✓ - question/problem/issue ✓
- Action ✓ -min 2 ? outdoor experiences ✓  
or multi-day + action related to environmental change/study ✓
- Reflection ✓ – emphasis on analysis ✓ /assessment  
/communication

❖ Aligned with standards ✓

❖ Employing NOAA sciences (e.g., data ✓ , personnel)

❖ Hands on, focused on question/issue/project-oriented ✓

Learning ✓

Behavior change ?

# So what? “Minimum MWEE” should include ...

## TEACHERS/PROFESSIONAL DEVELOPMENT

- ❖ 3 day professional development including outdoors
- ❖ Adequate reflection/follow up/support
- ❖ Incentives (stipends, continuing credits)



# NOAA B-WET's Evaluation System Plan

**Learned about program:  
documents, interviews**

**Decided on goals:  
improvement  
& accountability**

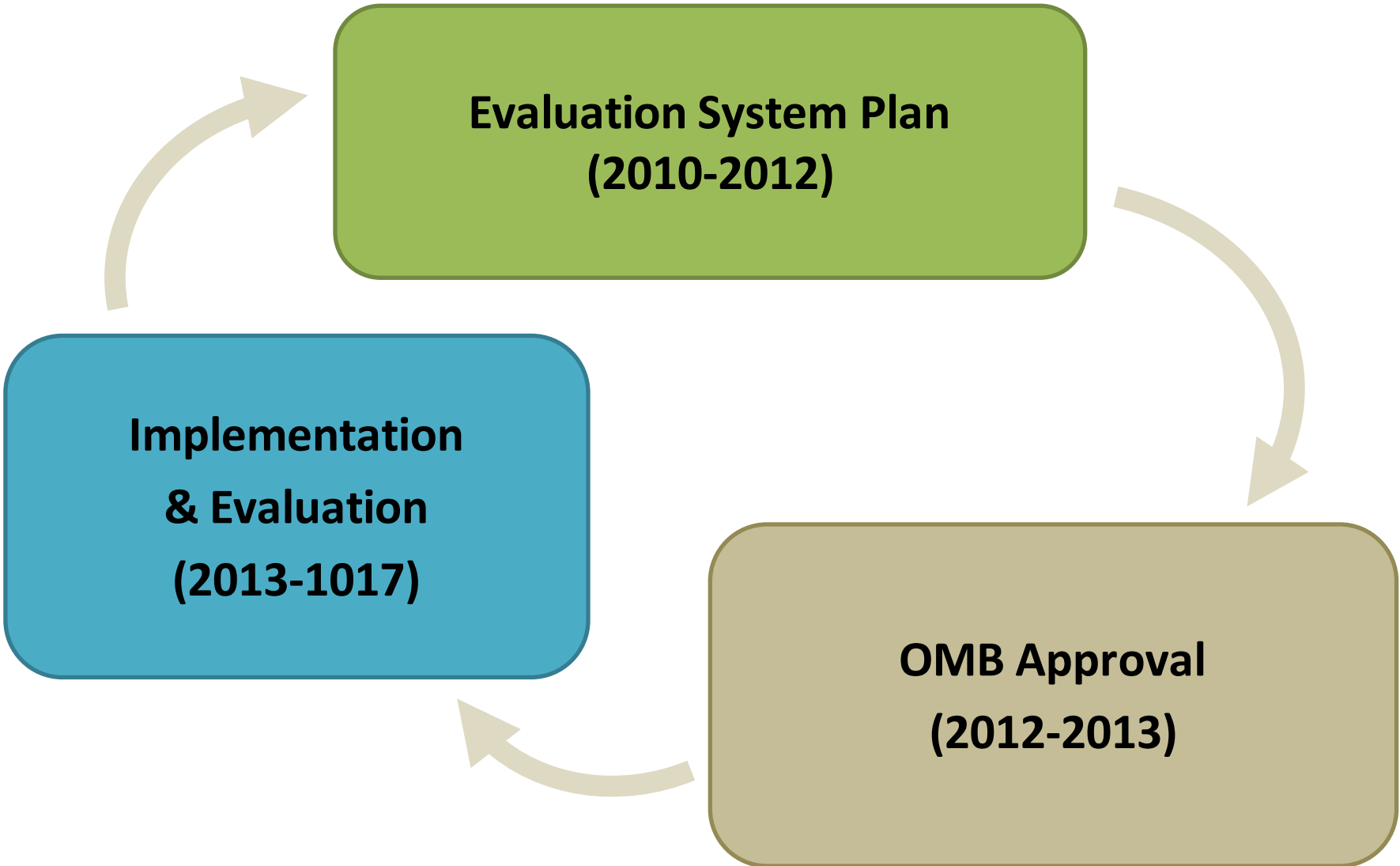
**Focused evaluation  
questions:  
logic model,  
literature review**

**Determined design:  
questionnaires  
Grantees (post)  
Teachers (post PD. MWEEs)  
Students (pre & post)**

**Developed and tested  
measures:  
literature review,  
metrics matrix  
UM pilot-testing**

**Create & test  
database**

# NOAA B-WET's Evaluation System



```
graph TD; A[Implementation & Evaluation (2013-2017)] --> B[Evaluation System Plan (2010-2012)]; B --> C[OMB Approval (2012-2013)]; C --> A;
```

**Evaluation System Plan  
(2010-2012)**

**Implementation  
& Evaluation  
(2013-2017)**

**OMB Approval  
(2012-2013)**



★  
**Strategies for Motivating Watershed  
Stewardship:**  
A Guide to Research-based Practices

# A guide to watershed outreach

**Contact:  
Chesapeake Bay Trust**



Meghan Kelly | Samuel Little | Kaitlin Phelps | Carrie Roble

Under the guidance of Dr. Michaela Zint

With support from the Chesapeake Bay Trust

April 2012 | School of Natural Resources and Environment

# Behavior Change

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## STRATEGIES

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Commitment  
Extrinsic Rewards  
Feedback  
"How-To" Skills  
Intrinsic Rewards

Positive Emotional  
States  
Prompts  
Social Norms  
Stories

# Commitment

## Commitment



### Definition:

Using verbal or written agreements, such as pledges, to encourage people to adopt a behavior

### Example:

Asking homeowners to sign a pledge to only use organic fertilizers on their lawns

### Benefits:

- Commitment is an effective strategy for both short- and long-term behavior change (Lokhorst et al., 2011)
- Because people are socialized to favor consistency, they are more likely to prescribe to a new behavior that they have made a commitment towards (Cialdini, 2001)
- Commitment does not require extensive resources

### Challenges:

- Research does not show why commitment works, nor what occurs in an individual's psyche that makes commitment effective (Cialdini, 2001)
- Group commitment is less effective than individual commitment
- Commitment does not necessarily change environmental attitudes (Werner et al., 1995)

### Evidence:

- Commitment can alter one's personal norms, which can cause adherence to a new behavior (Lokhorst et al., 2011)
- Individual commitments made in a group of people that respect each other, such as neighbors, can create long-term change (Cobern et al., 1995)

### Tips:

- Make the commitment an active process, such as by writing down the commitment (Werner et al., 1995)
- Make the commitment specific, straightforward, and easy to understand
- Attach the participant's name to the commitment
- Make the commitment conspicuous and public
  - Public commitments are shown to be more effective than commitments not shared with others (Lokhorst et al., 2011)
- Allow people to feel that they have made a commitment voluntarily and that it is internally motivated (See p. 12: *Intrinsic Rewards*).
- Encourage participants to discuss their commitment with a friend or family member; persuading others to adopt a new behavior encourages the persuader to adhere to the behavior him/herself (Lokhorst et al., 2011 and Cobern et al., 1995)
- Regularly remind the participant of their commitment
  - For example, give the participant a physical take-home reminder (e.g. refrigerator magnet) that can remind the participant of his or her commitment
- May be combined with other strategies, especially feedback, social norms, and intrinsic rewards.



## Commitment

### Howard County Master Gardeners: Making ERB Stick

In an effort to encourage Howard County residents to use rain barrels and compost bins at their homes, University of Maryland's Master Gardeners Extension turned to personal commitments to help these two behaviors stick. Interested community members are given free rain barrels and/or compost bins for attending supply distribution days at the local landfill, learning how to install and use the barrel and/or bin, and signing a pledge that commits them to installing and using the barrel and/or bin at their home. These pledges require residents to publicly sign their names to a piece of paper that states explicit expectations of use for the free barrel and/or bin and a requirement to read supplementary directions for installation and use. The agreement also includes a contingency statement that stresses if the resident no longer wishes to use the barrel and/or bin, they are required to return the supplies to the county for recycling. Ultimately, this program effectively combines commitment with "how-to" skills to create a strategic behavior change program.

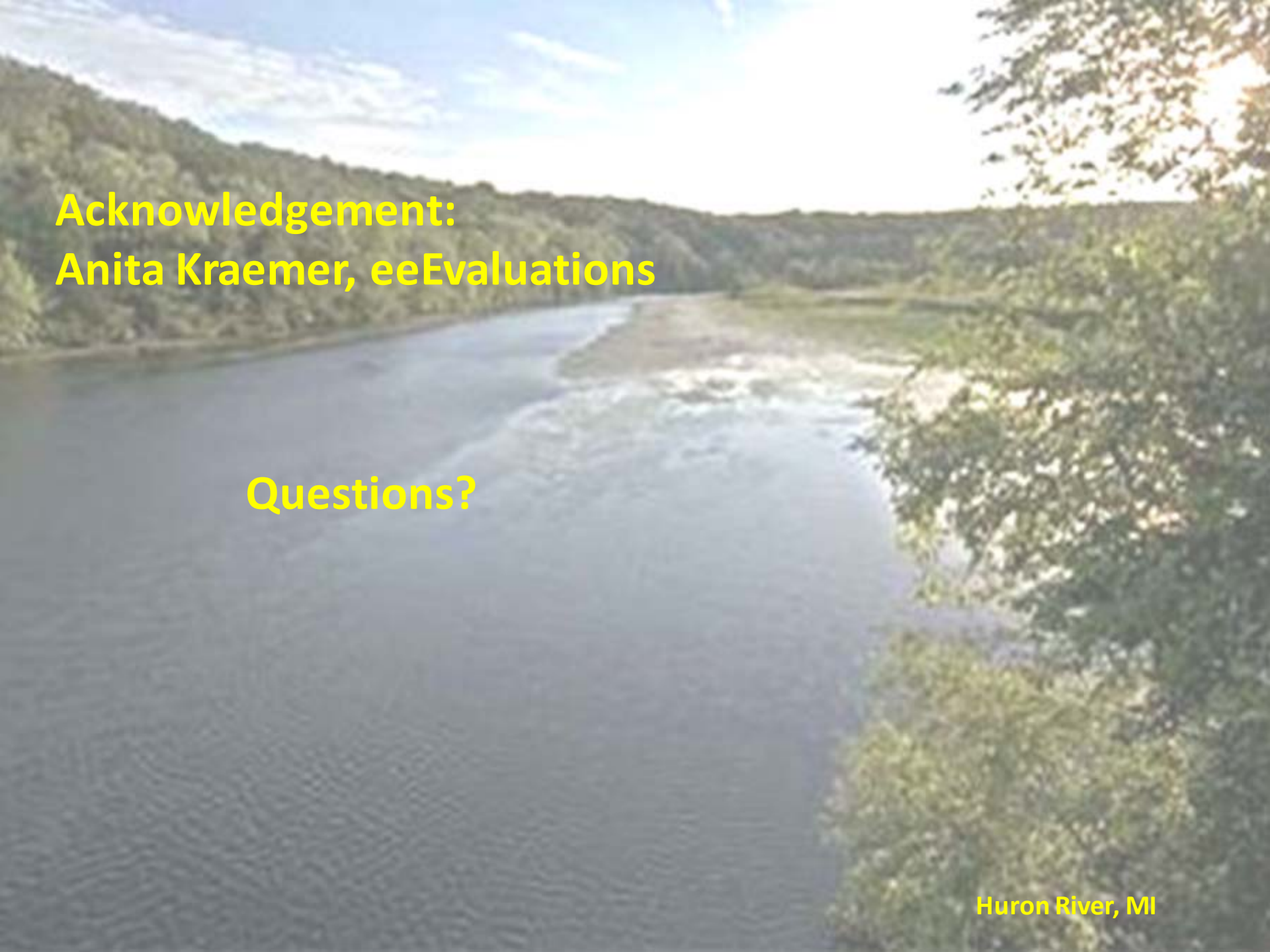


Master Gardeners at Rain Barrel and Composting Demonstration Event



# Summary

- ❖ **MWEE practices are mostly supported by past research/evaluations but can be strengthened further based on:**
  - **Environmental education and related research/evaluation findings, including as related to duration and behavior change strategies**
  - **Future insights from B-WET's evaluation system**

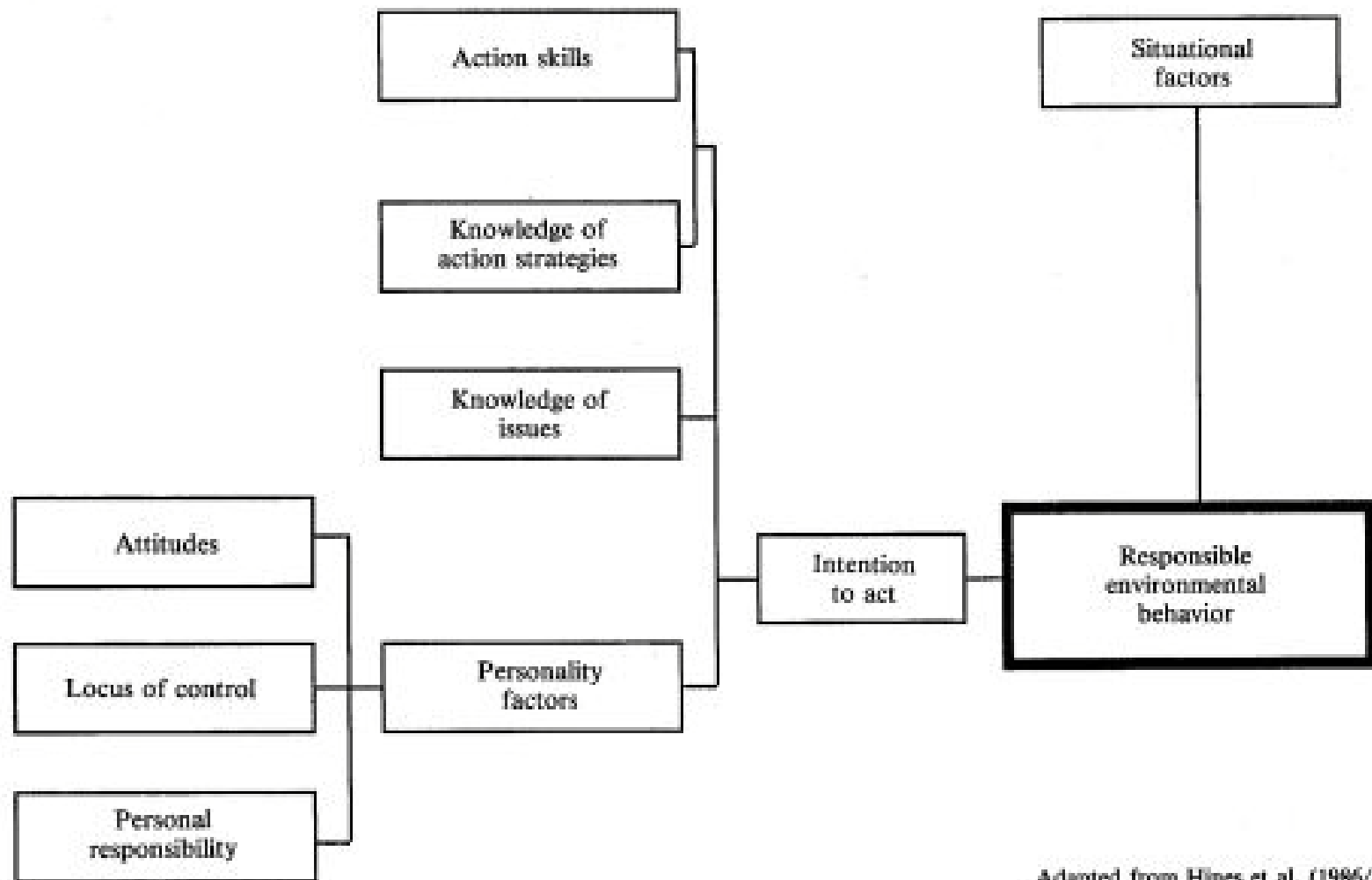


**Acknowledgement:  
Anita Kraemer, eeEvaluations**

**Questions?**

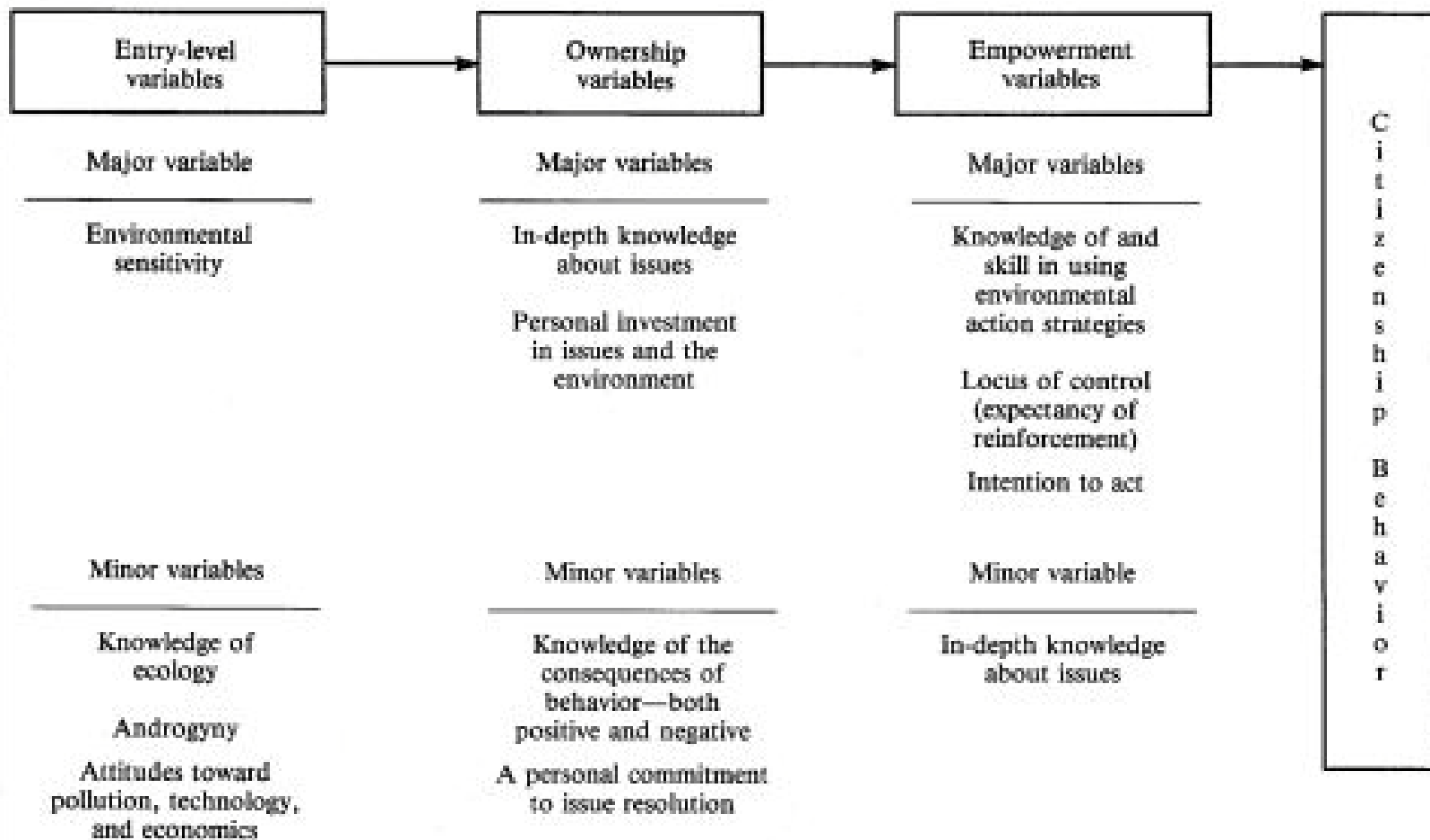
**Huron River, MI**

**FIGURE 2.—The Hines Model of Responsible Environmental Behavior**



Adapted from Hines et al. (1986/87).

**FIGURE 3.—Behavior Flow Chart: Major and Minor Variables Involved in Environmental Citizenship Behavior**



# Outdoor field work:

- ❖ External and personal factors also matter!
- ❖ External factors :
  - fear and concern about health and safety
  - teachers lack of confidence in teaching outdoors
  - school curriculum requirements
  - shortage of time, resources, and support
  - trends in education and other policies
- ❖ Personal factors:
  - age (i.e., younger students tend to be more enthusiastic than older students)
  - prior knowledge and experience
  - fears and phobias
  - learning styles and preferences (e.g., preference for teacher led vs. student led activities)
  - physical disabilities and special education needs
  - ethnic and cultural identity
  - the educational setting (i.e., there is a need to balance novelty and familiarity)

# Environmental Stewardship

## *Results*

Effect size scale: .3 small, .5 medium, .8 large

	<b>Significance</b>	<b>Effect Size</b>
Personal Responsibility		0.10
Environmental Sensitivity		0.16
Knowledge of Ecology		0.30
<b>Knowledge of Issues</b>	<b>p &lt; .001</b>	<b>0.60</b>
<b>Knowledge of Actions</b>	<b>p &lt; .001</b>	<b>0.47</b>
Internal Locus of Control		0.24
Group Locus of Control		0.09
<b>Intention to Act</b>	<b>p &lt; .05</b>	<b>0.33</b>

Analysis could detect .33 effect size or higher

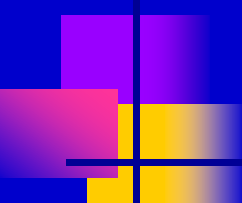
# Professional Development

## *Teacher Use of MWEEs*

<b>After the professional development...</b>	<b>Teachers who taught about watershed or Bay after PD n=345 %</b>
Students learned about local watershed or Bay ecology	89
Students learned outdoors about the local watershed or Bay	74
Students researched a watershed or Bay environmental issue	58
Students completed an action to address a local watershed or Bay environmental issue	49
Students did none of these	2

# Professional Development

## *Teacher Use of MWEEs*



<b>Type of action project</b>	<b>n=169</b> <b>%</b>
Restoration project (for example, growing/planting wetland plants or raising/releasing fish)	63
Communication or information-sharing (for example, making a presentation to the community)	46
Monitoring project (for example, conducting periodic water tests)	42
Pollution prevention project (for example, erosion control)	40

# Professional Development

## *Teacher Change*

n=60 teachers	Fall 2005 Extremely likely	Spring 2006 Did the practice
MWEE practice	number of teachers	%
Teach about watershed/Bay	43	93
Teach outdoors	38	79
Conduct issue research	33	55
Conduct action project	32	56

# Academic Achievement Methods

- Final sample:
  - 31 MWEE, 30 comparison classes in one school district for one MWEE program
  - De-identified data provided by school district
- Analysis:
  - Multi-level analysis of covariance (ANCOVA) using hierarchical linear modeling (HLM)

# Academic Achievement Results

- MWEE 3<sup>rd</sup> graders did better on 1 of 4 categories
- 55% of these students' teachers (n=11) and 70% of PD teachers (n=277) believed their students were better prepared for state assessments.