

# **FLOW**

**FISHERIES LEARNING ON THE WEB**



## **Assessment, Content Expectations and National Benchmarks**

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## About Lesson Assessment

The FLOW assessment charts are designed for teachers to create their own assessment. Recommended points show the relative difficulty of student performance. In creating assessments, the total point value will depend on the number and type of performances selected.\*

Assessments are provided for each lesson and include the following three components:

1. *Learning Objective*. Example: describe the difference between herbivores, carnivores, and producers.
2. *Student Performance*. Example: Define herbivore, carnivore and producer.
3. *Recommended Points*. Example: 1 point for each definition above (herbivore, carnivore and producer).

### Example Assessment: Unit 1 Lesson 5 - Ruffe Musical Chairs

16 points total (Picking a subset of questions from those given with the lesson)

1. (3 points) Identify three things that every living thing needs to live.
2. (4 points) Explain 2 things that might happen if an animal does not get its needs met.
3. (3 points) Explain why an animal may not be able to meet its needs sometimes.
4. (3 points) List three characteristics of Eurasian Ruffe, which give them an advantage in meeting their needs as compared to native species.
5. (3 points) Explain how humans can decrease Eurasian Ruffe (and other non-native species) from spreading more.

**Additional Ideas About Assessment:** Teachers may wish to incorporate electronic journals into the lesson assessment process. E-journals can be as simple as using word processing software. They allow students to communicate about their understanding of lesson content, and provide teachers with the capability of monitoring student development during the entire learning process. Educators have found that the following resources for assessment are helpful in creating assessment tools (rubrics):

- Rubistar, online rubric development, <http://rubistar.4teachers.org>
- Kathy Schrock's Guide for Educators, <http://school.discovery.com/schrockguide/assess.html>

\*The assessment components above are based on Bloom's Taxonomy, named after Benjamin Bloom, an educational psychologist. Bloom identified the following levels of learning or cognition and provided specific verb examples that represent learning activity:

- Knowledge: arrange, define, label, memorize, order, recognize, restate, and repeat.
- Comprehension: classify, discuss, express, identify, locate, review, and translate.
- Application: choose, demonstrate, illustrate, practice, sketch, solve, and write.
- Analysis: appraise, calculate, compare, contrast, differentiate, examine, question, and test.
- Synthesis: assemble, compose, create, develop, formulate, plan, propose, and write.
- Evaluation: appraise, argue, attach, choose, defend, predict, select, support, value.

## About the State of Michigan Content Expectations

Each FLOW lesson is aligned to relevant sections from the State of Michigan Grade Level Content Expectations (specifically K 4-7) and the High School Content Expectations (primarily earth science and biology). The Michigan Department of Education developed Grade Level Content Expectations in response to the federal No Child Left Behind Act (NCLB). NCLB mandated that the state provide a set of comprehensive grade level assessments in science, as well as mathematics, English and language arts. According to the Michigan Department of Education, the “Grade Level Content Expectations (GLCE) are based on rigorous grade level content and are designed “to provide greater clarity for what students are expected to know and be able to do by the end of each grade.”

### References:

- *Grade Level Content Expectations, K-7 Science*, version 12.07, Michigan Department of Education, see: [www.michigan.gov/mde](http://www.michigan.gov/mde)
- *Essential Science, High School Content Expectations*, version 11.06, Michigan Department of Education, see: [www.michigan.gov/mde](http://www.michigan.gov/mde)

## About the National Benchmarks/Standards

In addition to the State of Michigan Content Expectations, each FLOW lesson is aligned to relevant sections from the national benchmarks (primarily science and social studies).

### References:

- *National Science Education Standards*, National Academy of Sciences, 1996, National Academy Press, Washington, DC (ISBN 0-309-05326-9), see: <http://www.nap.edu>
- *Benchmarks for Science Literacy, Project 2061*, American Association for the Advancement of Science, 1993, Oxford University Press, Inc., New York, New York (ISBN 0-19-508986-3), see: <http://www.project2061.org>
- North American Association of Environmental Education, see: <http://www.naaee.org>
- *Expectations of Excellence, Curriculum Standards for Social Studies National Council for the Social Studies*, 2004, Bulletin 89, Silver Spring, Maryland (ISBN 0-87986-065-0)

### Key:

**NSES** = National Science Education Standards

**AAAS** = American Association for the Advancement of Science (Benchmarks)

**NAAEE** = North American Association of Environmental Education (Guidelines for Excellence)

**NCSS** = National Council for the Social Studies (Standards)

# FLOW Unit 1, Food Web

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 1, Lesson 1: Make the Connection

### FLOW Unit 1, Lesson 1: Assessment

Learning Objective	Student Performance	Recommended # Points
Describe the difference between herbivores, carnivores, and producers	<b>Define:</b> Herbivore, Carnivore, producer	1 each
	<b>Order:</b> Place herbivore, carnivore, and producer in correct order of 'who eats whom'	1 each
Answer questions about interdependence of herbivores, carnivores, producers as members of a food chain	<b>Categorize:</b> Given cards or pictures or other information about certain plants or animals, categorize each as a herbivore, carnivore or producer	2 each
Answer questions about how pollution affects food chains	<b>Name:</b> Different sources of pollution or other disturbance to aquatic food chains	1 each
	<b>Predict:</b> The effects of pollution or other disturbance on a particular aquatic food chain	3 each

## Unit 1, Lesson 1: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b> <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i> S.IP.04.16 – Construct simple charts and graphs from data and observations S.IP.05-07.15 – Construct charts from data</p> <p><b>Reflection and social implications (RS)</b> <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i> S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities S.RS.04.18 – Describe the effect humans have on the balance of the natural world S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities S.RS.05-07.17 - Describe the effect humans have on the balance in the natural world</p>		<p><b>Organization of living things (OL)</b></p> <p><b>L.OL.E.1 Life requirements</b> L.OL.04.15 – Determine that plants require air, water, light, a source of energy and building material for growth and repair L.OL.04.16 – Determine that animals require air, water, a source of energy and building material for growth and repair <i>L.OL.M.5 Producers, consumers and decomposers</i> L.OL.06.51 – Classify organisms (producers, consumers, decomposers) based on their source of energy for growth and development L.OL.06.52 – Distinguish between the ways in which consumers and decomposers obtain energy</p> <p><b>Ecosystems (EC)</b> <i>L.EC.E.1 Interactions</i> L.EC.04.11 – Identify organisms as part of a food chain or food web <i>L.EC.E.2 Changed environment effects</i> L.EC.04.21 – Explain how environmental changes can produce a change in the food web <i>L.EC.M.2 Relationships of organisms</i> L.EC.06.23 – Predict how changes in one population might affect other populations based upon their relationships in the food web <i>L.EC.M.4 Environmental impact of organisms</i> L.EC.06.41 – Describe how human activity can alter the balance in ecosystems L.EC.06.42 – Predict possible consequences of overpopulation</p>	<p><b>Earth systems (ES)</b> <i>E.ES.M.4 Human consequences</i> E.ES.07.41 – Explain how human activities change the surface of the Earth and affect the survival of organisms E.ES.07.42 – Describe the origins of pollution in the atmosphere, geosphere and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species</p>

## Unit 1, Lesson 1: State of Michigan – High School Content Expectations – Essential science

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
	<p><b>Standard B1: Inquiry, reflection and social implications</b></p> <p><b>B1.1 Scientific inquiry</b>                      B1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard B3: Interdependence of living systems and the environment</b></p> <p><i>B3.3 Element recombination</i>                      B3.3A – Use a food web to identify and distinguish producers, consumers and decomposers and explain the transfer of energy through trophic levels</p> <p><i>B3.4 Changes in ecosystems</i>                      B3.4C – Examine the negative impact of human activities</p>		

## Unit 1, Lesson 1: National Standards

NSES		AAAS			
Elementary	Middle	Elementary		Middle	
C1-1 C3-1 C3-4	C4-2 C4-3 C4-4	5A-1 5D-2 5D-4	5E-1 5E-3	5A-1 5A-5 5D-2	5E-1 5E-2
NAAEE		NCSS			
Elementary	Middle	Elementary		Middle	
1-F 2.2-C 2.2-D 2.4-A	1-F 2.2-C 2.2-D	2.4-A 3-B	III.h VIII.b IX.d	III.h IX.d	

# FLOW Unit 1, Food Web

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 1, Lesson 2: Who's Eating Whom?

### FLOW Unit 1, Lesson 2: Assessment

Learning Objective	Student Performance	Recommended # Points
Diagram a food web	<b>Sketch:</b> The relationships between various plants and animals in an aquatic food web.	1 for each element in web
Compare a food web to a food chain and list similarities and differences	<b>List:</b> Similarities between a food web and a food chain.	1 each
	<b>List:</b> Differences between a food web and a food chain.	1 each
	<b>Explain:</b> The relationship between food chains and webs using the similarities and differences between them.	4 each
Discuss predator–prey and consumer–producer relationships using vocabulary words	<b>Explain:</b> Predator-prey relationships generally.	2 each
	<b>Support:</b> The general predator-prey relationship with specific aquatic examples.	2 each
	<b>Explain:</b> Consumer-producer relationships generally.	2 each
	<b>Support:</b> The general consumer-producer relationship with specific aquatic examples.	2 each
Make predictions about roles each link plays in the overall food web	<b>Identify:</b> A particular plant or animal as a producer, consumer, predator or prey within a food web.	1 each
Understand how lower links in a food web affect the highest links	<b>Predict:</b> What happens if there is an abundance of species lower in the food web; and what happens if there is a shortage of species lower in the food web. Trace the effects over time.	3 each



## FLOW Unit 1, Lesson 2: State of Michigan – Grade Level Content Expectations grades 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup>

Discipline 1: Science processes	Discipline 2: Physical science	Discipline 3: Life science	Discipline 4: Earth science
<p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>            S.RS.04.11 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities            S.RS.04.18 – Describe the effect humans and other organisms have on the balance of the natural world            S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities            S.RS.05-07.17 - Describe the effect humans and other organisms have on the balance of the natural world</p>		<p><b>Evolution (EV)</b>  <i>L.EV.M.1 Species adaptation and survival</i>            L.EV.05.11 – Explain how behavioral characteristics of animals help them to survive in their environment            L.EV.05.12 – Describe the physical characteristics of organisms that help them survive in their environment</p> <p><b>Organization of living things (OL)</b>  <i>L.OL.E.1 Life requirements</i>            L.OL.04.15 – Determine that plants require air, water, light, a source of energy and building material for growth and repair            L.OL.04.16– Determine that animals require air, water, a source of energy and building material for growth and repair</p> <p><i>L.OL.M.5 Producers, consumers and decomposers</i>            L.OL.06.51 – Classify organisms (producers, consumers, decomposers) based on their source of energy for growth and development            L.OL.06.52 – Distinguish between the ways in which consumers and decomposers obtain energy</p> <p><b>Ecosystems (EC)</b>  <i>L.EC.E.1 Interactions</i>            L.EC.04.11 – Identify organisms as part of a food chain or food web  <i>L.EC.E.2 Changed environment effects</i>            L.EC.04.21 – Explain how environmental changes can produce a change in the food web</p> <p><b>L.EC.M.2 Relationships of organisms</b>            L.EC.06.21 – Describe common patterns of relationships between and among populations            L.EC.06.23 – Predict how changes in one population might affect other</p>	<p><b>Earth systems (ES)</b>  <i>E.ES.4 Human consequences</i>            E.ES.07.41 – Explain how human activities change the surface of the Earth and affect the survival of organisms            E.ES.07.42 – Describe the origins of pollution in the atmosphere, geosphere and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species</p>

		<p>populations based upon their relationships in the food web</p> <p><i>L.EC.M.4 Environmental impact of organisms</i></p> <p>L.EC.06.41 – Describe how human activity can alter the balance in ecosystems</p> <p>L.EC.06.42 – Predict possible consequences of overpopulation</p>	
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**FLOW Unit 1, Lesson 2: State of Michigan – High School Content Expectations  
Essential Science**

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
	<p><b>Standard B1: Inquiry, reflection and social implications</b></p> <p><b>B1.1 Scientific inquiry</b></p> <p>B1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard B3: Interdependence of living systems and the environment</b></p> <p><i>B3.3 Element recombination</i></p> <p>B3.3A – Use a food web to identify and distinguish producers, consumers and decomposers and explain the transfer of energy through trophic levels</p>		

## FLOW Unit 1, Lesson 2: National Standards

<b>NSES</b>		<b>AAAS</b>	
Elementary	Middle	Elementary	Middle
C1-1 C3-1 C3-3	C4-2 C4-3 C4-4	5A-1 5D-2 5D-4 5E-1 5E-3	5A-1 5A-5 5D-2 5E-1 5E-2
<b>NAAEE</b>		<b>NCSS</b>	
Elementary	Middle	Elementary	Middle
1-F 2.2-D 2.4-A	1-F 2.2-C 2.2-D	IX.d	IX.d

# FLOW Unit 1, Food Web

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Lesson 3: Great Lakes' Most Unwanted

### FLOW Unit 1, Lesson 3: Assessment

Learning Objective	Student Performance	Recommended # Points
Name and visually recognize the primary aquatic invasive species of the Great Lakes	<b>Identify:</b> Invasive species using pictures	1 each
Understand and analyze the negative impacts that invasive species have on the Great Lakes ecosystem	<b>Explain:</b> Negative consequences that each invasive species has on the Great Lakes	2 each
Explain the ways in which non-native species are introduced into the Great Lakes	<b>Name:</b> The method of introduction of each non-native species	1 each
Describe ways to avoid the spread of aquatic invasive species	<b>Explain:</b> Methods for controlling the spread of aquatic invasive species	3 each

**FLOW Unit 1, Lesson 3: State of Michigan – Grade Level Content Expectations  
grades 4<sup>th</sup>, 5<sup>th</sup> – 7<sup>th</sup>**

Discipline 1: Science processes	Discipline 2: Physical science	Discipline 3: Life science	Discipline 4: Earth science
<p><b>Inquiry analysis and communication (IA)</b>  <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i>                      S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups                      S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative scientific discourse</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>                      S.RS.04.18 – Describe the effect humans have on the balance of the natural world                      S.RS.05-07.17 - Describe the effect of humans and other organisms on the balance of the natural world</p>		<p><b>Evolution (EV)</b>  <i>L.EV.M.1 Species adaptation and survival</i>                      L.EV.05.11 – Explain how behavioral characteristics of animals help them to survive in their environment                      L.EV.05.12 – Describe the physical characteristics of organisms that help them survive in their environment</p> <p><b>Ecosystems (EC)</b>  <i>L.EC.M.2 Relationships of organisms</i>                      L.EC.06.23 – Predict how changes in one population might affect other populations based upon their relationships in the food web  <i>L.EC.M.4 Environmental impact of organisms</i>                      L.EC.06.41 – Describe how human activity can alter balance in ecosystems</p>	

**FLOW Unit 1, Lesson 3: State of Michigan – High School Content Expectations  
Essential Science**

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
	<p><b>Standard B3: Interdependence of living systems and the environment</b>  <i>B3.4 Changes in ecosystems</i>                      B3.4C – Examine the negative impact of human activities</p>		

## FLOW Unit 1, Lesson 3: National Standards

NSES					AAAS				
Elementary			Middle		Elementary			Middle	
C1-1	C3-2	F4-1	C3-1	F4-2	5D-1	5D-4	5A-2	5D-2	
C1-2	C3-3	F4-2	C3-3	F4-4	5D-2	5F-1	5A-5	5D-2	5F-2
C1-3	C3-4	F4-3	C4-2	F5-7	5D-3		5D-1		
C2-1	E1-2	F5-1	C4-4						

NAAEE				NCSS			
Elementary		Middle		Elementary		Middle	
2.2-A	3-B	2.2-A	3-B	I.b	VIII.b	I.b	IX.b
2.2-C	3-C	2.2-C	3-C	II.a	VIII.e	II.b	IX.c
2.3-D	3-D	2.3-D	3-D	II.b	IX.c	III.h	IX.d
2.4-A	3.2-B	2.4-A	3.2-B	III.h	IX.d	III.i	X.c
2.4-E		2.4-E		VIII.a	X.c		

# FLOW Unit 1, Food Web

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 1, Lesson 4: Beat the Barriers

### FLOW Unit 1, Lesson 4: Assessment

Learning Objective	Student Performance	Recommended # Points
Discuss the differences among the various types of technology used to control the lamprey population	<b>List:</b> Similarities between various types of lamprey control methods	1 each
	<b>List:</b> Differences between various types of lamprey control methods	1 each
	<b>Explain:</b> the 'best' lamprey control method using the similarities and differences between them all the methods.	3 each
Locate the lamprey-associated, spawning ground "hot spots" in the Great Lakes	<b>Name:</b> The spawning ground areas, using a map of the Great Lakes	1 each
Describe parasite/host relationships	<b>Name:</b> The benefits that a parasite gets from its host	1 each
	<b>Name:</b> The problems that a host has when it has a parasite	1 each
Identify the placement of the Great Lakes and describe how the lakes are connected	<b>Name:</b> The Great Lakes using an unlabelled map	1 each
	<b>Name:</b> The waterways connecting the Great Lakes using an unlabelled map	1 each

## FLOW Unit 1, Lesson 4: State of Michigan – Grade Level Content Expectations grades 4<sup>th</sup>, 5<sup>th</sup> – 7<sup>th</sup>

Discipline 1: Science processes	Discipline 2: Physical science	Discipline 3: Life science	Discipline 4: Earth science
<p><b>Inquiry analysis and communication (IA)</b>  <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i>            S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups            S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative scientific discourse</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>            S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities            S.RS.04.18 – Describe the effect humans have on the balance of the natural world            S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities            S.RS.05-07.17 - Describe the effect humans and other organisms have on the balance of the natural world</p>		<p><b>Evolution (EV)</b>  <i>L.EV.M.1 Species adaptation and survival</i>            L.EV.05.11 – Explain how behavioral characteristics of animals help them to survive in their environment            L.EV.05.12 – Describe the physical characteristics of organisms that help them survive in their environment</p> <p><b>Ecosystems (EC)</b>  <i>L.EC.E.1 Interactions</i>            L.EC.04.11 – Identify organisms as part of a food chain or food web  <i>L.EC.M.2 Relationships of organisms</i>            L.EC.06.21 – Describe common patterns of relationships between and among populations            L.EC.06.23 – Predict how changes in one population might affect other populations based upon their relationships in the food web  <i>L.EC.M.4 Environmental impact of organisms</i>            L.EC.06.41 – Describe how human activity can alter the balance in ecosystems            L.EC.06.42 - Predict possible consequences of overpopulation</p>	<p><b>Earth systems (ES)</b>  <i>E.ES.M.4 Human consequences</i>            E.ES.07.41- Explain how human activities change the surface of the Earth and affect the survival of organisms</p>



## Unit 1, Lesson 4: State of Michigan – High School Content Expectations – Essential Science

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
	<p><b>Standard B1: Inquiry, reflection and social implications</b></p> <p><b>B1.1 Scientific inquiry</b></p> <p style="padding-left: 20px;">B1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard B3: Interdependence of living systems and the environment</b></p> <p style="padding-left: 20px;"><i>B3.4 Changes in ecosystems</i></p> <p style="padding-left: 20px;">B3.4C – Examine the negative impact of human activities</p>		

### FLOW Unit 1, Lesson 4: National Standards

NSES		AAAS	
Elementary	Middle	Elementary	Middle
C2-1 C3-4 E1-2 E2-1 F4-2 F5-1	C3-1 E1-1 E1-4 E1-5 E1-6 F4-2 F5-7	5D-4	5D-1

NAAEE		NCSS	
Elementary	Middle	Elementary	Middle
1-F 2.2-A 2.2-C 2.4-A 2.4-B 2.4-D	1-F 2.2-A 2.2-C 2.3-D 2.4-A 2.4-B	II.f III.b III.h III.i V.f VIII.b	II.f III.b III.h III.i V.f VI.c

2.4-E 3-B 3-C	2.4-E 3-A 3-B 3-C	VIII.e IX.d	VIII.b VIII.e IX.d
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# FLOW Unit 1, Food Web

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 1, Lesson 5: Ruffe Musical Chairs

### FLOW Unit 1, Lesson 5: Assessment

Learning Objective	Student Performance	Recommended # Points
Explain why fish populations in the Great Lakes change over time.	<b>Identify:</b> Three things that every living thing needs to live	1 each
	<b>Explain:</b> What happens if an animal gets its needs met	2 each
	<b>Explain:</b> What happens if an animal does not get its needs met	2 each
	<b>Explain:</b> Why an animal may/may not be able to meet its needs at different times	3 each
List three reasons why non-native ruffe have significant advantages over some native Great Lakes fishes.	<b>List:</b> Three characteristics of Ruffe that give them an advantage in meeting their needs as compared to native species	1 each
Identify two things that they can do to minimize the spread of ruffe	Explain how humans can help decrease the spread of Ruffe (and other non-native species)	3 each

**FLOW Unit 1, Lesson 5: State of Michigan – Grade Level Content Expectations  
grades 4<sup>th</sup>, 5<sup>th</sup> – 7<sup>th</sup>**

<b>Discipline 1: Science processes</b>	<b>Discipline 2: Physical science</b>	<b>Discipline 3: Life science</b>	<b>Discipline 4: Earth science</b>
<p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>            S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities            S.RS.04.18 – Describe the effect humans have on the balance of the natural world            S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities            S.RS.05-07.17 - Describe the effect humans have on the balance of the natural world</p>		<p><b>Organization of living things (OL)</b>  <i>L.OL.E.1 Life requirements</i>            L.OL.04.16 – Determine that animals require air, water and a source of energy and building material for growth and repair</p> <p><b>Evolution (EV)</b></p> <p><b>L.EV.M.1 Species adaptation and survival</b>            L.EV.05.11 – Explain behavioral characteristics of animals help them to survive in their environment            L.EV.05.12 – Describe the physical characteristics of organisms that help them survive in their environment</p> <p><b>Ecosystems (EC)</b>  <i>L.EC.E.1 Interactions</i>            L.EC.04.11 – Identify organisms as part of a food chain  <i>L.EC.M.2 Relationships of organisms</i>            L.EC.06.23 – Predict how changes in one population might affect other populations based upon their relationships in the food web  <i>L.EC.M.4 Environmental impact of organisms</i>            L.EC.06.41 – Describe how human activity can alter the balance in ecosystems            L.EC.06.42 - Predict possible consequences of overpopulation</p>	

## FLOW Unit 1, Lesson 5: State of Michigan – Grade Level Content Expectations High school – 8<sup>th</sup> grade

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
	<b>Standard 3: Interdependence of living systems and the environment.</b>  <b>B3.4 Changes in ecosystems</b>  B3.4C – Examine the negative impact of human activities		

## FLOW Unit 1, Lesson 5: National Standards

<b>NSES</b>				<b>AAAS</b>			
Elementary		Middle		Elementary		Middle	
C2-1 C3-2 C3-3 F4-1		C4-1		5D-1 5F-1		5A-2 5D-1 5D-2 5F-2	
<b>NAAEE</b>				<b>NCSS</b>			
Elementary		Middle		Elementary		Middle	
1-F 2.2-A 2.2-C	2.3-D 2.4-A 2.4-E	1-F 2.2-A 2.2-C	2.3-D 2.4-A 2.4-E	III.h VIII.b VIII.d	IX.c IX.d X.i	II.b III.h VIII.d	VIII.e IX.c IX.d

# FLOW Unit 2, Water

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 2, Lesson 1: Exploring Watersheds

### FLOW Unit 2, Lesson 1: Assessment

Learning Objective	Student Performance	Recommended # Points
Explain how water flows through a watershed	<b>List:</b> The ways that water might enter a watershed	1 each
	<b>Demonstrate:</b> (Using a model) the direction water flows on an incline or slope	2 each
	<b>Indicate:</b> (Using a model) the final destination of water in a watershed	1 each
	<b>Describe:</b> How high elevation, low elevation and slope are related	1 each
	<b>Define:</b> Run-off	1 each
Describe the characteristics of a watershed	<b>Explain:</b> What the boundaries of a watershed are (can use a model)	2 each
	<b>Demonstrate:</b> (Using a model) the relationship between the land area which defines a watershed and the river system that lies within it	3 each

**FLOW Unit 2, Lesson 1: State of Michigan – Grade Level Content Expectations**  
**4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades**

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b>  <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i>            S.IP.04.13 – Plan and conduct simple and fair investigations            S.IP.05-07.12 – Design and conduct scientific investigations</p> <p><b>Inquiry analysis and communication (IA)</b>  <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i>            S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups            S.IA.04.13 – Communicate and present findings of observations and investigations            S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse            S.IA.05-07.13 – Communicate and defend findings of observations and investigations using evidence</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>            S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities            S.RS.04.15 – Use evidence when communicating scientific ideas            S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities</p>	<p><b>Energy (EN)</b>  <i>P.FM.M.1 Kinetic and potential energy</i>            P.EN.06.11 – Identify kinetic or potential energy in everyday situations</p>		<p><b>Earth systems (ES)</b>  <i>E.ES.M.8 Water cycle</i>            E.ES.07.82 – Analyze the flow of water between components of a watershed, including surface features and groundwater</p>

## FLOW Unit 2, Lesson 1: State of Michigan – High School Content Expectations Essential Science

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
<p><b>Standard E1: Inquiry, reflection and social implications</b> <i>E1.2 Scientific reflection and social implications</i> E1.2D – Evaluate scientific explanations in a peer review process or discussion format</p> <p><b>Standard E4: The fluid Earth</b> <i>E4.1 Hydrogeology</i> E4.1A – Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth’s freshwater reservoirs and the dynamics of water movement</p>		<p><b>Standard P1: Inquiry, reflection and social implications</b> <i>P1.2 Scientific reflection and social implications</i> P1.2D – Evaluate scientific explanations in a peer review process or discussion format</p> <p><b>Standard P3: Forces and motion</b> <i>P3.4 Forces and acceleration</i> P3.4A Predict the change in motion of an object acted on by several forces</p>	

## FLOW Unit 2, Lesson 1: National Standards

NSES		AAAS	
Elementary	Middle	Elementary	Middle
n/a	D1-6	11B-1 11B-2	4B-7 11B-1
NAAEE		NCSS	
Elementary	Middle	Elementary	Middle
1.F 2.1-A	1-F 2.4-B	III.b III.e	III.b III.e



# FLOW Unit 2, Water

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 2, Lesson 2: Wetland in a Pan

### FLOW Unit 2, Lesson 2: Assessment

Learning Objective	Student Performance	Recommended # Points
Build a model wetland	<b>Identify:</b> The parts of the model that correspond to parts of a wetland (e.g. carpet=wetland, etc.)	1 each
	<b>Describe:</b> What happens to the 'rainwater' in the model with and without the 'wetland' in place	2 each
Understand that wetlands are defined by plants, soil, and water	<b>Name:</b> The three important aspects of a wetland	1 each
Identify some wetland types and their locations	<b>Describe:</b> Different types of wetlands and where they are generally found	1 or 2 each
Relate importance of wetland function to people's needs and daily lives	<b>Explain:</b> The various benefits or functions of a wetland for the whole ecosystem (including humans)	2 each
	<b>Predict:</b> What might happen if a lot of the wetlands disappear (e.g. by being developed, or via pollution)	3 each

## FLOW Unit 2, Lesson 2: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b> <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i> S.IP.04.13 – Plan and conduct simple and fair investigations S.IP.05-07.11 – Generate scientific questions based on observations, investigations and research S.IP.05-07.12 – Design and conduct scientific investigations</p> <p><b>Inquiry analysis and communication (IA)</b> <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i> S.IA.04.13 – Communicate and present findings of observations and investigations S.IA.04.15 – Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments or data S.IA.05-07.13 – Communicate and defend findings of observations and investigations using evidence S.IA.05-07.14 – Draw conclusions from sets of data from multiple trials of a scientific investigations</p> <p><b>Reflection and social implications (RS)</b> <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i> S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities S.RS.04.15 – Use evidence when communicating scientific ideas</p>		<p><b>Organization of life science (OL)</b> <i>L.OL.E.1 Life requirements</i> L.OL.04.15 – Determine that plants require air, water, light and a source of energy and building material for growth and repair L.OL.04.16 – Determine that animals require air, water and a source of energy and building material for growth and repair</p> <p><b>Ecosystems (EC)</b> <i>L.EC.E.2 Changed environmental effects</i> L.EC.04.21 – Explain how environmental changes can produce a change in the food web <i>L.EC.M.4 Environmental impact of organisms</i> L.EC.06.41 – Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance of ecosystems</p>	<p><b>Earth systems (ES)</b> <i>E.ES.M.4 Human consequences</i> E.ES.07.41 Explain how human activities change the surface of the Earth and affect the survival of organisms <i>E.ES.M.8 Water cycle</i> E.ES.07.82 – Analyze the flow of water between the components of a watershed, including surface features and groundwater</p>

<p>S.RS.04.18 – Describe the effect humans and other organisms have on the balance of the natural world</p> <p>S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities</p> <p>S.RS.05-07-17 – Describe the effect humans and other organisms have on the balance in the natural world</p>			
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<b>FLOW Unit 2, Lesson 2: State of Michigan – High School Content Expectations – Essential Science</b>			
<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
<p><b>Standard E1: Inquiry, reflection and social implications</b></p> <p><i>E1.1 Scientific inquiry</i></p> <p>E1.1C – Conduct scientific investigations using appropriate tools and techniques</p> <p>E1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard E4: The fluid Earth</b></p> <p><i>E4.1 Hydrogeology</i></p> <p>E4.1A – Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth’s freshwater reservoirs and the dynamics of water movement</p> <p>E4.1C – Explain how water quality in both groundwater and surface systems is impacted by land use decisions</p>	<p><b>Standard B1: Inquiry, reflection and social implications</b></p> <p><i>B1.1 Scientific inquiry</i></p> <p>B1.1C – Conduct scientific investigations using appropriate tools and techniques</p> <p>B1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard B3: Interdependence of living systems and the environment</b></p> <p><i>B3.4 Changes in ecosystems</i></p> <p>B3.4C – Examine the negative impact of human activities</p>		

## FLOW Unit 2, Lesson 2: National Benchmarks

<b>NSES</b>		<b>AAAS</b>	
Elementary	Middle	Elementary	Middle
n/a	D1-6	11B-1 11B-2	4B-7 11B-1
<b>NAAEE</b>		<b>NCSS</b>	
Elementary	Middle	Elementary	Middle
1.F 2.1-A	1-F 2.4-B	III.b III.e	III.b III.e

# FLOW Unit 2, Water

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 2, Lesson 3: Water Quantity

### FLOW Unit 2, Lesson 3: Assessment

Learning Objective	Student Performance	Recommended # Points
Experience the relative scarcity of freshwater on the planet	<b>Compare:</b> The amount of available freshwater to the total amount of water on the planet	1 each
Explain why some of the earth's water is not easily accessible	<b>List:</b> The places or types of water that are not readily useable by us	1 each
Understand that as the human population increases, the amount of freshwater per person decreases	<b>Explain:</b> That the amount of freshwater on the planet is basically constant	1 each
	<b>Explain:</b> That since the amount of freshwater stays the same, as the human population increases there is less freshwater per person.	3 each

### FLOW Unit 2, Lesson 3: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<b>Inquiry process (IP)</b> <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i> S.IP.04.13 – Plan and conduct simple and fair investigations S.IP.04.14 – Manipulate simple tools that aid observation and data collection S.IP.04.15 – Make accurate measurements with appropriate		<b>Organization of life science (OL)</b> <i>L.OL.E.1 Life requirements</i> L.OL.04.16 – Determine that animals require air, water and a	<b>Earth systems (ES)</b> <i>E.ES.M.4 Human consequences</i> E.ES.07.41 Explain how human activities change the surface of the Earth and

<p>units for the measurement tool  S.IP.05-07.12 – Design and conduct scientific investigations  S.IP.05-07.13 – Use tools and equipment appropriate to scientific investigations</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>  S.RS.04.11 – Demonstrate concepts using illustrations, performances, models, exhibits and activities  S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities</p>		<p>source of energy and building material for growth and repair</p> <p><b>Ecosystems (EC)</b>  <i>L.EC.M.4 Environmental impact of organisms</i>  L.EC.06.42 – Predict possible consequences of overpopulation of organisms, including humans</p>	<p>affect the survival of organisms</p>
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<b>FLOW Unit 2, Lesson 3: State of Michigan – High School Content Expectations  Essential Science</b>				
<b>Discipline:  Earth science</b>	<b>Discipline:  Biology</b>	<b>Discipline:  Physics</b>	<b>Discipline:  Chemistry</b>	
<p><b>Standard E1: Inquiry, reflection and social implications</b>  <i>E1.1 Scientific inquiry</i>  E1.1C – Conduct scientific investigations using appropriate tools and techniques  E1.1E – Describe a reason for a given conclusion using evidence from an investigation</p> <p><b>Standard E2: Earth systems</b>  <i>E2.1 Earth systems overview</i>  E2.1A – Explain why the Earth is essentially a closed system in terms of matter</p> <p><b>Standard E4: The fluid Earth</b>  <i>E4.1 Hydrogeology</i>  E4.1A – Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth’s freshwater reservoirs and the dynamics of water movement  E4.1C – Explain how water quality in both groundwater and surface systems is impacted by land use decisions</p>				

## FLOW Unit 2, Lesson 3: National Benchmarks

<b>NSES</b>			<b>AAAS</b>	
Elementary		Middle	Elementary	Middle
1-1 C1-1 C3-4 F2-1	F2-2 F3-1 F3-3 F4-2	C4-4 F1-7 F2-1	n/a	4B-8 4B-11 5D-1
<b>NAAEE</b>			<b>NCSS</b>	
Elementary		Middle	Elementary	Middle
2.3-D 2.4-A 2.4-E 3-B		2.3-D 2.4-A 2.4-E	IX.d	IX.d

# FLOW Unit 2, Water

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 2, Lesson 4: What Makes Water Healthy?

FLOW Unit 2, Lesson 4: Assessment		
Learning Objective	Student Performance	Recommended # Points
Develop their own criteria for the quality of water	<b>List:</b> Characteristics of water that they consider to be important for its health	1 each
	<b>Defend:</b> Their list above	2 each
Understand that there is more to water quality than 'meets the eye'	<b>Explain:</b> Why you can't tell the quality of water just by looking	2 each
Engage in some of the water quality tests used by scientists	<b>List:</b> Some of the tests that scientists do to test for water quality	1 each
	<b>Explain:</b> Why each test above is an important aspect of water quality	2 each
	<b>Interpret:</b> The results of various water quality tests – what does each one say about the quality of a water sample?	3 each



## Unit 2, Lesson 4: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b> <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations, developing solutions</i></p> <ul style="list-style-type: none"> <li>S.IP.04.13 – Plan and conduct simple and fair investigations</li> <li>S.IP.04.14 – Manipulate simple tools that aid observation and data collection</li> <li>S.IP.04.15 – Make accurate measurements with appropriate units for the measurement tool</li> <li>S.IP.05-07.12 – Design and conduct scientific investigations</li> <li>S.IP.05-07.13 – Use tools and equipment appropriate to scientific investigations</li> </ul> <p><b>Inquiry analysis and communication (IA)</b> <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i></p> <ul style="list-style-type: none"> <li>S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups</li> <li>S.IA.04.13 – Communicate and present findings of observations and investigations</li> <li>S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse</li> <li>S.IA.05-07.13 – Communicate and defend findings of observations and investigations using evidence</li> </ul> <p><b>Reflection and social implications (RS)</b> <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i></p> <ul style="list-style-type: none"> <li>S.RS.04.14 – Use data/samples as evidence to separate fact from opinion</li> <li>S.RS.04.15 – Use evidence when communicating scientific ideas</li> <li>S.RS.04.18 – Describe the effect humans and other organisms have on the balance of the natural world</li> <li>S.RS.05-07.13 – Identify the need for evidence in making scientific decisions</li> <li>S.RS.05-07.17 – Describe the effect humans and other organisms have on the balance in the natural world</li> </ul>	<p><b>Properties of matter (PM)</b> <i>P.PM.M.1 Chemical properties</i></p> <p>P.PM.07.11 – Classify substances by their chemical properties</p>	<p><b>Organization of life science (OL)</b> <i>L.OL.E.1 Life requirements</i></p> <p>L.OL.04.15 – Determine that plants require air, water, light and a source of energy and building material for growth and repair</p> <p>L.OL.04.16 – Determine that animals require air, water and a source of energy and building material for growth and repair</p>	<p><b>Earth systems (ES)</b> <i>E.ES.M.4 Human consequences</i></p> <p>E.ES.07.41 Explain how human activities change the surface of the Earth and affect the survival of organisms</p>

## FLOW Unit 2, Lesson 4: State of Michigan – High School Content Expectations Essential Science

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
<p><b>Standard E1: Inquiry, reflection and social implications</b>  <i>E1.1 Scientific inquiry</i>                      E1.1C – Conduct scientific investigations using appropriate tools and techniques                      E1.1E – Describe a reason for a given conclusion using evidence form an investigation</p> <p><b>Standard E4: The fluid Earth</b>  <i>E4.1 Hydrogeology</i>                      E4.1C – Explain how water quality in both groundwater and surface systems is impacted by land use decisions</p>			<p><b>Standard C1: Inquiry, reflection and social implications</b>  <i>C1.1 Scientific inquiry</i>                      C1.1C – Conduct scientific investigations using appropriate tools and techniques                      C1.1E – Describe a reason for a given conclusion using evidence form an investigation</p> <p><b>Standard C5: Changes in matter</b>  <i>C5.7 Acids and bases</i>                      C5.7D Classify various solutions as acidic or basic, given their pH</p>

## FLOW Unit 2, Lesson 4: National Benchmarks

NSES		AAAS			
Elementary	Middle	Elementary		Middle	
A1-1 C3-4 F1-4 F4-1	F1-7 F3-2 F4-2	11C-1		4B-8	
NAAEE		NCSS			
Elementary	Middle	Elementary		Middle	
1-A 1-E	1-A 1-E	III.h III.j	VIII.b IX.d	III.j III.k	VIII.b IX.d

2.4-A	2.4-A	III.k			
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## FLOW Unit 2, Water

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

### Unit 2, Lesson 5: Hydropoly: A Decision-Making Game

#### FLOW Unit 2, Lesson 5: Assessment

Learning Objective	Student Performance	Recommended # Points
Discuss land-use practices that affect Great Lakes wetlands	<b>List:</b> Various land-uses which occur at or near wetlands that reduces their health or existence	1 each
	<b>List:</b> Various land-uses which occur at a distance to the wetlands that reduces their health or existence	1 each
	<b>Explain:</b> How each of the above directly or indirectly affects wetlands	2 each
Make decisions and recognize personal priorities with regard to wetlands	<b>Argue or defend:</b> A personal position given a controversy over a wetland (can use news articles or create a story)	5-10 (depending on essay requirements and length, as well as grade level)
Describe some of the economic factors that often drive land use	<b>List:</b> Some ways that natural areas are altered by humans	1 each
	<b>Explain:</b> Each of the above in terms of the reasons people give for doing so	2 each

## FLOW Unit 2, Lesson 5: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry analysis and communication (IA)</b>  <i>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</i>            S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups            S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>            S.RS.04.18 – Describe the effect humans and other organisms have on the balance of the natural world            S.RS.05-07.11 – Evaluate the strengths and weaknesses of claims, arguments and data            S.RS.05-07-17 – Describe the effect humans and other organisms have on the balance in the natural world</p>		<p><b>Ecosystems (EC)</b>  <i>L.EC.M.1 Interactions of organisms</i>            L.EC.06.11 – List examples of populations, communities and ecosystems including the Great Lakes region  <i>L.EC.M.4 Environmental impact of organisms</i>            L.EC.06.41 – Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems</p>	<p><b>Earth systems (ES)</b>  <i>E.ES.M.4 Human consequences</i>            E.ES.07.41 - Explain how human activities change the surface of the Earth and affect the survival of organisms  <i>E.ES.M.8 Water cycle</i>            E.ES.07.82 – Analyze the flow of water between the components of a watershed, including surface features and groundwater</p>

## FLOW Unit 2, Lesson 5: State of Michigan – High School Content Expectations Essential Science

Discipline: Earth science	Discipline: Biology	Discipline: Physics	Discipline: Chemistry
<p><b>Standard E1: Inquiry, reflection and social implications</b> <i>E1.2 Scientific reflection and social implications</i> E1.2B – Identify and critique arguments about personal or societal issues based on scientific evidence</p> <p><b>Standard E4: The fluid Earth</b> <i>E4.1 Hydrogeology</i> E4.1C – Explain how water quality in both groundwater and surface systems is impacted by land use decisions</p>	<p><b>Standard B1: Inquiry, reflection and social implications</b> <i>B1.2 Scientific reflection and social implications</i> B1.2B – Identify and critique arguments about personal or societal issues based on scientific evidence</p> <p><b>Standard B3: Interdependence of living systems and environment</b> <i>B3.4 Changes in ecosystems</i> B3.4C – Examine the negative impact of human activities</p>		

## FLOW Unit 2, Lesson 5: National Benchmarks

NSES						AAAS																																												
Elementary			Middle			Elementary			Middle																																									
C1-1	F3-3	C4-4	F3-2	5D-1	4B-8	C3-2	F4-1	E1-5	F4-4	5D-4	4C-7	C3-4	F4-2	F2-1	11C-2	5D-1	11A-2	E1-2	F4-3																															
NAAEE						NCSS																																												
Elementary			Middle			Elementary			Middle																																									
2.2-C	2.4-A	3-B	2.2-C	2.4-A	3-C	II.f	V.g	IX.d	II.f	V.g	VIII.b	2.3-A	2.4-C	3.2-D	2.3-A	2.4-C	3.2-A	III.h	VI.c	IX.e	III.g	VI.a	VIII.e	2.3-D	2.4-E	4-D	2.3-C	2.4-E	4-D	III.i	VII.j	X.j	III.h	VI.c	IX.d	2.3-E			2.3-D	3-B		III.k	VIII.d		III.i	VII.f		III.k	VII.j	X.c

# FLOW Unit 3, Fish

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 3, Lesson 1: Fins, Tails and Scales: Identifying Great Lakes Fish

FLOW Unit 3, Lesson 1: Assessment		
Learning Objective	Student Performance	Recommended # Points
Observe important distinguishing characteristics of Great Lakes fish.	<b>Explain</b> what “distinguishing characteristic” means	2 each
	<b>Name</b> possible body parts that could be used to distinguish fish from one another	1 each
Describe how these characteristics help fish survive in their environment.	<b>Describe</b> how certain fish body parts help them survive.	2 each
Organize the collection of Great Lakes fish cards based on similarities and differences	<b>Differentiate</b> between two or more example fish based on a certain characteristic.	1 each

FLOW Unit 3, Lesson 1: State of Michigan – Grade Level Content Expectations 4 <sup>th</sup> , 5 <sup>th</sup> - 7 <sup>th</sup> grades			
Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<b>Inquiry analysis and communication (IA)</b> S.IA.E&M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations <i>S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups</i> <i>S.IA.04.13 – Communicate and present findings of observations and investigations</i> S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse S.IA.05-		<b>Evolution (EV)</b> <i>L.EV.E.2 Survival</i> L.EV.04.21 – Identify individual differences in organisms of the same kind <i>L.EV.M.1 Species adaptation and survival</i> L.EV.05.11 – Explain how behavioral characteristics of animals help them to survive in their environment L.EV.05.12 – Describe the physical	

<p>07.13 – Communicate and defend findings of observations and investigations using evidence</p> <p><b>Reflection and social implications (RS)</b></p> <p>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</p> <p>S.RS.04.15 – Use evidence when communicating scientific ideas</p>		<p>characteristic of organisms that help them survive in their environment</p>	
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<b>FLOW Unit 3, Lesson 1: State of Michigan – High School Content Expectations Essential Science</b>				
<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>		<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
	<b>Standard B1: Inquiry, reflection and social implications</b> <i>B1.1 Scientific inquiry</i> B1.1E – Describe a reason for a given conclusion using evidence from an investigation			

<b>FLOW Unit 3, Lesson 1: National Benchmarks</b>			
<b>NSES</b>		<b>AAAS</b>	
Elementary	Middle	Elementary	Middle
A1.2 C1.2 C1.3	C1.1 C3.4 C4.2	5A.1 5A.2	5A.2 5A.3 5A.5
<b>NAAEE</b>		<b>NCSS</b>	
Elementary	Middle	Elementary	Middle
1-C 1-E 2.2-A	1-C 1-E 2.2-A	n/a	n/a

# FLOW Unit 3, Fish

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 3, Lesson 2: Fish Habitat

### FLOW Unit 3, Lesson 2: Assessment

Learning Objective	Student Performance	Recommended # Points
Name basic requirements for fish survival	<b>Name</b> basic requirements for fish survival	1 each
	<b>Describe</b> the preferred habitat characteristics of a Great Lakes fish	1 each
	<b>Compare</b> and <b>contrast</b> the habitat requirements for two Great Lakes fish	2 each
Identify some of the variables that <b>compromise</b> Great Lakes fish habitats	<b>Explain</b> how some fish habitat characteristics have been altered over time	2 each
Record observations of a nearby aquatic area using illustrations, photographs and narratives	<b>Complete</b> tasks associated with role within the group (i.e., notes, illustrations, narrative)	3 per task
Use observations to predict which Great Lakes fish might favor that particular habitat	<b>Predict</b> a Great Lakes fish that might live in the observation area	1 each

### FLOW Unit 3, Lesson 2: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<b>Inquiry process (IP)</b> <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i> S.IP.04.11 – Make purposeful observation of the natural world using the appropriate senses S.IP.04.14 – Manipulate simple tools that aid observation and data collection		<b>Organization of living things (OL)</b> <i>L.OL.E.1 Life requirements</i> L.OL.04.16 – Determine that animals require air, water, a source of energy and building material for growth and repair <b>Ecosystems (EC)</b>	<b>Earth systems (ES)</b> <i>E.ES.M.4 Human consequences</i> E.ES.07.41 – Explain how human activities change the surface of the Earth and affect the survival of organisms



<p>S.IP.04.15 – Make accurate measurements with appropriate units for the measurement tool</p> <p>S.IP.05-07.11 – Generate scientific questions based on observations, investigations and research</p> <p>S.IP.05-07.13 – Use tools and equipment appropriate to scientific investigations</p> <p><b>Inquiry analysis and communication (IA)</b></p> <p>S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations</p> <p>S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative groups</p> <p>S.IA.04.13 – Communicate and present findings of observations and investigations</p> <p>S.IA.04.14 – Develop research strategies and skills for information gathering and problem solving</p> <p>S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse</p> <p>S.IA.05-07.13 – Communicate and defend findings of observations and investigations using evidence</p> <p><b>Reflection and social implications (RS)</b></p> <p><i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i></p> <p>S.RS.04.15 – Use evidence when communicating scientific ideas</p> <p>S.RS.04.18 – Describe the effect humans and other organisms have on the balance of the natural world</p> <p><i>S.RS.05-07.17 – Describe the effect humans and other organisms have on the balance in the natural world</i></p>		<p><i>L.EC.E.2 Changed environmental effects</i></p> <p>L.EC.04.21 – Explain how environmental changes can produce a change in the food web</p> <p><i>L.EC.M.3 Biotic and abiotic factors</i></p> <p>L.EC.06.31 – Identify the living (biotic) and nonliving (abiotic) components of an ecosystem</p> <p>L.EC.06.41 – Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems</p> <p><b>Evolution (EV)</b></p> <p><i>L.EV.M.1 Species adaptation and survival</i></p> <p>L.EV.05.12 – Describe the physical characteristic of organisms that help them survive in their environment</p>	<p>E.ES.07.42 – Describe the origins of pollution in the atmosphere, geosphere and hydrosphere and how pollution impacts habitats, climatic change and threatens or endangers species</p>
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## FLOW Unit 3, Lesson 2: State of Michigan – High School Content Expectations Essential Science

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
<p><b>Standard B1: Inquiry, reflection and social implications</b>  <i>B1.1 Scientific inquiry</i>            B1.1C – Conduct scientific investigations using appropriate tools and techniques  <i>B1.2 Scientific reflection and social implications</i>            B1.2D – Identify patterns in data and relate them to theoretical models</p> <p><b>Standard B3: Interdependence of living systems and the environment</b>  <i>B3.4 Changes in ecosystems</i>            B3.4C – Examine the negative impact of human activities</p>			

## FLOW Unit 3, Lesson 2: National Standards

<b>NSES</b>				<b>AAAS</b>			
Elementary		Middle		Elementary		Middle	
C1.1 C3.2 C3.4 F3.2	F4.1 F4.2 G1.3	C3.1 C3.4 C4.1	C4.4 G1.1 G2.3	5D.1 5D.4 12A.1	12A.2 12C.3	5D.1 5D.2 5F.2	12A.1 12A.2 12D.1
<b>NAAEE</b>				<b>NCSS</b>			
Elementary		Middle		Elementary		Middle	
1-C 1-E 2.2-A 2.2-C		1-C 1-E 2.2-A		III.h III.i	VIII.b IX.d	III.i IX.d	

# FLOW Unit 3, Fish

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Unit 3, Lesson 3: Fish Habitat

### FLOW Unit 3, Lesson 3: Assessment

Learning Objective	Student Performance	Recommended # Points
Name stages of the fish life cycle	<b>Name</b> the stages of the fish life cycle	1 each per life cycle stage
Diagram progression from egg, fry, maturity	<b>Illustrate</b> the progression from egg, larval fish, fry, juvenile, adult	1 each per life cycle stage
Describe 2 general animal reproductive strategies	<b>Contrast</b> 2 general reproductive strategies	2 each
Describe the reproductive strategies of Great Lakes fish	<b>Describe</b> the spawning strategy of a Great Lakes fish	2 each

### FLOW Unit 3, Lesson 3: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b>  <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i>            S.IP.04.16 – Construct simple charts and graphs from data and observations            S.IP.05-07.15 – Construct charts and graphs from data and observations</p> <p><b>Inquiry analysis and communication (IA)</b>            S.IA.E&amp;M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations            S.IA.04.11 – Summarize information from charts and graphs to answer scientific questions            S.IA.04.12 – Share ideas about science through purposeful conversation in collaborative</p>		<p><b>Organization of living things (OL)</b>  <i>L.OL.E.1 Life requirements</i>            L.OL.04.16 – Determine that animals require air, water, a source of energy and building material for growth</p>	

<p>groups  S.IA.04.13 – Communicate and present findings of observations and investigations  S.IA.05-07.11 – Analyze information from data tables and graphs to answer scientific questions  S.IA.05-07.12 – Evaluate data, claims and personal knowledge through collaborative science discourse  S.IA.05-07.13 – Communicate and defend findings of observations and investigations using evidence</p> <p><b>Reflection and social implications (RS)</b>  <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i>  S.RS.04.11 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities  <i>S.RS.05-07.15 – Demonstrate scientific concepts through various illustrations, performances, models, exhibits and activities</i></p>		and repair	
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**FLOW Unit 3, Lesson 3: State of Michigan – High School Content Expectations  
Essential Science**

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
	<p><b>Standard B1: Inquiry, reflection and social implications</b>  <i>B1.2 Scientific reflection and social implications</i>  B1.2C – Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.</p>		

### FLOW Unit 3, Lesson 3: National Benchmarks

<b>NSES</b>				<b>AAAS</b>			
Elementary			Middle	Elementary			Middle
C1.1 C2.1 C3.2	C3.4 F4.1 F4.2	C2.1 C4.4		5F.1 12B.1 12D.3		5F.2 12C.1	
<b>NAAEE</b>				<b>NCSS</b>			
Elementary		Middle		Elementary		Middle	
2.2-A 2.2-C 2.4-A		2.2-B 2.4-A		iii.h iv.b		N/A	

# FLOW Unit 3, Fish

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Lesson 4: Fish Populations

### FLOW Unit 3, Lesson 4: Assessment

Learning Objective	Student Performance	Recommended # Points
Describe latitude and longitude	Compare and contrast latitude vs. longitude	1 each
Describe the components of a GIS	Describe the components of a GIS	1 each
Explain why researchers study fish	Explain why researchers study fish	2 each
Describe movement patterns of salmon	Describe why salmon locations differ during May - September	1 each

### FLOW Unit 3, Lesson 4: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<p><b>Inquiry process (IP)</b>  <i>S.IP.E&amp;M.1 Inquiry involves generating questions, conducting investigations and developing solutions</i>            S.IP.05-07.16 – Identify patterns in data</p> <p><b>Reflection and social implications (RS)</b>            S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations  <i>S.RS.04.15 – Use evidence when communicating scientific ideas</i>  <i>S.RS.04.17 – Identify current problems that may be solved through use of technology</i></p>		<p><b>Ecosystems (EC)</b>  <i>L.EC.M.1 Interactions of organisms</i>            L.EC.06.11 – List examples of populations, communities and ecosystems including the Great Lakes region</p>	

## FLOW Unit 3, Lesson 4: State of Michigan – High School Content Expectations Essential Science

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
	<b>Standard B1: Inquiry, reflection and social implications</b> <i>B1.1 Scientific inquiry</i> B1.1D – Identify patterns in data and relate them to theoretical models.		

## FLOW Unit 3, Lesson 4: National Benchmarks

<b>NSES</b>				<b>AAAS</b>			
Elementary		Middle		Elementary		Middle	
A1.1 A1.2 A1.4 A1.5 C1.1	C1.3 C3.2 C3.4 G1.3	N/A		N/A	A1.1 A1.3 A1.6	C4.4 G2.1 G2.3	
<b>NAAEE</b>				<b>NCSS</b>			
Elementary		Middle		Elementary		Middle	
1-B 1-F 2.2-C		2.2-A		N/A	1-B 1-E	1-G 2.4-D	

# FLOW Unit 3, Fish

Assessment | State of Michigan Content Expectations | National Benchmarks/Standards

## Lesson 5: Great Lakes, Great Careers

### FLOW Unit 3, Lesson 5: Assessment

Learning Objective	Student Performance	Recommended # Points
Name at least five careers in marine and aquatic science, including both the oceans and the Great Lakes	Name two or three careers that are specific to the oceans	1 each
	Name two or three careers that are specific to the Great Lakes region	1 each
Identify several contributions people have made in marine and aquatic science fields	Describe the position of one or more marine/aquatic scientists and explain the benefits to the world (physical, animal, or human) of that position	3 each
Describe a marine or Great Lakes science career that interests them	Describe the career that most interests you, choosing from the careers explored in class or on the web	2 each
	Explain which aspects of that career seem interesting	2 each
	Explain how science plays a role in that career	2 each

### FLOW Unit 3, Lesson 5: State of Michigan – Grade Level Content Expectations 4<sup>th</sup>, 5<sup>th</sup> - 7<sup>th</sup> grades

Discipline 1: Science Processes	Discipline 2: Physical Science	Discipline 3: Life Science	Discipline 4: Earth Science
<b>Reflection and social implications (RS)</b> <i>S.RS.E&amp;M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations</i> S.RS.04.19 – Describe how people have contributed to science throughout history and across cultures			



S.RS.05-07.19 – Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures

## FLOW Unit 3, Lesson 5: State of Michigan – High School Content Expectations Essential Science

<b>Discipline: Earth science</b>	<b>Discipline: Biology</b>	<b>Discipline: Physics</b>	<b>Discipline: Chemistry</b>
<b>Standard B1: Inquiry, reflection and social implications</b> <i>B1.2 Scientific reflection and social implications</i> B1.2E – Evaluate the future career and occupational prospects of science fields			

## FLOW Unit 3, Lesson 5: National Benchmarks

<b>NSES</b>				<b>AAAS</b>			
Elementary		Middle		Elementary		Middle	
E1.3 E1.4 E1.5	F5.1 G1.2 G1.4	E1.2 E1.3 F5.2 F5.4	F5.5 G1.1 G1.2 G3.1	1C.1 1C.3		1C.1 1C.3	
<b>NAAEE</b>				<b>NCSS</b>			
Elementary		Middle		Elementary		Middle	
n/a		n/a		VIII.b		n/a	

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