Wisconsin Department of Public Instruction
EQUIVALENT OPTIONS FOR AGRICULTURE
PI-1803-AG (Rev. 03-14)

INSTRUCTIONS:
Via U.S. mail, submit **one (1) original signature page** to:
WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION
ATTN: JEFF HICKEN
DIVISION FOR ACADEMIC EXCELLENCE
125 SOUTH WEBSTER STREET
P. O. BOX 7841
MADISON, WI 53707-7841

and **e-mail application** to: **dpiequivalency@dpi.wi.gov**

For questions regarding this form, contact Jeff Hicken at jeffrey.hicken@dpi.wi.gov or (608) 267-9255 or Shelley Lee at shelley.lee@dpi.wi.gov or (608) 26 3319.

Applicants will be notified within 60 days for verification of receipt of equivalent application.

I. GENERAL INFORMATION

Participating School District	Participating High School	
Chippewa Falls Area United School District	Chippewa Falls Senior High School	
Name of Contact Person *First and Last*	**Contact Person Phone** *Area/No.*	**Contact Person Email Address**
Jeanna Burgan	(715) 726-2406	burganjm@chipfalls.org
Mailing Address *Street, City, State, Zip*	**Date Applying** *Mo./Yr.*	**Equivalent Course Title**
735 Terrill St, Chippewa Falls, WI 54729	6/2017	Biotechnology ES

II. DESCRIPTION OF EQUIVALENT COURSE

Provide a brief description of the proposed equivalent course and include how much equivalency credit you are applying for. Best practice examples can be found at: *http://ag.dpi.wi.gov/ag_asec*

This science based laboratory course deals with the idea of changing living things. Some of the laboratory work will include studies with cloning, plant tissue culture, DNA extraction from plant and animal materials, artificial insemination, embryo transfer, product fermentation, and yeast studies. Students will learn how to complete electrophoresis using different DNA. In addition, issues related specifically to the biotechnology industry, such as understanding the product development process, ethical, legal and social concerns will be addressed. Other equipment students may use are: hot plates, pipettes, incubators and water baths.

Students will earn ½ science equivalency credit.

III. EQUIVALENT VERIFICATION REQUIREMENTS

1. List of committee members and their titles.
2. Brief summary of the district Ag/Science equivalent process.
3. Documentation of agriculture equivalent course content/syllabus—with proposed instructional time documented.
4. Completion of the Ag/Science crosswalk—how the crosswalk was used to develop the content of the equivalent course.

IV. CERTIFICATION SIGNATURES

ON BEHALF OF THE BOARD OF EDUCATION, I HEREBY AFFIRM that the above-named equivalent course contains the time allotment and substantially the same objectives to develop the knowledge, concepts, and skills of the course for which the equivalent is proposed, consistent with s. 118.33, Wis. Stats., and Ch. PI-18 Wis. Admin. Code and subject to the state superintendent's approval.

Signature of School Board President *Blue Ink Only*	Date Signed *Mo./Day/Yr.*
➢ Amy Mason	06/20/2017
Date Approved by Local School Board *Mo./Day/Yr.* 6/20/17	
Signature of High School Principal *Blue Ink Only*	**Date Signed** *Mo./Day/Yr.*
➢ [signature]	06/20/2017
Signature of District Administrator *Blue Ink Only*	**Date Signed** *Mo./Day/Yr.*
➢ Heidi [signature]	06·20·2017

III. Equivalent Verification Requirements

1. List of committee members and their titles:

   - Jeanna Burgan, Agriscience Instructor
   - Nicholas Gagnon, Science Instructor and Science Department Chair

2. Brief Summary of the district Ag/Science equivalent process

   - This course was proposed, as part of a 5-year plan, during the Fall 2015. The plan was created by Agriscience Instructor, Jeanna Burgan. The plan was brought for discussion in a meeting with the principals of the middle and high school levels. Nicholas Gagnon, was given the course description, outline, and crosswalk for this class for his review. All parties were in favor of this course. The class was approved at the June 21, 2017 Chippewa Falls Board of Education meeting.

3. Documentation of agriculture equivalent course content/syllabus- with proposed instructional time documented.

   - See attachment(s)

4. Completion of the Ag/Science crosswalk

   - See attachment(s)

Biotechnology ES Crosswalk
Chippewa Falls Senior High School
Chippewa Falls, WI

Local Course Curriculum / Units or Lessons Objectives	**Title of Standards:** Agriculture, Food, and Natural Resources **Date of Copyright:** 2013 **Organization:** Wisconsin Department of Public Instruction	**Title of Standards:** Next Generation Science Standards **Date of Copyright:** 2013 **Organization:** NGSS
1.1 Foundations in Biotechnology a. Complete a series of activities to explore the applications of biotechnology. b. Write a definition of biotechnology. c. Develop a Laboratory Notebook to record observations and protocols. d. Determine the date and significance of a biotechnological discovery. e. Work collaboratively to develop a timeline of biotechnology discoveries. f. Explore their personal beliefs and knowledge to gain perspective on practices in biotechnology.	**AB3.a:** Prepare and maintain all files as needed for effective record keeping practices **BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).	**Science and Engineering Practices:** 1. Obtaining, evaluating, and communicating information **Understandings about the Nature of Science:** 1. Scientific investigations use a variety of methods 2. Science is a human endeavor 3. Science addresses questions about the natural and material world
Lesson 1.2 Standard Operating Procedures a. Review the Lab Safety Manual and determine safe practices for the biotechnology laboratory. b. Diagram and describe where emergency equipment and safety hazards in the biotechnology laboratory are located.	**BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials.	**Science and Engineering Practices:** 1. Planning and carrying out investigations **Understandings about the Nature of Science:** 1. Scientific investigations use a variety of methods

c. Explain appropriate uses of safety and emergency equipment. d. Use SDS forms to determine the proper use and clean-up of compounds used in the course. e. Mix diluted solutions based on the percentage of a substance desired. f. Prepare solutions based on the desired molar concentration. g. Use pipets to transfer accurate volumes of solutions. h. Transfer microliters of solutions using a micropipet. i. Prepare and pour nutrient agar plates using sterile procedures.		
Lesson 1.3 Basics of Cells & DNA a. Prepare culture plates using proper sterile and streaking techniques. b. Observe differences in growth patterns of prokaryote and eukaryote model organisms. c. Develop a model of a DNA strand as a class and using simulation materials. d. Research DNA replication and develop a visual representation of the replication process. e. Determine the location of a specific gene sequence in a DNA segment.	**BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials.	**Disciplinary Core Ideas:** **LS1.A: Structure and Function-** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. **LS3.A: Inheritance of Traits-** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. **Science and Engineering Practices:** 1. Developing and using models **Crosscutting Concepts** 1. Patterns 2. Cause & Effect: Mechanism & Prediction 3. Scale, Proportion, & Quantity 4. Systems & System Models 5. Structure & Function

Lesson 2.1 Diving into DNA a. Write an experiment to extract DNA from kiwi fruit. b. Extract DNA from kiwi fruit using procedures developed. c. Mix solutions and pour gel trays to prepare agarose gels. d. Conduct gel electrophoresis to observe the migration of dyes and extracted DNA. e. Demonstrate the action of restriction enzymes using paper DNA strands. f. Digest a DNA sample using restriction enzymes and conduct gel electrophoresis to analyze the results. g. Solve a problem determining the culprit of a crime using restriction enzymes and gel electrophoresis.	**BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials.	**Disciplinary Core Ideas:** **LS1.A: Structure and Function-** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. **LS3.A: Inheritance of Traits-** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. **LS4.A: Evidence of Common Ancestry and Diversity-** Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. **Science and Engineering Practices:** 1. Asking questions (for science) and defining problems (for engineering) 2. Planning and carrying out investigations 3. Constructing explanations (for science) and designing solutions (for engineering) **Crosscutting Concepts** 1. Patterns 2. Scale, Proportion, & Quantity 3. Systems & System Models **Understandings about the Nature of Science:** 1. Scientific investigations use a variety of methods 2. Science is a way of knowing
Lesson 4.1 Genetically Modified Organisms	**BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators,	**Disciplinary Core Ideas:** **ETS1.A: Defining and Delimiting Engineering Problems-** Criteria and constraints also include

a. Reflect upon the term genetically modified and develop personal perceptions and beliefs pertaining to the term. b. Research published perceptions of genetically modified organisms of different groups and organizations and discuss in class. c. Conduct a public perception survey of genetically modified foods. d. Perform a lateral flow test to determine the presence of Round-Up Ready® genes in corn. e. Conduct a polymerase chain reaction to determine the presence of genetic modifications in a common food item.	historical developments, potential applications of biotechnology, etc.). **BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials. **BT2.c:** Evaluate the application of genetic engineering to improve products of AFNR systems.	satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. -Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **ETS1.B: Developing Possible Solutions-** When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. **Science and Engineering Practices:** 1. Asking questions (for science) and defining problems (for engineering) 2. Analyzing and interpreting data 3. Constructing explanations (for science) and designing solutions (for engineering) 4. Engaging in argument from evidence 5. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Structure & Function 2. Stability & Change **Understandings about the Nature of Science:** 1. Scientific investigations use a variety of methods 2. Scientific knowledge is based on empirical evidence 3. Scientific knowledge is open to revision in light of new evidence 4. Science is a human endeavor 5. Science addresses questions about the natural and material world
Lesson 4.2.1 Performance Enhanced Plants a. Research and compare methods of inserting genes into plants and discuss the advantages and disadvantages of each.	**BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.). **BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials.	**Disciplinary Core Ideas:** **LS1.A: Structure and Function-** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. **LS4.C: Adaptation-** Adaptation also means that the distribution of traits in a population can change when

b. Propagate a plant species using tissue culture c. Sanitize, sterilize, and maintain an aseptic environment to promote success during tissue culture.	**BT2.c:** Evaluate the application of genetic engineering to improve products of AFNR systems. **PS3.a:** Demonstrate plant propagation techniques.	conditions change. -Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. **ETS1.A: Defining and Delimiting Engineering Problems-** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. -Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **ETS1.B: Developing Possible Solutions-** When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. **Science and Engineering Practices:** 1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Cause & Effect: Mechanism & Prediction 2. Systems & System Models **Understandings about the Nature of Science:** 1. Scientific investigations use a variety of method
Lesson 4.3 Animal Applications of Biotech a. Perform enzyme-linked immunosorbent assays to detect the immunological response of animals. b. Research and present their	**AS1.a.8.h:** Predict trends and implications of future development of the animal systems industry. **AS5.f:** Compare and contrast scientific methods associated with animal reproduction. **BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of	**Disciplinary Core Ideas:** **LS1.B: Growth and Development of Organisms-** In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair)

findings on reproductive technologies used in animal agriculture. c. Perform PCR and electrophoresis to use marker assisted selection to determine ideal genotypes for specific situations.	biotechnology, etc.). **BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials. **BT2.c:** Evaluate the application of genetic engineering to improve products of AFNR systems.	to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism **ETS1.A: Defining and Delimiting Engineering Problems-** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. -Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **ETS1.B: Developing Possible Solutions-** When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. **Science and Engineering Practices:** 1. Asking questions (for science) and defining problems (for engineering) 2. Analyzing and interpreting data 3. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Cause & Effect: Mechanism & Prediction **Understandings about the Nature of Science:** 1.Science is a human endeavor 2. Science addresses questions about the natural and material world
Lesson 4.4 Bioremediation a. Design and conduct an experiment determining the effectiveness of oil-eating microbes in various environmental conditions.	**BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.). **BT2.a:** Demonstrate safe and proper laboratory procedures and record keeping using biological materials. **BT2.c:** Evaluate the application of genetic	**Disciplinary Core Ideas:** **LS4.D: Biodiversity and Humans-** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential

	engineering to improve products of AFNR systems.	to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. **ESS3.C: Human Impacts on Earth Systems-** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **ETS1.A: Defining and Delimiting Engineering Problems-** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **Science and Engineering Practices:** 1. Asking questions (for science) and defining problems (for engineering) 2. Planning and carrying out investigations 3. Constructing explanations (for science) and designing solutions (for engineering) 4. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Cause & Effect: Mechanism & Prediction **Understandings about the Nature of Science:** 1. Science is a human endeavor 2. Science addresses questions about the natural and material world
Lesson 2.2.4 Rooted in Research a. Research Agrobacterium tumefaciens to determine applications in the agricultural field. b. Complete the annotated bibliography, the rough draft, and a peer review of the A. tumefaciens research paper. c. Write a scientific research paper using valid resources and parenthetical citations.	**BT1.a:** Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).	**Disciplinary Core Ideas:** **ETS1.A: Defining and Delimiting Engineering Problems-** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **Science and Engineering Practices:** 1. Constructing explanations (for science) and designing solutions (for engineering) 2. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Patterns

		2. Cause & Effect: Mechanism & Prediction **Understandings about the Nature of Science:** 1. Scientific knowledge is based on empirical evidence 2. Scientific knowledge is open to revision in light of new evidence 3. Science is a way of knowing 4. Science is a human endeavor 5. Science addresses questions about the natural and material world

Biotechnology ES
Chippewa Falls Senior High School
Chippewa Falls, WI

Unit 1: Foundations of Biotechnology — 10 Days
- Defining Biotechnology
- Biotechnology Laboratory Notebooks
- When in Time?
- Ethical Dilemmas

Unit 2: Standard Operating Procedures — 12 Days
- Surrounded by Safety
- Deciphering SDS
- Making Percent Solutions
- Making Molar Solutions
- Moving Microliters
- Mixing Media

Unit 3: Basics of Cells & DNA — 10 Days
- Growing Cells
- DNA Strands
- Replicating DNA
- From DNA to Genes

Unit 4: Diving into DNA — 16 Days
- DNA Extraction Protocol
- Agarose Gels
- Electrophoresis Currents
- Cutting up DNA
- Dicing Lambda DNA
- The Chewed Shoe Mystery

Unit 5: Genetically Modified Organisms — 20 Days
- What is a GMO?
- Planting Seeds of GMOs
- Grocery Store GMOs

Unit 6: Agricultural Applications of Biotechnology — 15 Days
- Culturing Plants
- Animal Immunology
- Reproductive Technologies
- Marker Assisted Selection
- Bioremediation

Ongoing Semester Research Paper
- Rooted in Research- Agricultural use of the *Agrobacterium tumefaciens*