IMSA Fusion

IMSA Fusion is a teacher professional development and student STEM enrichment program for Illinois students who are talented, interested and motivated in mathematics and science. IMSA Fusion places a special emphasis on students who are historically underrepresented in those areas. Fusion works with teachers and students in grades 4-8.

In brief, the program goals are:

- Maintain or increase students interest, involvement and literacy in science and mathematics
- Enhance the knowledge and skills of teachers in science, mathematics, and technology; stimulate excellence in schools
- Stimulate excellence in schools' science and mathematics programs
- Help increase access to programming for students who are historically under-resourced in science, mathematics and technology and for all areas of the state

By design, the IMSA Fusion curriculum is inquiry based, problem centered and integrative. The learning experiences focus on helping students "learn how to learn" and emphasize logic, mathematical thinking and experimental scientific thinking. Topics relate to the students' lives, thereby arousing their curiosity and increasing their motivation to learn.. Teachers from each participating school are supported with on-going professional development for the delivery of the curriculum and use of appropriate pedagogy.

Out of the Silo: Agronomic STEM

Designed for Grades 6-8

Out of the Silo: Agronomic STEM is a grade 6 – 8 curriculum which highlights the interplay between science, technology, engineering and mathematics inherent in the field of Agronomy. The growing of plants for commercial use, particularly food, is the essence of agronomy and the heart of this curriculum.

Agronomy in the Illinois region began long before Europeans arrived. Native Americans found the soil and climate well suited to growing corn and so it remains today. Fields for growing corn and soybeans dominate the state, as can be seen easily from the air. Students living in urban centers, who were unaware of Illinois' rural nature, will use satellite imagery to see how dominant agriculture is in Illinois and come to understand just how much we all depend on the state's number one business.

Students who frequently pass through the countryside in an automobile will learn much about what they have been seeing out the window. No longer will it be possible to drive past a silo, combine, or field of corn without remembering what they learned in IMSA Fusion. These students will enjoy explaining to their parents what is happening in these fertile fields and how all the parts of this complex business fit together to keep us fed.

Out of the Silo: Agronomic STEM Unit Summaries

Farming Frenzy

Illinois agriculture has a long and rich history. From the introduction of farming practices by the Native Americans to the development of storage facilities, transportation systems and implementation of machinery, the historical evolution of farming has flourished. Today, with over 74,000 farms accounting for approximately 72% of Illinois' land, the state has become a national leader in the production of several crops. In the unit ***Farming Frenzy***, students will race to uncover a variety of agricultural facts in an attempt to collect pentomino pieces needed to complete a puzzle. Many of the concepts featured in this activity serve as a preview of several units featured in this curriculum.

Tractor Physics

Modern tractors are sophisticated machines, shaped by the physics of their operating requirements. The interface between tire and soil is the focus for this unit. Tires must keep a tractor from sinking into soft soil and allow it to pull heavy loads, all without damaging the essential properties of the soil. By participating in ***Tractor Physics,*** students will tackle an engineering challenge by designing, constructing, and testing a set of tractor tires.

Out of the Silo: Agronomic STEM Unit Summaries

G-ROW-in' Soybeans

For the last several years, Illinois has been the national leading producer of soybeans. With fertile soil and a mild climate, Illinois serves as a perfect environment for this crop. Each year, at the beginning of the growing season, famers develop and execute a management system to achieve their primary goal of optimizing crop yield. In the unit ***G-ROW-in' Soybeans,*** students will explore one agronomic practice related to maximizing crop yield: row spacing. Asked to develop a row spacing recommendation for a hypothetical farmer, students will consider how the distribution of plants provides access to natural resources and nutrients necessary for growth. Students will also determine the economic efficiency of the row spacing models prior to making their recommendation.

Drift Mitigation

The application of chemical fertilizers and pesticides is an important part of crop management used to maximize yield. However, the improper application of these chemicals can have adverse effects on our environment. In the unit ***Drift Mitigation***, students will use a model to investigate the relationship between spray droplet size and drift of chemicals away from a target plant. They will also analyze the trade-off between plant coverage and potential chemical drift and will research and recommend a series of management practices to reduce the impact of chemical drift on animal habitats, water bodies, neighboring plants, and the atmosphere.

Out of the Silo: Agronomic STEM Unit Summaries

Water Management

Because Illinois receives abundant rainfall, most farms require no irrigation. Many fields, however, do not drain quickly, which limits their productivity. In ***Water Management,*** students will learn about the variable nature of the water table and use Geographic Information Systems to identify actual Illinois fields which might benefit from drainage tiling. Finally, students will design and build a model tile drainage system for their field.

It's All about Those Traits

For over 10,000 years, farmers have been selecting plants with desirable traits and breeding them so that the offspring will also exhibit these desirable traits. With advances in science, techniques exist beyond traditional selective breeding to produce plants with an ever-increasing variety of traits. Genetic engineering has introduced characteristics such as pest and weed resistance, adaptability to climate change, and increased nutritional value into food plants such as corn and rice. Research into manipulating a plant's epigenome in order to induce differences in observable traits has led to some exciting possibilities for modifying a plant's traits without changing the underlying DNA code. In the unit It's All About Those Traits, students will explore traditional selective breeding through analyzing kernel "samples" from two different ears of corn. They will learn about commercially-developed genetic modifications to corn and will research and propose new, novel traits to develop a corn plant of the future. Finally, students will simulate a cell's production of proteins to explore how regulating the rate of transcription and translation impacts the expression of certain proteins, thus leading to variation in phenotypic traits.

Out of the Silo: Agronomic STEM Unit Summaries

Nutrient Management

Crops don't appear out of thin air, or do they? In the unit ***Nutrient Management,*** students will critically examine the first recorded experiment in biology and learn about the sources of a growing plant's mass. Next they will examine pictures of crops which are experiencing nutrient deficiencies. After diagnosing the deficiencies, students will select the appropriate fertilizers to apply on their fields. Applying fertilizer is one thing, but keeping it in the soil is another challenge. Students will select an actual Illinois farm field and design for it a nutrient retention system.

Soil Science

The United States is one of the most productive agricultural countries in the world. However, according to the book *Know Soil, Know Life*, only about 18% of total land is available for producing crops. As the human population continues to grow, soils used to grow annual crops will be pressed to produce more food per acre. ***Soil Science*** introduces students to the importance of soil in agriculture. Through activities in this unit, students will assume the role of soil scientists and will analyze soil samples to determine the soil's texture. They will then debate which characteristics of the inorganic components of soil are best suited to growing crops. Furthermore, students will perform chemical tests on a soil sample to analyze the pH, nitrogen, phosphorus, and potassium levels in soil to determine its suitability for producing various crops such as corn, soybeans, wheat, and oats.

Out of the Silo: Agronomic STEM Unit Summaries

Amber Waves of Grain

By carefully observing images of traditional harvesting techniques, students will learn about the three basic phases of harvesting cereal crops in ***Amber Waves of Grain***. Then students will design and build small machines capable of reaping, threshing, and winnowing. Next, students will explore the inner workings of modern combine harvesters. Finally, students will analyze data which highlight the dramatic effect of 200 years of agricultural mechanization.

So High, Silo

Following harvest, a farmer must store their grain. Depending on the intended use of the crop, time of year, and supply, a farmer may transfer the crop into a grain silo or grain bin. These large structures, typically cylindrical and made of cement staves and steel panels, house grain at an appropriate moisture level for a designated period of time until needed for feed or market distribution. In the unit ***So High, Silo***, students will be presented with an engineering design challenge to develop a storage container that holds a grain sample. Students will exercise their knowledge of volumetric measurement and properties of three dimensional figures to construct their container, and then evaluate their design for efficiency and optimization level.

Out of the Silo: Agronomic STEM Unit Summaries

Precision Agriculture

Agronomists are continually seeking ways to maximize the productivity of crops. New technologies are being evaluated to make use of an abundance of available data that can allow producers to constantly evaluate the status of crops and make decisions on a site-specific basis. Areas of crops that are stressed can be located and treated, thus providing important savings, both monetary and environmental. Students will be introduced to two different technologies in the unit ***Precision Agriculture*** - remote sensing and yield mapping. Students will learn about the use of satellite imagery and UAVs to remotely scout fields and will generate a model yield map to analyze high- and low-producing areas within a particular field.

Feed the World

In the culminating activity, students will revisit many of the agronomic concepts investigated in this curriculum by applying their knowledge to a real-world problem. By 2050, it is predicted that the world's population will increase by approximately two to three billion people. Already struggling to provide food and nourishment to our current population, there is a growing concern that the demand for more food will surpass the ability to produce. In ***Feed the World,*** students will explore the implications of this global crisis and pose potential solutions that increase crop yield while minding the planet's environment. Applying their understanding of science and technology, students will build their own cyber farm using the interactive simulation *Top Crop: Farming for the Future*. Designed by National Geographic Education, this experience will require students to systematically apply multiple agricultural technologies and tools in an effort to produce a high-yielding, sustainable farm.