

New Fairfield Public Schools
New Course or New Instructional Program Proposal

Directions:

Before completing this form, please discuss this proposal with the appropriate administrator(s) in your school. Complete this proposal form thoroughly, and attach any supporting documentation that would help the District Curriculum and Program Council understand this proposal better. Be sure that you adhere to all deadlines*, and be certain to acquire all required signatures. The deadline* for any course or program proposal that has budgetary implications and/or needs to be published in the NFHS *Program of Studies* is October 31, so please plan accordingly to make certain that all approvals of this application can be completed by October 31. All other proposals can be forwarded at any time of the year.

- 1. Please list the names and identify the school/department of those individuals who are making this proposal? If those making the proposal are not teachers, please explain thoroughly:**

Mrs. Jean Gephart, Science Department Chairperson
Mrs. Kimberly Salta, Science Teacher

- 2. Give the title of new course or instructional program. Indicate the department in which this course/program will reside:**

The instructional program being proposed is **Human Genomics**. This course will be taught in the high school science department.

- 3. Please indicate if the new course or instructional program is a semester or year long, and indicate the applicable grade levels. Please indicate the course level if applicable:**

This is a semester-long course intended for students who have successfully passed biology and chemistry. This would be a science elective course with an honors option (weight 3 or weight 4).

- 4. Please give the rationale for this proposal, and include its relationship to the past, current and future development of curricular offerings in New Fairfield:**

There is a study of historical genetics (Mendel's laws, structure of DNA, protein synthesis) that is part of the biology curriculum. This course will allow students the opportunity to further explore human genomics in depth from gene mapping and laboratory techniques to bioinformatics and bioethics. There is so much information about genomics circulating in the media that students need to be well-educated in this area so that they may make informed decisions, be those about genomic sequencing, healthcare, or politics. Our students will benefit greatly from this course as future science students, future scientists, and as informed citizens.

5. Please indicate the target population for this proposal:

This course will be for any student who has successfully passed biology at any level and has an interest in further exploring biotechnology and its role in our current and future lives.

6. Please explain if this course or instructional program is an addition or a replacement for an existing course or program.

This is not a replacement for an existing program. Instead, it is an addition (STEM enrichment) to the biology program.

7. List any prerequisite for this course or instructional program:

In order to enroll in Human Genomics, students must successfully complete biology or honors biology with a passing grade. Students and parents must also sign an informed consent document regarding collection of DNA samples as well as sign the "Student Rights and Responsibilities in the Discussion and Study of Sensitive Topics" document, which acknowledges that they understand much of this content may be of a sensitive nature. There are no other prerequisites for this course.

8. Please write a short description of the new course or instructional program that would be suitable for the high school *Program of Studies* or for a curriculum document:

The study of human genomics will allow students to personally connect to gene mapping. Learning about our DNA can offer insights about our health, behavior, family history and other traits. Students will learn complex laboratory techniques, including advanced DNA extraction, polymerase chain reactions, and gel electrophoresis. The course will help students answer complicated questions about how to use genetics personally and as a society. It will also tackle challenges about how to ensure fairness and equity in genetic advances.

9. Please list (or attach a list) of the long-term course or program goals that define the broad outcomes that this course or program seeks to help students achieve:

The science curriculum process has focused on increasing student's ability to analyze data and information. This course will continue this focus by providing a highly important lens through which students need to be able to analyze current information related to biotechnology. It will also allow students the ability to improve highly advanced laboratory techniques, better preparing students who plan to enter STEM fields.

10. Please indicate what topics, units, or material will be used to meet the long-term goals listed above. How will technology be utilized to enhance the course or program goals? What assessment strategies will be used in this course or program? What are the unique components of this course or program content that makes it a worthwhile addition for our students?

This semester-long course will have three main areas of study that are integrated throughout the entirety of the course:

- Laboratory Techniques
- Bioinformatics
- Bioethics

Each topic will be addressed through a series of phenomena, including ACE (endurance gene), OXTR (the oxytocin receptor gene a.k.a. the “love gene”), and TAS2R38 (bitter taste gene). Case studies and primary source documents will be incorporated throughout.

Biotechnology is the foundation for this course, including but not limited to microcentrifuges, micropipettes, vortexes, thermal cyclers, online gene databases (OMIM, NCBI, e!Ensembl), Chromas/4Peaks gene sequencing programs and more. Students will be assessed in a variety of ways including classroom discussions, CERs, laboratory practicals, laboratory notebooks, and laboratory reports.

This course is worthwhile because not only will we be discussing information that comes up in current events and will be affecting all of our lives as technologies continue to improve, but also students will have the opportunity to perform biotechnology experiments that many students do not have exposure to until college. Even if these students do not plan to study biology, these laboratory skills can be translated into a variety of STEM careers.

11. Resources

The science department owns BioRad equipment that can be used for some of the labs, but will require some consumables in order to operate properly. Reagents will be provided at no cost to the district by Jackson Laboratories, but is dependent on a current grant. Should Jackson Labs no longer receive the grant in the future, the district may need to purchase these consumable reagents.

12. Please indicate any special location needs, such as the computer lab:

A science laboratory setting is necessary for the course.

13. Please enumerate the resources – both human and financial – that you anticipate will be needed to develop this course or program correctly. Please indicate any special training that will be necessary to implement this course or program, and give the cost of this training:

There is no anticipated impact on FTE due to the shift of courses with the NGSS alignment. There is a financial investment in the upkeep of the program, including purchase of equipment and consumables. Training will also be necessary for the teacher(s) involved in delivering the program, including continued training as technologies improve. “Teaching the Genome Generation” training is currently provided by Jackson Labs at no cost to the district, but does not include travel expenses (i.e., mileage, tolls) for new teachers. Continuing training for experienced TtGG teachers is free, but may require housing for one to two nights. As this training is part of a grant, the cost may change in the future. Teacher participation in TtGG training enables teachers to access to the Jackson Labs regents for the duration of the grant.

14. Please give the title and cost of the proposed text and attach it, if possible. Indicate any special equipment needs for this course and the anticipated cost of this equipment:

- Teacher-created Consumable Laboratory Manual (Price TBD) including:
 - Teaching the Genome Generation Lab Protocols
 - Personal Genetics Education Project bioethics lessons
 - Case Studies

Item	Vendor Recommended by Jackson Labs	Approximate Price
Equipment (one time purchase)		
Dry bath and block	USA Scientific	\$450
Centrifuge (1.5 mL tubes)	Eppendorf	\$1,700
Centrifuge (0.2 mL tubes)	USA Scientific	\$30
Thermal cycler	Bio-Rad	\$2,000
Vortex	Cambridge Scientific	\$175
Micropipettors (P20, 200 and 1000)	MiniPCR	\$150 (per set, 8 recommended)
Tube racks (1.5 and 0.2 mL)	USA Scientific	\$30 (pack of 7)
Laptop cooler	Nalgene	\$30 (pack of 5, 2 packs recommended)
Gel electrophoresis system	Lonza/VWR	\$1,700
Total Equipment (one time purchase)		\$7,345
Consumables (purchased as needed)		
Micropipettor tips (P20, 200 and 1000)	USA Scientific	\$65 each (box of 10, 2 of each recommended)
Tubes (1.5 mL)	USA Scientific	\$20 (bag of 500)
Tubes (0.2 mL)	USA Scientific	\$80 (box of 1000)
Lonza agarose gels	Lonza	\$0 (Provided by JAX)
Total Consumables (per section)		\$490

Reagents (Provided by Jax for duration of grant)		
DNA extraction kits (saliva)	DNAGenotek or miniPCR	N/A
Ethanol	variable	N/A
Molecular Biology grade water	Sigma	N/A
PCR master mix	Sigma	N/A
Primers (specific for gene of interest)	Integrated DNA Technologies	N/A
Restriction digestion enzymes	New England Biolabs	N/A
DNA ladder	New England Biolabs	N/A
PCR clean-up enzyme	Affymetrix	N/A
Total Reagents (per section)		No cost to district with JAX grant
Supplies (purchased as needed)		
Genes & Consequences (one time purchase)	Carolina Biological Supply	\$54
Thin Tip Sharpies	Amazon	\$9
Total Supplies		\$63
TOTAL		\$7,898

15. Please address the questions below separately, and then attach your responses to this form:

a) What impact will this course/program proposal have upon other courses/programs currently being offered in the district?

There will be no impact on course offerings overall, but there will be a positive impact on the students in this course, in that they will be more likely to be successful in STEM fields. This course provides an opportunity for students to explore in a laboratory setting a more in-depth STEM topic that is built upon their foundational biology and chemistry knowledge. The course would be an enrichment opportunity for our students, especially for students interested in further study in the STEM fields.

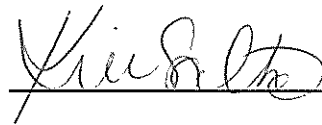
b) What impact would this proposal have on scheduling, staffing, and resources?
There are no impacts on scheduling, staffing, or resources except as noted above.

c) Do you anticipate that this course/program will have an impact on feeder programs and follow-up courses/programs currently being offered in the district?
This course has the potential to increase enrollment in AP science courses, if students take this course concurrently with chemistry or physics as underclassmen.


d) What do you anticipate will be the impact – in terms of new print and non-print materials on the library/media center?
None. Bioinformatics is accessed through online, free databases. Gene sequencing is done through Chromas (PC) or 4Peaks (Mac) computer programs.

e) Would adoption of this course/program proposal require specific staff adjustments, such as hiring new staff or retaining veteran staff?
This will not have an impact on staff or hiring, except that it is necessary for the teacher(s) delivering the program to be trained in its use. There is no expectation that a new teacher would have this specialized training. Continued training will be necessary, as these biotechnologies are rapidly improving and changing.

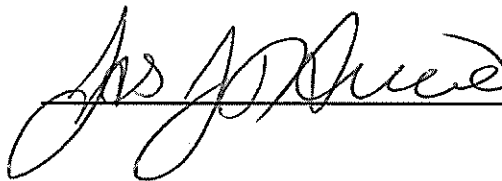
Signatures of those making this proposal: (The signatures indicate that all parts of this proposal have been thoroughly completed.)

 _____ Date: 9/27/19
_____ Date: _____

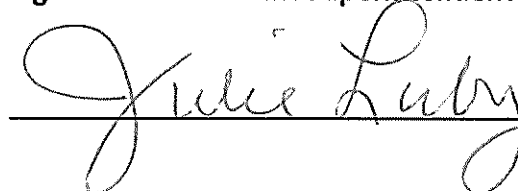
Signature of Department Chair indicating approval (if applicable):

 _____ Date: 9/27/2019

Signature of Principal indicating approval: (Please note that this proposal must bear the principal's signature before it can be sent to District Curriculum and Program Council.)

 _____ Date: 9/27/19

Signature of Assistant Superintendent indicating approval:

 _____ Date: 10/2/19

Human Genomics Topics

Unit 1: ACE (endurance) - IN/DEL

Essential Question: How do we determine the percentage of the class with each variant of the ACE (endurance) gene?

- Intro to genomics & bioinformatics
 - What is genomics and how is it different than genetics?
 - What are the fields of genomics research?
 - How do we access genomic information and models (bioinformatics)?
- Introduction to personalized genetics
 - How might new advances in personal genetics impact our lives, our medical decisions and society?
 - How would you decide whether or not to get your genome analyzed?
 - How might genome analysis change healthcare?
 - What are the benefits and concerns for you and other stakeholders?
- Ancestry tests
 - Are they accurate? What are the limitations?
 - What is admixture? How does this affect the accuracy of ancestry tests?
 - What are the ethical challenges? What are some solutions?
- Laboratory Techniques
 - Micropipetting
 - Crude DNA extraction
 - Benefits/drawbacks?
 - Polymerase Chain Reaction
 - Why do we need to use this technique? How do we carry out this technique?
 - Gel electrophoresis
 - How does this technique separate DNA fragments?

Unit 2: OXTR (the “love gene”) - SNP with A variant restriction site for BamHI

Essential Question: How can more precise and technical methodologies be utilized to determine an accurate percentage of the class with each variant of OXTR (“love”) gene if the two variants are the same number of base pairs in length?

- Genetic Variants
 - What are the different types of variants? How can each be tested for?
 - What factors affect the pathway from a gene to a disease?
 - If multiple gene variants can cause the same disorder, will treatments be the same? If not, how is the treatment determined?
- Bioinformatics
 - Utilizing case studies to become familiar with various gene databases and what each has to offer
 - What are the benefits & limitations of animal models & orthologues (comparable genes in other species)?

- What are the ethical questions surrounding the use of animals for medical/genetic models?
- History of eugenics in the US
 - How can we as a society avoid the mistakes of the past to take advantage of the promise of genetics
 - What is eugenics?
 - Why would improvements in healthcare that have the potential to save lives and reduce suffering through the use of genetic information cause people to worry about eugenics?
 - How did the eugenics movement in the United States impact people?
 - Why did some leaders think it would be beneficial to control who could have children and who could not?
 - Supreme Court case: Buck v. Bell
 - How can we avoid the mistakes of previous years so that society can benefit from advances in healthcare without the fear of unethical treatment?
- Reproductive Genetic Testing
 - How does genetic testing of embryos and fetuses offer hope to individuals wishing to have children, and what are some of the ethical implications of that testing?
 - Why have some people welcomed the option of genetic tests to learn about the genetic makeup of an embryo or fetus? What are the ethical issues surrounding the use of these tests?
 - What are the possibilities and limits of genetic testing to choose characteristics of offspring?
 - Are all of our traits determined by our genetic makeup?
 - What are potential barriers for accessing reproductive genetic technologies?
 - Do we need rules for the use of reproductive genetic technologies? If so, who should make the rules and how should they be enforced?
- Laboratory Techniques
 - Advanced DNA extraction
 - Benefits/drawbacks?
 - Polymerase Chain Reaction
 - Restriction Digestion
 - How do restriction enzymes work? How are they beneficial for genetic testing?
 - Gel Electrophoresis with Lonza Gels (most advanced/up to date way to carry out gel electrophoresis)

Unit 3: TAS2R38 (bitter taste gene) - SNP, needs to be sequenced by JAX

Essential Question: How can we determine the percentage of the class with each variant of TAS2R if the variants cannot be distinguished by one another via by gel electrophoresis? How can a full gene sequence be obtained and analyzed?

- Bioinformatics
 - How can we determine chromosomal loci?
 - How can we use genomic databases to give us information about evolution?
- Genome editing & CRISPR
 - How might advances in our ability to change genomes impact individuals and society?
 - What is the difference between analyzing DNA and modifying DNA?
 - What are the newest techniques being developed? What is CRISPR?
 - How do we make decisions about whether or not and how to proceed with genome editing?
 - How can society ensure the promises of new genetic techniques are safe and equitably shared?
- DNA, Crime & Law Enforcement
 - How will advances in DNA technology impact individuals, law enforcement and society?
 - How is scientific progress affecting how DNA is used to solve crimes in the United States?
 - What are the benefits and dilemmas of collecting DNA from people when they are arrested, but before they have been charged with a crime?
 - As a society, how should we balance privacy rights with the rights of crime victims?
 - How can DNA evidence be used to free innocent people?
 - How are different communities (within and outside your own) affected by the policies and procedures around DNA collection and law enforcement?
- Laboratory Techniques
 - Advanced DNA extraction
 - Polymerase Chain Reaction
 - Gel Electrophoresis
 - What is the purpose of carrying out this step prior to sequencing if we know it will not distinguish between our variants?
 - Prep for Sequencing
 - Sequencing the gene (carried out by Jackson Labs, results sent to us)
 - Sequence Analysis via Chromas (PC) or 4Peaks (Mac)

