C2 Pipeline Lesson Plan
Series 1

Lesson Title:

1) Introduction: Glucose, Insulin, and Diabetes
2) Glucose Monitoring: Technology and Procedures
3) Insulin Delivery: Technology and Procedures
4) Living with Diabetes: Advance and Future Technology

Objectives:

- Define and explain what is diabetes
- What causes diabetes
- What is the differences between type I and type II diabetes
- Assess personal lifestyle for risk factors of diabetes
- Measure glucose concentration in fruits and juices

- Discuss ways in which to monitor blood glucose levels
- Describe the test procedures and test principles
- Perform the test procedure and interpret results
- Comprehend how to handle low glucose readings

- Discuss various Insulin delivery techniques and procedure
- How do the various technologies work
- How are these technologies created
- Learn about engineering design and redesign.
- Learn about circuits, computers, and software coding.

- Learn how engineering innovations and technology made living with diabetes simpler
- Learn about the engineering design, creation, and marketing process
- Encourage creative thinking

Skill Development:

Measuring glucose concentrations in common foods
Properly using glucose monitoring devices
Creating process charts
Performing time studies
Reverse engineering
Engineering Design and creation process
Computer Engineering
Team Work

MI Standards/Day School Connection:

General Knowledge Needed/Taught:

Introduction to diabetes and the concepts of glucose, insulin levels, and their relationship. The differences between type I and type II are explained.
What are the necessary procedures needed to live with diabetes
How technology plays a role in assisting with living with diabetes
What tools and skills do engineers use to assist those living with diabetes

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Opening Instruction:

Class1

-Explain what glucose, why it is important, and its relationship to diabetes. Have students watch a video (See resource1) explaining glucose levels and its relationship to Diabetes. Pause video periodically to give further explanation and answer questions.
-Go through a series of myths and facts about glucose and diabetes.
-Have students perform project1, which measures glucose concentrations in common foods and juices
-Have students discuss their findings in group discussion

Class2

-Describe Glucose monitoring and why it is important for managing diabetes.
-Discuss how the different monitoring devices (blood vs. non-invasive) work. Include discussion on future technologies i.e. Phone apps and attachments
-Students perform activity2, which has them create process charts and time studies of various glucose monitoring techniques. *Optional: Students must make an instructional video for their designated glucose monitoring technique explaining the process, pros, and limitations.*
-Have students discuss their findings in group discussion. Discussion to include the respective pros and cons of the various techniques.
-Explain the complications that may occur from a low glucose reading.
-Revisit Activity 1. People with diabetes might occasionally experience low blood sugar. When this occurs, they need to eat or drink something with glucose in it right away, typically aiming for a fast intake of 15 g. Calculate how much of each food you tested would need to be consumed to provide 15 g of glucose.

Class 3

-Discuss the difference between insulin delivery techniques.
-Explain insulin pumps (and other computerized delivery devices) and how computer engineers collaborate with mechanical engineers to create them.
-Students perform activity3, which has them program Arduino board to automatically turn a light on and off at a 5 second on and 2 second off interval.
-Optional: Once student have a grasp of simple programing functions, create other blink challenges with different time intervals
-Have students discuss their findings in group discussion

Class 4

-Visit future insulin delivery technologies that are currently being explore including InsuLenz, Insulin Inhalers, Insulin Patch, etc.
-Discuss Engineering Design Process
-Student perform activity4, which challenges them to come up with a device/technology that would make the lives of people with diabetes simpler. Encourage students to use imaginations and be as creative as possible. Students are encouraged to create a mock-up image or 3D Model
-Students must then create an elevator pitch (shark tank style) to get potential investors (teacher and spectators) interested in their product.

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Supplies/Equipment/Resource:

- Resource1 - http://www.youtube.com/watch?v=rPLjSY00JlE
- Resource2 - http://photonicssociety.org/newsletters/apr98/overview.htm
- Resource3 - http://medcitynews.com/2013/10/will-first-noninvasive-bloodless-glucometers-look-like-theyll-probably-clip-ear/
- Resource4 - http://www.diabetesmine.com/2013/06/vision-of-the-diabetes-future-contact-lenses-that-deliver-insulin.html
- Individual student journals
- Disposable cups, at least 8 oz. (8 plus one for each food or juice you want to test)
- Permanent marker
- Glucose tablets with 4 g of glucose per tablet; available at most drug stores or online at Amazon.com.
- Optional: Knife and spoon
- Water
- Graduated cylinder (100 mL volume)
- Diastix® glucose test strips for urinalysis (8 plus three for each food or juice you want to test); available at drug stores or online at Amazon.com.
- Foods and juices to test. Categorize as fresh or processed. Some examples are listed below.
    - Fruit juices: orange juice, lemon juice (you will be surprised!)
    - Fresh fruit (sliced): apple, pear, pineapple, cucumber, tomato
    - Processed foods: soft drinks, diet soft drinks, salad dressing, baby food, vinegar, peanut butter, sauces used on fast food hamburgers, ice cream (melted)
    - Miscellaneous: honey, sugar water (sucrose mixed with tap water), molasses
- Graduated cylinder (10 mL volume) or measuring teaspoons
- Video recorder / Camera phone (optional)
- Stopwatch
- Blood glucose control solutions (can be purchased or made)
- Blood Glucose Meters (Variety)
- Compatible Glucose Test Strips
- Classroom Materials: computer with internet access
- (for set up);
- Arduino Board kit (You can purchase individual items or a starter kit
    - Arduino Uno
    - 3' USB Cable
    - Solderless breadboard
    - 65 jumper wires
    - Breadboard holder
    - (can be purchased for $38 US via Amazon; items can also be purchased directly from other electronics suppliers and links are available through Arduino at http://arduino.cc/en/)
- Student Team Materials: Arduino board, connectors, optional breadboard, led lights, fan, insulators.

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Guided Practice Activities:
Activity1 – Estimating Glucose Concentration in Your Food
http://www.sciencebuddies.org/science-fair-projects/project_ideas/FoodSci_p049.shtml#procedure

Activity2 – Glucose Monitoring Technology Presentations

Activity3 – Arduino Blink Challenge
http://www.tryengineering.org/sites/default/files/lessons/arduinoblink.pdf

Activity4 – Technology Pitch Competition

Closure/Reflection:
Students record project results and finding into student journals during every class
Teacher responsible for guiding group discussion to reflect on projects relevance on topic of diabetes

Assessment/Notes:
-Each class should begin and end with group discussion to gage current knowledge of classroom and reflect on the day's learnings

Grant Alignment (circle or highlight all that apply):

School of Medicine	School of Social Work	Honors College
College of Pharm/Health Science	College of Nursing	College of Engineering
STEM: Engineering	Health Care Career	

C2 Pipeline Lesson Plan
Series 2

Lesson Title:

1) Living with Diabetes: Diabetes and Amputation
2) Prosthetic Limbs Design1
3) Prosthetic Limbs Design2
4) Prosthetic Limb Design wrap-up

Objectives:

- Assess personal lifestyle for risk factors of diabetes
- Learn how prosthetic technologies are created
- Learn about 3D Modeling
- Learn design concepts.
- Improve problem solving techniques.

Skill Development:

Mechanical engineering
Biomedical engineering
Engineering Design and creation process
Team Work

MI Standards/Day School Connection:

General Knowledge Needed/Taught:
How technology plays a role in assisting with living with diabetes
What tools and skills do engineers use to assist those living with diabetes

Opening Instruction:

Class1
-Discuss the potential risks and complications associated with diabetes, including: heart disease, kidney disease, retinopathy and neuropathy. Can be done by watching a video and periodically stopping in order to provide further explanation and answer questions.
-Discuss how severe neuropathy leads to amputation.
-Take students on tour of Computer Assisted Robot Enhances Systems (CARES) Lab
-Student perform activity1, which includes building a robot arm using common materials. Student will be challenged to develop and design to assist a patient who may need assistance picking up an object. Students will be judge on amount of materials used and design performance.
-Have students discuss their findings in group discussion
-If time permits begin introduction to AutoDesk 3D modeling software.

Class2
-Begin session by reviewing Class1 learnings about amputations.
-Describe various concepts and tools engineers use in modeling and designing prosthetic limbs
-Students participate in AutoDesk Inventor tutorials.
-Allow time for students to explore using 3D modeling software freely.

Class 3
-Continue AutoDesk Inventor tutorials.

-Gage the overall level of comfort using the software
-Challenge student try to create a 3D model of a limb. Use measuring tape to gather dimension estimates (Advance)
-Provide students with 3D drawing of limb. Provide students with prosthetic limb dimensions and have student create a design to specifications.

Class 4
-Complete Prosthetic Limb Design Project
-Discuss 3D printing and how designs are prototyped and fit for patients in real world (optional)
-Discuss Gait Lab Analysis (optional)
-Have students perform Activity4 (optional)
-Do a comprehensive review of all material covered in course (optional)
-Have students end with a post-test (optional)

Supplies/Equipment/Resource:

- Resource1 - http://www.3dcadbrowser.com/download.aspx?3dmodel=57856
- Resource2 - http://www.huffingtonpost.com/2013/11/04/dad-prints-prosthetic-hand-leon-mccarthy_n_4214217.html
- Resource3 - http://www.youtube.com/watch?v=DpdlJ79ACCo
- Resource4 - http://www.youtube.com/watch?feature=player_embedded&v=zUWX1Tmt4x8
- Resource5 - http://www.diabetes.co.uk/diabetes-and-amputation.html
- Resource6 - http://www.youtube.com/watch?v=cjyik_wss5U
- AutoDesk Inventor (free student version download)
- 3" wide and approx. 22" long strips of cardboard-- 5 or so
- Binder clips (different sizes)-- 8 or more
- Brads-- @10
- Clothespins-- 6
- Craft sticks--10-15
- Fishing line-- 3-4 feet
- Hangers-- 1 or 2
- Paper clips (diff. Sizes)-- 10-15
- Pencils-- 3-4
- Rubber bands (different sizes)--15
- Tape-- clear and masking (partial rolls should be fine)
- Twine-- 3-4 feet
- Various size scraps of cardboard--10 assorted
- Measuring Tape
- Sample prosthetic limb
- Stop Watch
- Ankle weights
- Velcro Straps
- Crutches

C2 Pipeline Lesson Plan
Series 2

Guided Practice Activities:
Activity1 – Robotic Arm Design Competition
http://www.sciencebuddies.org/science-fair-projects/project_ideas/FoodSci_p049.shtml#procedure

Activity 2 - 3D Modeling and Design

Activity4 – Gait Analysis (optional)

Closure/Reflection:
Students record project results and finding into student journals during every class
Teacher responsible for guiding group discussion to reflect on projects relevance on topic of diabetes

Assessment/Notes:
-Each class should begin and end with group discussion to gage current knowledge of classroom and reflect on the day's learnings

Grant Alignment (circle or highlight all that apply):

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