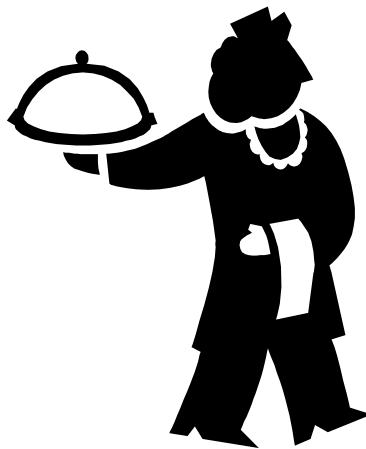




# **Type II Diabetes Prevention Curriculum**

## **Educating Youth about Diabetes and Nutrition**



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Dear Educator:

This curriculum is designed as a supplement to Anatomy & Physiology curriculums (or other science curriculums). The lesson plans and activities make use of existing websites and other resources to integrate information about type 2 diabetes as examples of science concepts. As a classroom teacher, I strive to bring real world applications into every aspect of my courses. This curriculum simply uses the topic of diabetes to accomplish this. Worksheets and lesson plans were developed by me to make use of existing websites. Website information is included within the worksheets to direct students to the correct site. Website information that was pulled out and placed within the curriculum worksheets has URL information listed to ensure the correct party receives credit for their information.

Most lesson plans are independent of each other and may be used in any order. If lesson plans are sequential, a note is made on the teacher page. All worksheets and objectives are provided in an editable form. Please edit as needed to provide the best fit for your classroom needs.

The following websites contain articles discussing the increase in Type II diabetes in children and teenagers.

[http://www.heartcenteronline.com/myheartdr/home/research-detail\\_print.cfm?reutersid=950](http://www.heartcenteronline.com/myheartdr/home/research-detail_print.cfm?reutersid=950)

[http://www.heartcenteronline.com/myheartdr/home/research-detail\\_print.cfm?reutersid=2419](http://www.heartcenteronline.com/myheartdr/home/research-detail_print.cfm?reutersid=2419)

## **Curriculum Objectives**

### **TEKS provided for Anatomy & Physiology of Human Systems on each teacher page**

1. Student will analyze current dietary choices.
  - a. Student will describe current dietary choices by completing the Daily Menu worksheet. Teacher will provide information about portion sizes using the Nutritional Information Sheet.
  - b. Student will assess nutritional background by completing the Assess Yourself worksheet.
  - c. Student will analyze current dietary choices using websites given on Diabetes Analysis worksheet.
  
2. Students will demonstrate current knowledge of diabetes in a pretest activity.
  - a. Students will form small groups of 3-4 students.
  - b. Students will list all current knowledge about diabetes gathered from the group using the Diabetes Brainstorm Pre-test Activity.
  - c. Class will summarize knowledge gained from all groups.
  - d. Teacher will type up summary for use in post-test analysis at end of unit or simply save all student sheets.
  
3. Students will identify the molecules and pathways involved in processing and storing energy in the body.
  - a. Student will receive information on basic biological molecules: carbohydrates, lipids, and proteins through lecture or textbook.
  - b. Students will receive Biochemical Aspects of Diabetes Notes.
  - c. Students will organize material from notes onto body chart provided by the teacher.
  - d. Students will demonstrate mastery of concepts by taking Biochemical Aspects of Diabetes Quiz.
  
4. Student will research the relationship of cell receptor insensitivity and insulin uptake.
  - a. Teacher will provide information over basic cell structure, cell membrane structure, and integral and peripheral proteins within the cell membrane.
  - b. Student will complete computer based lesson using the Relationship of Cell Receptors and Insulin Uptake Worksheet.
  
5. Students will identify the different cell types present in pancreatic tissue and discuss the functions of each cell type.
  - a. Teacher will provide information on basic histology using textbook.
  - b. Students will receive information about pancreatic tissue using the notes: Histological Study of the Cells Involved in Glucose Metabolism.
  - c. Students will identify, sketch, and label prepared slides of pancreatic tissue.

6. Students will analyze why certain organs are damaged by diabetes.
  - a. Students will complete the Potential Complications of Diabetes Worksheet using the website provided or a copy of the website pages.
  - b. Students will synthesize and apply the following concepts through class discussion following worksheet completion:
    1. Biological molecule types & functions
    2. Transport across cell membranes with or without transport molecules
    3. Structure and function integration
    4. Cause and effect relationship
7. Students will research and organize information on common diabetic complications.
  - a. Students will complete the Diabetic Complications Research Project Sheet.
  - b. Students will organize information gained from research and give an oral presentation to the class.
8. Students will research and describe the contributions of scientists to the knowledge of diabetes.
  - a. Students will complete diabetes research using Internet sources.
  - b. Students will arrange findings into a class Diabetes Timeline.
9. Students will determine risk factors associated with Type 2 Diabetes and assess their own personal risk of contracting diabetes.
  - a. Students will work with a partner to brainstorm diabetes risk factors.
  - b. Class will discuss all possible risk factors and reasoning behind their choice.
  - c. Class will compare prepared list with class list and analyze their personal risk.
10. Students will prepare and follow a five day meal plan to improve their personal nutrition.
11. Students will research and organize an informational booklet on type II diabetes and nutrition. The target audience will be teenagers.

## **Lesson #1 – Teacher Instruction Page**

**Use of activities: To help students become interested in the basic biological molecules or as an introduction into nutrition & metabolism**

TEKS: 2BCD, 3BC

Student will analyze current dietary choices.

- a. Student will describe current dietary choices by completing the Daily Menu worksheet. Teacher will provide information about portion sizes using the Nutritional Information Sheet.
- b. Student will assess nutritional background by completing the Assess Yourself worksheet.
- c. Student will analyze current dietary choices using websites given on Daily Menu Analysis worksheet.

### **Activity 1: 30-45 minutes**

1. Bring in a deck of playing cards, a 1 cup (8 ounce) measuring cup, teaspoon and tablespoon measuring spoons, an empty soda (not diet) can, and a food scale (if one is available).
2. Explain to students that they will be listing what they eat on a typical day. They will need to list specific sizes or quantities for each item.
3. Using the items from #1, demonstrate:
  - a. a serving of meat 3-4 ounces (16 oz. Equals 1 lb) = a deck of playing cards
  - b. a serving of cooked vegetables = ½ cup
  - c. a serving of leafy vegetables = 1 cup
  - d. a serving of most liquids = 8 ounces
  - e. for fast food items: put size of item ex: large french fries
4. Hand out Daily Menu Worksheet:
  - a. allow students approximately 20 minutes to complete
  - b. keep measuring props out so students can estimate their portion sizes

### **Activity 2: 30 minutes to 1 hour (dependent on student's ability to utilize computer skills)**

1. Before going to computer lab:
  - a. Students should know their current height, weight, waist measurement, and hip measurement.
  - b. Students should know the distance between the 2 bones on the backside of their elbow. (between lateral and medial epicondyles).
2. Hand out the Assess Yourself Worksheet.
3. Have students log on to computer and Internet Explorer or Netscape Navigator.
4. Students should type in website addresses and follow instructions.
5. Students should take brief notes on the information they learn from the websites in order to answer the overview questions.

### **Activity 3: 3: 1-1 ½ hours (dependent on student's ability to utilize computer skills)**

1. Hand out the Daily Menu Analysis Worksheet.
2. Have students log on to computer and Internet Explorer or Netscape Navigator.
3. Students should type in website addresses and follow instructions.
4. I highly recommend trying out these websites ahead of time. The second one can be a bit cumbersome to explain if you have not gone through it yourself.

5. When grading this 3-day assignment, check for the basic information that students were asked to provide. This is a participation and instruction-following assignment to capture their attention about the necessity of knowing about biological molecules.
6. Save this activity for use with lesson #8 - the personal health plan activity

## **Daily Menu Worksheet**

**Name :** \_\_\_\_\_

List every item that you had for breakfast yesterday. Include beverages and approximate amounts.

List every item that you had for lunch yesterday. Include beverages and approximate amounts.

List every item that you had for supper yesterday. Include beverages and approximate amounts.

List the items from the above menu that you feel are the healthy choices.

List the items from the above menu that you feel are the unhealthy choices.

How often per week do you eat "fast food" choices?

## **Assess Yourself Worksheet**

On most websites, you will need to enter your age as 18.

1. Use the website below to run the Healthy Body Calculator.  
<http://www.dietitian.com/ibw/ibw.html>
2. Use the website below to run the Fat Screener.  
[http://www.nutritionquest.com/fat\\_screener.html](http://www.nutritionquest.com/fat_screener.html)
3. Use the website below to run the Fruit, Vegetable, and Fiber Screener.  
[http://www.nutritionquest.com/fv\\_screener.html](http://www.nutritionquest.com/fv_screener.html)
4. Briefly summarize the information gained from using the above websites. Include answers to questions such as: Is your nutrition above or below the recommended guidelines? Is your body healthy? What changes could you make to increase your health?

## Daily Menu Analysis

Use the website below to analyze the choices that you have selected.

<http://dawp.anet.com/>

To use the website, complete the following steps:

- a. Set your demographics.
- b. Add Food by Category.
- c. View Intake when Finished with all Your Selections.
- d. Analyze your Diet.
- e. Print the Diet Analysis Page.

If the above website is not working, try this one but it is more cumbersome to use.

Option: <http://www.nat.uiuc.edu/mainnat.html>

- a. Choose your personal category in step 1.
- b. Step 2: type in a basic description of your food.
- c. Click on "add food".
- d. A list of foods covering your basic description will come up. You need to scroll down the lists until you find the closest description and pick it.
- e. Then click on "add selected food".
- f. Choose serving number and serving size.
- g. Then click on "Add this amount".
- h. Continue adding foods until your menu is completed.
- i. Then click on "analyze foods".
- j. Then click on "display all nutrients".
- k. To Print: go to the file menu, pick print, only print page 1 of this document.

Option: <http://www.kenkuhl.com/fastfood/fastfacts.shtml>

This website contains nutritional information about fast food restaurants. You may look up specific items to include in your analysis but will need to add up the calorie, etc, totals.

Staple the Daily Menu Worksheet, Assess Yourself worksheet, Diet Analysis Page and any additional information used or notes taken to the back of this page.

## **Lesson #2 – Teacher Instruction Page**

**Use of activities: Demonstrate current knowledge of diabetes as a pretest activity. This may be used directly after Lesson #1 in order to focus the students on the Diabetes strand that will be taught throughout the course.**

TEKS: 4BC

Students will demonstrate current knowledge of diabetes in a pretest activity.

- a. Students will form small groups of 3-4 students.
- b. Students will list all current knowledge about diabetes gathered from the group using the Diabetes Brainstorm Pre-test Activity.
- c. Class will summarize knowledge gained from all groups.
- d. Teacher will type up summary for use in post-test analysis at end of the unit or simply save all student sheets.

### **Activity 1: 30 minutes**

1. Have students divide up into partners or small groups depending on class size.
2. Hand out the Diabetes Brainstorm Pre-test Activity.
3. Give students approximately 15 minutes to brainstorm or until all groups appear to be finished.
4. Using an overhead transparency of a blank copy of the Diabetes Brainstorming Pre-test Activity, summarize the class knowledge. I have found it to be very successful to call on each group and have each group state one fact. I continue to go around the room until there are no new facts. Save this transparency or make a copy of it to use at a later date.
5. You may choose at this time to deal with misconceptions immediately or wait until you have reached the chapter that covers that particular topic.

### **Activity 2: 30 minutes**

Handout the Overview of Diabetes Notes Worksheet and discuss it briefly with the students. This information will give them a framework of reference for future discussions about diabetes. I have also included a notes worksheet to go along with the Marieb book edition. Change page numbers as needed.

1. I do not grade this activity at all but use it as a focus point for the rest of the course.
2. A good resource for your information is  
<http://www.cdc.gov/diabetes/pubs/factsheet.htm>

## **Diabetes\_Brainstorming Pre-test Activity**

### **Instructions:**

Form groups of 3-4 students. List all the knowledge that you currently have about Diabetes under the appropriate category.

1. Types of Diabetes and a description of each.

2. Role of the following in Diabetes

a. Pancreas

b. Insulin

c. Glucagon

d. Glucose

3. Complications of Diabetes

4. Prevention & Control of Diabetes

5. Other facts about Diabetes

# Overview of diabetes

Information below excerpted from the following website.

[http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/pancreas/insulin\\_phys.html](http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/pancreas/insulin_phys.html)

Diabetes mellitus is an insulin deficiency state. Two principal forms of this disease are recognized:

**a. Type I or insulin-dependent diabetes mellitus** is the result of a deficiency of insulin. The onset of this disease typically is in childhood. It is due to destruction of pancreatic B cells, most likely the result of autoimmunity to one or more components of those cells. Many of the acute effects of this disease can be controlled by insulin replacement therapy, but inevitably, there are long-term adverse effects on blood vessels, nerves and other organ systems.

Type 1 - insulin-dependent

- a. Usually develops before age of 15
- b. beta cells affected
- c. totally lacking insulin activity
- d. insulin injections required

**b. Type II or non-insulin-dependent diabetes mellitus** begins as a syndrome of insulin resistance. That is, target tissues fail to respond appropriately to insulin. Typically, the onset of this disease is in adulthood. Despite monumental research efforts, the nature of the defect has been difficult to ascertain - in some patients, the insulin receptor is abnormal, in others, one or more aspects of insulin signaling is defective, and in others, no defect has been identified. Because there is not, at least initially, an inability to secrete adequate amounts of insulin, insulin injections are not useful for therapy. Rather the disease is controlled through dietary therapy and hypoglycemic agents.

Type 2 - insulin-independent

- a. usually occurs in obese adults after age 40
- b. rapid increase of diagnosis in younger age group
- c. heredity factors and dietary factors influence onset
- d. 90% of diabetes cases are Type 2

**c. Main symptoms**

1. polyuria – excessive urination due to prevention of water reabsorption caused by excess glucose
2. polydipsia – excessive thirst due to dehydration from polyuria
3. polyphagia – excessive hunger due to glucose unavailability to cells
4. most common symptom is fatigue from energy deficiency state

**d. treatment : Type 2**

1. dietary intervention
2. exercise
3. possible insulin pill /injection
4. antidiabetic drugs
  - a. stimulate normal insulin production
  - b. increase insulin sensitivity at the cellular level
5. regular physician visits

**e. diagnosis :**

1. random blood glucose level equal or above 200 mg/dl
2. fasting plasma glucose level equal to or greater than 140 mg/dl at 2 hours

# Overview of the Pancreas and Diabetes Mellitus

From Human Anatomy & Physiology, Elaine Marieb

## The Pancreas - page 555 - 559

1. The pancreas is both an endocrine & exocrine gland
  - a. the endocrine part is composed of \_\_\_\_\_ which produce pancreatic \_\_\_\_\_.
  - b. the exocrine part is composed of \_\_\_\_\_ cells which produce \_\_\_\_\_.
2. Major populations of secretory cells - list product
  - a. alpha -
  - b. beta -
  - c. delta -
3. Hypoglycemic hormone is \_\_\_\_\_.
4. Hyperglycemic hormone is \_\_\_\_\_.
5. One molecule of glucagon releases \_\_\_\_\_ molecules of glucose.
6. Glucagon targets the \_\_\_\_\_ and acts through \_\_\_\_\_ to promote (list & define):
  - a.
  - b.
7. Glucose is then released to the bloodstream which raises \_\_\_\_\_ and lowers \_\_\_\_\_. Secretion of glucagon is prompted by the \_\_\_\_\_ stimuli such as \_\_\_\_\_ or \_\_\_\_\_.
8. Study and memorize fig 17.18 and know the cycles of regulation.
9. Circulating insulin lowers blood glucose levels by enhancing \_\_\_\_\_ by \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
10. Insulin is not necessary for glucose uptake by \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

11. After entering cells, insulin triggers enzymatic activities that
  - a.
  - b.
  - c.
12. As a rule, insulin is utilized in the following order:
  - a.
  - b.
  - c.
13. Insulin also induces \_\_\_\_\_ demonstrating that it is essential for \_\_\_\_\_
14. Its release is stimulated by any \_\_\_\_\_ and depressed by \_\_\_\_\_ demonstrating that it is controlled by both \_\_\_\_\_ & \_\_\_\_\_ stimuli.

**Answer the following questions from the diabetes mellitus imbalance symbol on page 557. Also study fig 17.20 on page 558**

1. Diabetes mellitus arises from the \_\_\_\_\_ or \_\_\_\_\_ of insulin.
2. What are the symptoms when a person becomes hyperglycemic?
3. How does this inappropriately lead to a further increase in blood sugar levels?
4. Glycosuria -
5. Define ketosis and discuss briefly how it occurs.

6. What physiologically results from untreated ketosis?

7. List and explain the 3 cardinal signs of diabetes.

a.

b.

c.

8. IDDM

a. cause:

b. age range:

c. treatment:

d. symptoms & complications:

9. NIDDM

a. cause:

b. age range:

c. treatment:

d. symptoms & complications: Same as IDDM

## **Lesson #3 – Teacher Instruction Page**

**Use of activities: Provide real life examples of the types of biological molecules in the body and the chemical reactions that release energy for the body.**

TEKS: 4ABC

Students will identify the molecules and pathways involved in processing and storing energy in the body.

- a. Student will receive information on basic biological molecules: carbohydrates, lipids, and proteins through lecture or textbook.
- b. Students will receive Biochemical Aspects of Diabetes Notes.
- c. Students will organize material from notes onto body chart provided by the teacher.
- d. Students will demonstrate mastery of concepts by taking Biochemical Aspects of Diabetes Quiz.

### **Activity 1: Time dependent on method of presentation**

1. Provide information to students through lecture, etc, over basic structure and function of carbohydrates and proteins.
2. Biochemical Aspects of Diabetes Notes may be provided to the students at this time to study over for the following day's activity or you may choose to hand out the notes just prior to the activity.

### **Activity 2: 1 to 1 ½ hours**

1. Teacher should create a Biochemical Aspects of Diabetes Worksheet using a Digestive system diagram, a negative feedback diagram, concept mapping or a Venn diagram.
2. Students will complete the diagrams by using their Anatomy & Physiology books and the Biochemical Aspects of Diabetes Notes. Encyclopedias, medical information texts, websites, etc could also be used. The Study Guide that accompanies the Human Anatomy & Physiology book by Elaine Marieb has good diagrams of both the digestive system and the negative feedback system. Diagrams were not provided to ensure copyright protection.
3. Students should be required to organize the processes from the notes and integrate descriptions of the processes onto the appropriate diagram.

### **Activity 3: 20 minutes**

1. Students will take quiz over Biochemical Aspects of Diabetes.

## **Biochemical Aspects of Diabetes Notes**

### **I. Glucose (monosaccharide)**

- A. Dietary sources
  1. Milk sugar – lactose
  2. Glycogen in meats
  3. Most derived from plants
- B. Digestion of carbohydrates
  1. Salivary amylase in the saliva begins splitting starch into smaller fragments.
  2. Pancreatic amylase in the small intestine split carbohydrates into maltose and short chain dextrans and oligosaccharides (4-9 glucose molecules long).
  3. Intestinal brush border enzymes (dextrinase, glucoamylase, maltase, sucrase, & lactase) further digest these products to monosaccharides.
- C. Absorbed monosaccharides delivered directly to liver where conversion to glucose takes place.
- D. Glucose is:
  1. Released to blood to enter body cells to be metabolized for Energy.
  2. Converted to glycogen which is stored in liver.
  3. Converted to fat which is released to blood to go to adipose cells for storage (80-85% of stored energy).

### **II. Insulin (hypoglycemic hormone)(51 amino acid polypeptide)**

- A. Beta cells of pancreatic islets of Langerhans stimulated to secrete insulin by:
  1. Blood glucose levels above 100 mg glucose/100 ml blood
  2. Elevated amino acid and fatty acid levels in blood
- B. Liver, kidney, and brain tissue all have easy access to glucose independent of insulin levels
- C. Insulin functions to:
  1. Transport glucose into muscle cells, fat, connective tissue, and white blood cells for use as energy by triggering activities which catalyze the oxidation of glucose to ATP
  2. Join glucose together to form glycogen for storage
  3. Enhance free fatty acid storage in fat deposits
  4. Stimulate amino acid uptake and protein synthesis in muscle tissue
  5. Inhibit any of the metabolic activities listed below that would increase plasma levels of glucose
    - a. Breakdown of glycogen to glucose
    - b. Conversion of amino acids or fatty acids to glucose
    - c. Decreases cyclic AMP levels

### **III. Glucagon (hyperglycemic hormone)(29 amino acid polypeptide)**

- A. Secreted by alpha cells of pancreatic islets of Langerhans in response to:
  - 1. Declining blood glucose levels.
  - 2. Increasing amino acids blood levels (ie. protein rich meal).
- B. One molecule causes the release of 100 million molecules of glucose into the blood.
- C. Target organ is liver.
- D. Acts through cyclic AMP to:
  - 1. Convert glycogen to glucose (glycogenolysis) which is released to blood to raise blood sugar levels.
  - 2. Form glucose from fatty acid and amino acid molecules (gluconeogenesis) causing a drop in amino acid level of blood.

## **Biochemical Aspects of Diabetes Worksheet**

Use the information given in the Biochemical Aspects of Diabetes Notes to complete the diagrams provided.

### **Excellent references**

<http://web.indstate.edu/thcme/mwking/diabetes.html#insulinaction>

Medical biochemistry: upper level reference with details on insulin action, definition of diabetes, etc

[http://c4.cabrillo.cc.ca.us/projects/insulin\\_tutorial/](http://c4.cabrillo.cc.ca.us/projects/insulin_tutorial/)

Tutorial on protein molecule structure using insulin as an example

<http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/pancreas/index.html>

Covers anatomy of pancreas, action of insulin, action of glucagon

# Biochemical Aspects of Diabetes Quiz

## Multiple choice

1. Which one of the following is NOT a major source of glucose?
  - a. Milk
  - b. Butter
  - c. Meat
  - d. Fruits & vegetables
2. Which one of the following enzymes is found in both the saliva and the pancreas?
  - a. Amylase
  - b. Dextrinase
  - c. Maltase
  - d. Lactase
3. Brush border enzymes in the \_\_\_\_ further digest carbohydrates into monosaccharides.
  - a. stomach
  - b. mouth
  - c. large intestine
  - d. small intestine
  - e. liver
4. Glucose is converted into glycogen and stored in which organ?
  - a. stomach
  - b. mouth
  - c. large intestine
  - d. small intestine
  - e. liver
5. Which one of the following cells do NOT have access to glucose unless insulin is present?
  - a. liver
  - b. kidney
  - c. skeletal muscle
  - d. brain
6. Insulin is secreted by the \_\_\_\_ cells of the pancreas.
  - a. alpha
  - b. beta
  - c. gamma
  - d. delta
7. Insulin secretion is stimulated when the blood glucose levels rise above \_\_\_\_mg glucose per 100 ml of blood.
  - a. 25
  - b. 50
  - c. 75
  - d. 100
  - e. 125

8. Glucagon is secreted by the \_\_\_\_ cells of the pancreas
- a. alpha
  - b. beta
  - c. gamma
  - d. delta

---

**Place the following events in the order that the body utilizes glucose.**

- \_\_\_\_\_ Converted to fat
- \_\_\_\_\_ Released to blood
- \_\_\_\_\_ Converted to glycogen

---

**Determine if each of the following refers to:**

- I. Insulin
- G. Glucagon

- \_\_\_\_\_ Joins glucose together to form glycogen for storage
- \_\_\_\_\_ Transports glucose into muscle cells, fat, connective tissue, and WBC for use as energy
- \_\_\_\_\_ Secreted in response to declining blood glucose levels
- \_\_\_\_\_ Converts glycogen to glucose which is released to blood
- \_\_\_\_\_ Forms glucose from fatty acid and amino acid molecules
- \_\_\_\_\_ Stimulates amino acid uptake and protein synthesis in muscle tissue

---

**Complete the labels on the diagram.**

## Key: Biochemical Aspects of Diabetes Quiz

### Multiple choice

1. Which one of the following is NOT a major source of glucose?
  - a. Milk
  - b. Butter**
  - c. Meat
  - d. Fruits & vegetables
2. Which one of the following enzymes is found in both the saliva and the pancreas?
  - a. Amylase**
  - b. Dextrinase
  - c. Maltase
  - d. Lactase
3. Brush border enzymes in the \_\_\_\_ further digest carbohydrates into monosaccharides.
  - a. stomach
  - a. Mouth
  - b. large intestine
  - c. small intestine**
  - d. liver
4. Glucose is converted into glycogen and stored in which organ?
  - a. stomach
  - b. Mouth
  - d. large intestine
  - e. small intestine
  - f. liver**
5. Which one of the following cells do NOT have access to glucose unless insulin is present?
  - a. liver
  - b. kidney
  - c. skeletal muscle**
  - d. brain
6. Insulin is secreted by the \_\_\_\_ cells of the pancreas.
  - a. alpha
  - b. beta**
  - c. gamma
  - d. delta
7. Insulin secretion is stimulated when the blood glucose levels rise above \_\_\_\_mg glucose per 100 ml of blood.
  - a. 25
  - b. 50
  - c. 75
  - d. 100**
  - e. 125

6. Glucagon is secreted by the \_\_\_\_ cells of the pancreas
- a. **alpha**
  - b. beta
  - c. gamma
  - d. delta

---

**Place the following events in the order that the body utilizes glucose.**

- 3** \_\_\_\_ Converted to fat  
**1** \_\_\_\_ Released to blood  
**2** \_\_\_\_ Converted to glycogen

---

**Determine if each of the following refers to:**

- I. Insulin  
G. Glucagon

- \_\_\_ **I** \_\_\_ Joins glucose together to form glycogen for storage  
\_\_\_ **I** \_\_\_ Transports glucose into muscle cells, fat, connective tissue, and WBC for use as energy  
\_\_\_ **G** \_\_\_ Secreted in response to declining blood glucose levels  
\_\_\_ **G** \_\_\_ Converts glycogen to glucose which is released to blood  
\_\_\_ **G** \_\_\_ Forms glucose from fatty acid and amino acid molecules  
\_\_\_ **I** \_\_\_ Stimulates amino acid uptake and protein synthesis in muscle tissue

---

**Complete the labels on the diagram.**

## **Lesson #4 – Teacher Instruction Page**

**Use of activities: Provide real life examples of the functions of cellular receptors in regulation of body chemistry.**

TEKS: 4ABC, 6AB, 8ABC

Student will research the relationship of cell receptor insensitivity and insulin uptake

- a. Teacher will provide information over basic cell structure, cell membrane structure, and integral and peripheral proteins within the cell membrane.
- b. Student will complete computer based lesson using the Relationship of Cell Receptors and Insulin Uptake Worksheet

### **Activity 1: Time dependent on method of presentation**

1. Provide students with information over basic cell structure, cell membrane structure, and integral and peripheral proteins within cell membrane.
2. Provide students with diagrams of the above structures

### **Activity 2: 30-45 minutes**

1. Hand out the Relationship of Cell Receptors and Insulin Uptake Worksheet.
2. Briefly discuss the Basic Information contained in the Worksheet.
3. Have students complete the information on the worksheet in the computer lab or at home if necessary.

## **Relationship of Cell Receptors and Insulin Uptake**

### **Basic Information**

- A. Obesity contributes to the resistance to endogenous insulin.
- B. Stress causes prolonged elevation of hormone levels (cortisol, epinephrine, glucagon, and growth hormone which leads to a rise in blood glucose levels which in turn increases demands on pancreas.
- C. Some medications can antagonize effects of insulin  
examples: thiazide diuretics, adrenal corticosteroids, and oral contraceptives.

To complete this worksheet, please go to each website & read through the information. Use the information to answer each of the questions.

### **I. The Insulin Receptor and Mechanism of Action**

[http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/pancreas/insulin\\_phys.html](http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/pancreas/insulin_phys.html)

1. Where is the receptor for insulin located?
2. What is the insulin receptor composed of?
3. Sketch the structure of an insulin receptor using the diagram provided in the website. Be sure to label each component.
4. What is the only mechanism by which cells can take up glucose? Use your textbook to give a brief description of this mechanism.
5. The major transporter for insulin is called \_\_\_\_\_ and is normally found in the \_\_\_\_\_.
6. Using the moving simulation provided on the website, describe the sequence of events that must occur to allow a cell to take up glucose.
7. What happens to the glucose transporters when insulin levels in the blood decrease?
8. Which tissues do not require insulin and why?

## II. DIET AND INSULIN RESISTANCE

Go to the following website and scroll down until you find the diet and insulin resistance portion. Use the information to answer the following questions. Those students who have an interest in exercise physiology will find the entire article interesting.

<http://www.rice.edu/~jenky/sports/Insulin.athlete.html>

1. Describe insulin sensitization, what it accomplishes, and how it is accomplished.

2. What are obesity and high fat diets responsible for?

3. How can insulin resistant individuals be helped?

4. Using your book, notes, & knowledge about diabetes type II; Discuss in a brief paragraph, the physiological effects of insulin resistance to the human body.

For Extra Credit: Go to the following article, read it, and write a one page front and back summary of the article and your thoughts about this topic.

<http://www.joslin.harvard.edu/news/obesity02.shtml>

## DIET AND INSULIN RESISTANCE

It is not hyperinsulinemia that is the problem, it is the receptor. It has been repeatedly shown in the medical literature that increasing the sensitivity of peripheral insulin receptors reduces hyperinsulinemia and hypertension. This process is termed insulin sensitization and is accomplished by aerobic exercise, low-fat / high-carbohydrate diet, and reduction of excessive body fat. Conversely, obesity and high fat diets have been shown to induce insulin resistance. It is important that the high carbohydrate diet have predominantly complex carbohydrates and also have a high fiber content. Overly refined, simple sugars do not appear to have the same effect as complex carbohydrates. If one looks at epidemiological data, the traditional diet of many third world countries consists of high complex carbohydrate content, very low fat, and high fiber. Atherosclerotic disease was virtually unheard of until the introduction of the high fat Western diet. There are many published studies which show that starting insulin resistant individuals on a high carbohydrate / low fat diet reduces hyperinsulinemia, hypertension, and hyperlipidemia. For example in a study published in the American Journal of Cardiology (Am J Cardiol 1992;69:440-444), diabetic patients (NIDDM), insulin resistant patients, and normal controls were started a 3 week program of diet ( 75 - 80% carbohydrate, 10-15% protein, and <10% fat) and exercise. In all there were statistically significant reductions in blood pressure, insulin levels, and triglycerides. Additionally, high-carbohydrate / high-fiber diets have been shown to lower cholesterol and may reduce the risk of colon cancer.

Article provided from:

<http://www.rice.edu/~jenky/sports/Insulin.athlete.html>

(not copyright protected as stated in full text article on website)

## **Lesson #5 – Teacher Instruction Page**

### **Use of activities: Perform an histological study of the pancreatic tissue involved in the production of insulin and glucagon.**

TEKS: 10A

Students will identify the different cell types present in pancreatic tissue and discuss the functions of each cell type.

#### **Activity 1: Time dependent on method of presentation**

1. Discuss basic histology with the students. Utilize Anatomy & Physiology textbook or laboratory text.
2. Hand out and discuss Histological Study of the Cells Involved in Glucose Metabolism.

#### **Activity 2: 20-30 minutes**

1. Give students prepared slides of pancreatic tissue.
2. Have students identify, sketch, and label alpha and beta cells. Use a histology book or the following website to verify.

<http://www.medinfo.ufl.edu/year1/histo/index.html>

Contains large index of histology slides including pancreas

#### **Enrichment information:**

<http://arbl.cvmb.colostate.edu/hbooks/pathphys/endocrine/pancreas/index.html>

Covers anatomy of pancreas, action of insulin, action of glucagon

<http://www.cfsan.fda.gov/~dms/fdpancre.html>

Probing the pancreas – pancreatic disorders

<http://www.medinfo.ufl.edu/year1/histo/index.html>

Histology quizzes

## Notes: Histological Study of the Cells Involved in Glucose Metabolism

### Endocrine system/Pancreatic tissue

<http://arbl.cvmb.colostate.edu/hbooks/pathphys/endocrine/pancreas/anatomy.html>

### Information below comes directly from the website listed above

- A. The pancreas is an elongated organ nestled next to the first part of the small intestine. Its gross anatomy and the structure of [pancreatic exocrine tissue and ducts are discussed in the context of the digestive system](#). The endocrine pancreas refers to those cells within the pancreas that synthesize and secrete hormones.
- B. The endocrine portion of the pancreas takes the form of many small clusters of cells called islets of Langerhans or, more simply, islets. Humans have roughly one million islets. In standard histological sections of the pancreas, islets are seen as relatively pale-staining groups of cells embedded in a sea of darker-staining exocrine tissue. Pancreatic islets house three major cell types, each of which produces a different endocrine product:
1. **Alpha cells** (A cells) secrete the hormone **glucagon**.
  2. **Beta cells** (B cells) produce **insulin** and are the most abundant of the islet cells.
  3. **Delta cells** (D cells) secrete the hormone somatostatin, which is also produced by a number of other endocrine cells in the body.
- C. Interestingly, the different cell types within an islet are not randomly distributed - beta cells occupy the central portion of the islet and are surrounded by a "rind" of alpha and delta cells. Aside from the insulin, glucagon and somatostatin, a number of other "minor" hormones have been identified as products of pancreatic islets cells.
- D. Islets are richly vascularized, allowing their secreted hormones ready access to the circulation. Although islets comprise only 1-2% of the mass of the pancreas, they receive about 10 to 15% of the pancreatic blood flow. Additionally, they are innervated by parasympathetic and sympathetic neurons, and nervous signals clearly modulate secretion of insulin and glucagon.

## **Lesson #6 – Teacher Instruction Page**

### **Use of activities: Determine why diabetic complications occur in certain organs by synthesizing previous concepts**

TEKS: 2C, 4C, 6AB, 8B, 10B

Students will analyze why certain organs are damaged by diabetes.

- a. Students will complete the Potential Complications of Diabetes Worksheet using the website provided or a copy of the website pages.
- b. Students will synthesize and apply the following concepts through class discussion following worksheet completion.
  1. biological molecule types & functions
  2. transport across cell membranes with or without transport molecules
  3. structure and function integration
  4. cause and effect relationship

#### **Activity 1: 1 to 1 ½ hours**

1. Hand out the Potential Complications of Diabetes Worksheet.
2. Students will answer the following questions using their Anatomy & Physiology books and the website reference on the Worksheet (or copy the article if computer access is limited).
3. The main idea to have students understand is that long term complications of diabetes are caused by too much glucose in the cells. (Tie In: concepts of diffusion) Since blood glucose is high, the concentration gradient between extracellular fluid and intracellular fluid is steep. However, without insulin or due to insulin receptor insensitivity, glucose cannot enter body cells. The exceptions are cells in the brain, eyes, kidneys, and red blood cells. The majority of complications are located in these tissues because large quantities of glucose are forced into these cells due to the high concentration gradient.

#### **Enrichment/Extension activities:**

1. Have students explore the entire complications of diabetes section within the website given on the worksheet.
2. Assign groups of students to research & present information on each complication with this objective as the groundwork. Have them include prevention/treatment information. The presentations may be given during the appropriate chapter. See next objective.
3. Ward's catalog has a Clinical Diagnosis of Diabetes kit which is excellent.

## **Potential Complications of Diabetes**

[http://diabetesnet.com/diabetes\\_complications/diabetes\\_organ\\_damage.php](http://diabetesnet.com/diabetes_complications/diabetes_organ_damage.php)

### **Why Are Only Certain Organs Damaged?**

From **STOP the Rollercoaster**

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Cell health depends on a steady supply of fuel from glucose and free fatty acids. These two major fuels are both regulated by insulin released directly into the blood from beta cells in the pancreas. From the blood, an insulin molecule crosses the blood vessel wall and attaches to an insulin receptor on the outer wall of a muscle, liver or fat cell. This attachment triggers the movement of glucose into the interior of the cell, where it can be converted into energy for metabolism, repair and defense.

In contrast to the complicated transport system for glucose, and to the chagrin of many, fat moves easily across cell membranes. If insulin levels are too low, less glucose enters cells, but more glucose is released by the liver and more fat is released from fat cells. So a low insulin level causes not only a high blood sugar but it also causes more fat to enter the blood.

Cells in the muscle, liver, and fat need insulin to receive glucose. The first group of cells that need insulin, those in muscle, liver, and fat, do not become exposed to high internal glucose levels when the blood sugars are high and insulin levels are low. The lack of insulin slows the movement of glucose into these cells, and probably spares them from damage when blood sugars are high.

However, other cells such as those in the brain, nervous system, heart, blood vessels and kidneys pick up glucose directly from the blood without using insulin. These cells, except the brain, are more prone to damage from high blood sugars because they become exposed to high internal levels of glucose.

This is one reason why damage tends to occur in these areas of the body, such as in nerve and kidney cells, and in small blood vessels like those in the eyes. They always have their "doors open" to glucose. When blood sugars are high, these cells have high interior glucose levels. The excess glucose makes it impossible for cells or organs to function as they are meant to. They fail to produce key enzymes, fail to repair themselves and fail to transport nutrients needed in the cells.

Nerve cells, are vulnerable also because of their shape. Many nerve cells are extremely long compared to their width. Each nerve depends on thousands of tiny blood vessels along its path to receive oxygen, fuel, and other nutrients. If one or more of these supporting microvessels become damaged, that part of the nerve is also damaged. Electrical signals in these damaged nerves can then no longer pass, or they pass at a slower speed. This dependence on numerous small blood vessels is why the longest nerves going to the feet are the first to be damaged in neuropathy. Good messaging in nerves also depends on an outer protective coating called myelin. This electrical insulator is also vulnerable to damage from high blood sugars.

Eyes are vulnerable because blood flow to the retina is driven by the need for oxygen. The small blood vessels in the retina (on the back wall of the eye where nerves receive incoming light)

have no muscles to limit blood flow. When oxygen is less available (which is worsened by smoking and inactivity) the normal controls on excessive blood flow break down. Blood then engorges the small vessels in the retina where oxygen is low. For instance, when the blood sugar climbs from 100 mg/dl (5.6 mmol) to 400 mg/dl (22 mmol), blood flow to the retina rises to five times its normal levels in a short period of time. This excessive blood flow and blood pressure to the small blood vessels in the retina creates an environment highly likely to cause damage. This is especially true when a balancing pressure in the vitreous, the clear gel in the middle of the eye, is low.<sup>71</sup>

Heart damage is caused by the same risk factors found in the general population. But these risks become magnified by high blood sugars. High blood sugars create harmful changes in LDL, HDL, and triglyceride levels, increased clotting, higher blood pressure, and altered blood flow. People with diabetes have other, as yet unexplained, risks. The standard heart risks magnified by high blood sugars do not explain all of the excess heart damage seen in diabetes. Some possible explanations are discussed in the next chapter.

Brain cells, in contrast to nerve cells, appear to be relatively protected even though glucose is their only source of energy and their "doors" are always open. The brain may derive this protection from the blood-brain barrier and from having different glucose transporters than those found in other organs. Glucose levels in brain cells are normally only one third the levels found in the blood!<sup>72</sup> These factors provide a relative degree of protection to the brain. However, IQ levels were found to drop temporarily in Australian children as their blood sugars rose. When the children's blood sugar climbed to 400 mg/dl (22 mmol), their IQ dropped by 10 percent.<sup>73</sup> Fortunately, this loss of intelligence was corrected when blood sugars were brought back down.

But research in Kansas found that a permanent loss of IQ seems to occur following ketoacidosis that requires hospitalization. Each ketoacidosis episode, with its high blood sugars, in the children studied appeared to cause a loss of just over one point in the IQ. (Although low blood sugars can certainly cause a temporary impairment of consciousness and reasoning, these researchers found no permanent effect on the IQ from severe hypoglycemia in these children.

\_\_\_\_\_

Very severe and prolonged hypoglycemia can cause this type of loss, however.)

[TopTop](#)

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## **Potential Complications of Diabetes Worksheet**

Use the following website or a copy of the information to complete the following worksheet. You may also need to use your textbook or other references to answer the questions. [http://diabetesnet.com/diabetes\\_complications/diabetes\\_organ\\_damage.php](http://diabetesnet.com/diabetes_complications/diabetes_organ_damage.php)

1. Glucose & free fatty acids are used by cells for \_\_\_\_\_.
2. Briefly discuss how these molecules enter a cell.
  
3. If insulin levels are too low, what happens & why?

4.

List the cells requiring insulin	List the cells not requiring insulin
Are these cells prone to damage from high blood glucose? Explain.	Are these cells prone to damage from high blood glucose? Explain.

5. High interior levels of glucose make it impossible for cells or organs to function as they are meant to due to the following reasons.
  - a.
  - b.
  - c.

6. Complete the chart.

<b>Cell type</b>	<b>When blood glucose is high, what happens &amp; why?</b>
<b>Nerve</b>	
<b>Eye</b>	
<b>Heart</b>	
<b>Brain</b>	

## **Lesson #7 – Teacher Instruction Page**

### **Use of activities: Demonstrate research, organization and presentation skills to inform peers about diabetic complications.**

TEKS: 2BCD, 3A, 4C, 5D, 6A, 10B

Students will research and organize information on common diabetic complications.

- a. Students will complete the Diabetic Complications Research Project Sheet.
- b. Students will organize information gained from research and give an oral presentation to the class.

**Before class:** Consult with the English teachers. I have my students use the same research skills/formats learned in their English classes. Examples: note taking format, bibliography format, presentation guidelines, research skills. It is much easier for the students and yourself to use skills that they are already familiar with. Edit the Project Sheet to suit your needs.

#### **Activity 1: 15 minutes**

1. Hand out the Diabetic Complications Research Project Sheet.
2. Assign students to groups of 2-3 people. Assign each group one of the complications listed on the project sheet. Modify for extra topics as needed.
3. Discuss the major points of the project listed on the sheet and the grading system. Clear guidelines should be given on your expectations for project organization.
4. Plan some class time for students to research and to coordinate with their group. Most of the presentation research, organization, and practice will be done outside of class. Student groups should decide research duties and sub-topics amongst themselves.
5. I require my students to have visuals to increase the clarity and interest of their presentations. These may include Power Point presentations, posters, overheads, computer images, etc. depending on the student's level of skill. Visuals must be clearly seen by every audience member. Visuals for this project would include: charts, graphs, photographs of complications, lists of treatment options, etc.

#### **Activity 2: 1 – 1 ½ hours**

1. Students will begin to research the topic assigned using:
  - a. The computer websites listed
  - b. A web search
  - c. Reference texts
  - d. Etc.

**Activity 3: 30 – 45 minutes or longer**

1. Students should bring all research materials, visuals, notecards, etc. to class. Allow student groups some class time to consolidate, coordinate, and practice their presentations.
2. Students should time their presentations to make sure that they are within the parameters of the project. Timed presentations are invaluable practice for college, etc. Change the time frame as needed for your class size, class length and information required from the students.

## **Diabetic Complications Research Project Sheet - Class presentation**

Your project will be worth a **100 point test grade**. If one of your group is absent on the day of your presentation, you must schedule a make up time with me. If the make up time is missed, your project will be considered late. A **25 point per school day penalty** will be assessed for each late day.

### **What is my topic?**

Diabetic Complications:

- a. Nephropathy
- b. Retinopathy
- c. Autonomic neuropathy
- d. Peripheral neuropathy
- e. Cardiovascular complications
- f. Non healing wounds
- g. Others must be approved by teacher

### **What information is required in my presentation?**

1. Physiological explanation of complication at the molecular level
2. Outward symptoms experienced by the diabetic person
3. Prevention of complication
4. Treatment of complication
5. Clinical trials regarding complication in your state/area

### **What needs to be turned in?**

1. works cited list of all sources
2. notes from **at least 3 different sources** other than your textbook.
  - a. Use encyclopedias, books, periodicals, newspapers, interviews, your own medical records, internet sites.
  - b. Notes may be handwritten or highlighted photocopies/printouts of the pertinent info
  - c. Include bibliography information on the top of each page from each source and place in order of the works cited list
  - d. Remember to include the sources for any diagrams/pictures/etc.
  - e. **Remember** - I must be able to find the information in your final project contained within your notes.

### **Guidelines**

1. You may use **one** 4x6 index card during your actual presentation, containing an **outline** of your subject matter. I will require a copy of this card to look at while you give your presentation. You will hand me this card immediately before your presentation and you will give me your card immediately after your presentation.
2. Your presentation must be a minimum of 4½ minutes and a maximum of 5½ minutes. You must use visuals for clarity but do not read them to your audience for your presentation.
3. Questions may be solicited by you or brought up by your audience at the end of this time.

**Evaluation** - I will be evaluating you based on the accompanying checklist of criteria. Also, checklists will be given to 2 of your classmates at random to evaluate your actual presentation. I will take these into account when compiling your final project grade.

**Websites to start with:**

<http://www.diabetesnet.com>

<http://www.diabetes.org>

<http://clinicaltrials.gov>

<http://www.niddk.nih.gov/health/diabetes/diabetes.htm>

<http://www.intelihealth.com>

Choose diabetes under diseases & conditions

## Evaluation Sheet for Presentation

Start time \_\_\_\_\_ Stop time \_\_\_\_\_

### **70 pts - information and organization**

0	2	4	6	8	10	Physiological explanation of complication at the molecular level
0	2	4	6	8	10	Outward symptoms experienced by the diabetic person
0	2	4	6	8	10	Prevention of complication
0	2	4	6	8	10	Treatment of complication
0	2	4	6	8	10	Clinical trials regarding complication in your state/area
0	2	4	6	8	10	Information is sequenced & logically presented
0	1	2	3	4	5	Information is easily understood by target audience
0	1	2	3	4	5	All information is accurate & current

### **15 points – reference materials**

0	3	6	9	12	Notes: amount, accuracy, organization
0	1	2	3		Works cited correctly

### **5 pts - use of language**

0	1				Variety of terms
0	1	2			Grammatically correct
0	1	2			Smooth transitions between sections/presenters

### **5 pts - use of voice**

0	1				Loudness/clarity of speech
0	1	2			Rate of speech
0	1	2			Inflections (no monotone)

### **5 pts - use of body**

0	1				Posture
0	1	2			Gestures/motions controlled and appropriate
0	1	2			Attention to audience/eye contact

## **Lesson #8 – Teacher Instruction Page**

### **Use of activities: Research**

TEKS 3CE

Students will research and describe the history of diabetes research and the contributions of scientists to the knowledge of diabetes.

#### **Activity 1: 45 minutes or may be done at home if internet access is available**

1. Group students as indicated on the Defining Moments in the Study of Diabetes Project sheet and assign 2 groups of students to each topic (to cover the average class size). Topics may also be added such as: Discovery/production of diabetic medication (glucophage, etc.), clinical trials in your state, & alternative therapies.
2. Discuss basic points of project with students.
3. Have students research the assigned topic and organize the information according to the project sheet.

#### **Activity 2: Time dependent on method of presentation**

1. Students will briefly present their information.
2. Students will arrange their portion of the Diabetes Timeline on the wall or other designated place.
3. I usually assign three homework/daily grades for this project (Or a test grade, depending on how intensive I decide to make it). I also add a few questions to the next test over information discussed during this project. The information displayed on the timeline is then used to review/reinforce other information throughout the course.

#### **We also use it to discuss:**

- a. **How scientists build on each others' discoveries.**
- b. **The importance of getting information out to the public.**
- c. **How scientific research impacts societal issues.**

Diabetes Timeline Information to use in customizing this project

<http://www.jdrf.ca/about/timeline.cfm?startrow=1>

<http://www.intelihealth.com/IH/ihIH/WSANP000/21054/21150.html>

## **Defining Moments in the Study of Diabetes**

### **A Diabetes Research Timeline Project**

For this project, you will be assigned one of the following topics to research. Websites have been provided to help guide your search. You should also use additional resources.

#### **Final product guidelines:**

1. Information will be clearly displayed on ½ sheet of colored posterboard.
  - a. Date/time frame
  - b. Person or organization responsible
  - c. Major discovery or summary of findings
  - d. Impact on society/leads to future research
  - e. Misc. interesting facts and pictures/graphs
  - f. References will be cited on back of posterboard.
2. Information will be briefly presented to the class.
3. Posterboard will be placed on classroom wall along with that of other groups to form a Diabetes Timeline.

#### **Group 1: 4 people – One scientist per ½ posterboard**

Frederick Banting

Charles Best

John James Richard MacLeod

J.B. Collip

<http://www.discoveryofinsulin.com/Home.htm>

<http://www.pbs.org/wgbh/nova/cancer/discoveries2.html>

<http://us.expasy.org/spotlight/articles/sptlt009.html>

#### **Group 2: 2 people – One scientist per ½ posterboard**

Oskar Minkowski

Joseph von Mering

<http://www.whonamedit.com/doctor.cfm/1616.html>

<http://www.pbs.org/wgbh/nova/cancer/discoveries2.html>

#### **Group 3: 2 people – One full size posterboard**

Diabetes Control and Complications Trial

<http://www.niddk.nih.gov/health/diabetes/pubs/dcct1/dcct.htm>

<http://www.bsc.gwu.edu/bsc/studies/dcct.html>

#### **Group 4: 2 people – One full size posterboard**

United Kingdom Prospective Diabetes Study

<http://www.diabetes.org/pg99/sessions/genuth.asp>

<http://medweb.bham.ac.uk/easdec/prevention/UKPDS%20study.htm>

#### **Group 5: 2 people – One full size posterboard**

Fredrick Sanger

Paul Berg

Walter Gilbert

<http://www.nobel.se/chemistry/laureates/1958/>

<http://www.nobel.se/chemistry/laureates/1980/>

<http://us.expasy.org/spotlight/articles/sptlt009.html>

## **Lesson #9 – Teacher Instruction Page**

**Use of activities: Gain knowledge of diabetes risk factors to determine own level of risk. This objective should be done prior to lesson #10**

TEKS 9AB

Students will determine risk factors associated with Type II Diabetes, eliminate previous misconceptions of risk factors, and assess their own personal risk of contracting diabetes.

### **Activity 1: 15 – 30 minutes**

1. Instruct students to get a partner. They will need one sheet of paper and a pen/pencil.
2. Give students ~5 minutes to list everything they believe puts a person at risk for Type II Diabetes.
3. Have each group write on the board one risk factor from their list. Rotate through the groups until all risk factors chosen by students are listed on the board at one time. As each group lists their risk factor, have them briefly defend why they believe this is a risk factor for diabetes (ask them to tie in some physiology knowledge with their defense!).
4. Place the **Am I at Risk?** Worksheet on the overhead and compare it with the student list.
5. Ask students to think about their own personal risk for Type II Diabetes.

### **Enrichment/Extension**

1. Assign a risk factor to each interested student. Have them complete a web search to determine the physiology behind each risk factor. They may do a brief oral presentation to the class when complete.
2. Students may also complete a “family tree” of relatives to determine risk factors in their family and, therefore, their personal risk.

## Am I at Risk for Type 2 Diabetes?

From: [http://www.avandia.com/right\\_for\\_you/ut2diabetes/ut2diabetes.jsp](http://www.avandia.com/right_for_you/ut2diabetes/ut2diabetes.jsp)

### Risk factors:

1. Obesity
2. Age (over 45)
3. Family history of diabetes
4. Lack of regular exercise
5. High blood pressure and/or high concentration of fats in the blood
6. History of gestational diabetes, a form of diabetes occurring in pregnancy, or giving birth to a baby weighing more than nine pounds.
7. African Americans, Hispanic/Latino Americans, Native Americans and Asian Americans are at greater risk

From: <http://www.diabetes.org/main/info/risk/risktext.jsp>

<b>At-Risk Weight Chart</b> Body Mass Index	
<b>Height</b> in feet and inches without shoes	<b>Weight</b> in pounds without clothing
4'10"	129
4'11"	133
5'0"	138
5'1"	143
5'2"	147
5'3"	152
5'4"	157
5'5"	162
5'6"	167
5'7"	172
5'8"	177
5'9"	182
5'10"	188
5'11"	193
6'0"	199
6'1"	204
6'2"	210
6'3"	216
6'4"	221
If you weigh the same or more than the amount listed for your height, you may be at risk for diabetes.	

## **Lesson #10 – Teacher Information Page**

**Use of activities: To apply knowledge of nutrition to everyday situations.**

**Students will prepare and follow a five day meal and exercise plan to improve their personal nutrition.**

TEKS 3BC

**Refer students back to lesson #1 for their calorie goals.**

### **Activity 1: 1 to 1 ½ hours**

1. Hand out the following three worksheets to students. They may work with one partner. However, their menus must reflect what each individual will be eating and the exercise they will be completing. Encourage students to get their families to participate with them for the evening meal. It will make following the plan easier for the student.
2. Briefly overview what you expect the final product to look like. I do not require them to provide a bibliography with this project. If they use websites other than the ones provided, they should list them on the back of the worksheets.
3. Students will need access to computers for this day's assignment. Let them work independently as long as they are focused on the project. They will often share ideas with other groups.
4. Allow students 2 or 3 days to work independently on the project.

### **Activity 2 (day before project is actually due): 30 minutes**

1. Allow students ~ 30 minutes of class time to discuss their personal plans with each other. They will often share great ideas at this time.
2. Make sure they have access to a few computers to make last minute changes as needed.
3. Project is due at the beginning of the next day's class.

### **Next full school week:**

Students should be encouraged to follow their nutritional plan for this week.

### **Enrichment/Extension:**

1. Mini field trip (or on student's own time) to local grocery store. Students will complete a grocery list prior to trip. This list is to be comprised of all ingredients necessary to prepare their 5 day meal plan. At the store, students are to list exact brands and prices for every item on their list and a complete total to prepare their menus.
2. If student is eating out, prices for fast food, etc. items must also be listed.

## **My Personal 5 Day Meal & Exercise Plan**

Use your information from Assess Yourself Activity to complete the following section:

1. My weight goal is \_\_\_\_\_.
2. I need to consume approximately \_\_\_\_\_ calories to maintain this weight.
3. I should consume approximately \_\_\_\_\_ fat grams per day.
4. I should consume approximately \_\_\_\_\_ fiber grams per day.
5. I need to drink \_\_\_\_\_ ounces of water each day.

Your assignment is to plan 5 days of meals, snacks, and activities that fit your above requirements. You are also to prepare a grocery list for the food items. Be realistic in your choices and ask your family to participate with you. **You will be following this dietary plan next week !!!**

You are to attach the following to your final product. You will need **2 copies** (One to turn in and one to keep)

1. This cover sheet
2. Meal Plan
3. Exercise Plan

### **Nutrition Websites to reference**

<http://www.dietitian.com/ibw/ibw.html>

<http://www.kenkuhl.com/fastfood/fastfacts.shtml>

<http://www.ianr.unl.edu/pubs/foods/nf62.htm>

fiber in foods

<http://www.nutri-facts.com/fastfood.asp>

BMI, calorie calculator, activities, etc.

Good overall info

<http://vm.cfsan.fda.gov/~dms/foodlab.html>

food label info

<http://www.eatright.org/nfs/>

nutrition facts sheets

<http://www.allfood.com/mmeal.cfm>

menu ideas with shopping list and nutrient info

<http://www.nat.uiuc.edu/mainnat.html>

<http://www.heartcenteronline.com/myheartdr/home/index.cfm>

Heart tools sections has various calculators, etc.

# Meal Plan Menu

Day	Breakfast	Lunch	Snacks	Supper
<b>Monday</b>       <b>Total calories</b> <hr/>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>
<b>Tuesday</b>       <b>Total calories</b> <hr/>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>
<b>Wednesday</b>       <b>Total calories</b> <hr/>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>
<b>Thursday</b>       <b>Total calories</b> <hr/>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>
<b>Friday</b>       <b>Total calories</b> <hr/>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>	       <b>Calories:</b>



## **Lesson# 11: Teacher Information Page**

### **Use of activities: Students will utilize research skills and organizational skills to synthesize nutritional information.**

Students will research and organize an informational booklet on type II diabetes and nutrition. The target audience will be teenagers.

TEKS 3ABC

#### **Activity 1: One class period**

1. Hand out project information sheet and grading criteria information. Groups of three students should be chosen if possible. Each student will be responsible for one section of the project. Cohesiveness of total project should also be considered when grading.
2. Allow students one class period for research and ample time outside of class to complete project. I usually assign the project on a Monday and have the project due on the Tuesday of the next week.
3. Give students minimal direction on how to lay out the booklet. They will get surprisingly creative when forced to.
4. I do not require a works cited page unless they use websites other than the ones given.

**Project: Nutrition, Exercise and Diabetes**      **due date** \_\_\_\_\_

You have been chosen by your school to create a booklet to help teenagers make wiser choices in the areas of nutrition and exercise in order to decrease/delay the onset of Type II Diabetes. Your booklet should include a **minimum** of the following information neatly arranged in sections to earn a 70. The more you add to the minimum information, the better your grade will be. Pictures and charts should be utilized to enhance the readability and attractiveness of your booklet. Be sure your information is easily understood and clearly organized.

**Information to include in Booklet:**

**1. Purpose/Rationale:**

- a. What is Type II Diabetes?
- b. What puts you at risk for Type II Diabetes?
- c. Why should information be targeted at teenagers?
- d. What benefits do you receive from delaying the onset of diabetes until you are older?

<http://www.heartcenteronline.com/myheartdr/home/index.cfm>

<http://www.diabetes.org>

good information throughout site

[http://www.diabetes.org/main/application/commercewf?origin=\\*.jsp&event=link\(B4\\_3\)](http://www.diabetes.org/main/application/commercewf?origin=*.jsp&event=link(B4_3))

<http://www.joslin.harvard.edu/news/risingtide.html>

<http://www.joslin.harvard.edu/news/obesity02.shtml>

**2. Good Nutrition & Exercise**

- a. What is good nutrition?
  - i. Number & type of food servings for the average male/female teenager?
  - ii. What should a typical food serving consist of?
  - iii. What is the % fat, % carbohydrate, etc.
  - iv. How do you read a food label to choose the right foods?
- b. What is a good level of exercise?
  - i. How long should you exercise for?
  - ii. How many times per week should you exercise?
  - iii. What are some fun activities for teenagers to do and how many calories do they burn?

<http://www.diabetes.org> search healthy living section

<http://www.health.gov/dietaryguidelines/dga2000/document/contents.htm>

**3. General tips on choosing healthier food items.**

- a. When eating out, what choices can make your meal healthier?
- b. What types of things should you avoid?
- c. Choose three fast food restaurants in your area. For each restaurant:
  - i. List three good choices for lunch.
  - ii. List three poor choices for lunch.
- d. How do you determine good portion sizes for major categories of foods?

<http://www.diabetes.org> search healthy living section

<http://www.kenkuhl.com/fastfood/fastfacts.shtml>

## Evaluation Sheet for

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### **Grading Criteria for Booklet (100 point Test Grade)**

You will be graded according to amount & quality of content, attractiveness of booklet, organization of information, and appropriateness of readability to target audience

#### **30 pts - Information and organization of purpose & rationale section**

0	2	4	6	Information is sequenced & logically presented
0	2	4	6	Information is easily understood by target audience
0	2	4	6	All information is accurate & current
0	2	4	6	Relevant information beyond minimum is provided
0	1	2	3	Informative, easily understood visuals provided
0	1	2	3	Correct use of grammar, spelling, and punctuation

#### **30 pts - Information and organization of good nutrition & exercise section**

0	2	4	6	Information is sequenced & logically presented
0	2	4	6	Information is easily understood by target audience
0	2	4	6	All information is accurate & current
0	2	4	6	Relevant information beyond minimum is provided
0	1	2	3	Informative, easily understood visuals provided
0	1	2	3	Correct use of grammar, spelling, and punctuation

#### **30 pts - Information and organization of general tips section**

0	2	4	6	Information is sequenced & logically presented
0	2	4	6	Information is easily understood by target audience
0	2	4	6	All information is accurate & current
0	2	4	6	Relevant information beyond minimum is provided
0	1	2	3	Informative, easily understood visuals provided
0	1	2	3	Correct use of grammar, spelling, and punctuation

#### **10 pts – Final product**

0	1	2	3	4	5	Smooth transitions between sections
0	1	2	3	4	5	Polished appearance of final product (not rough draft quality)

# Additional Activities to Use for Enrichment or Extension in the following areas:

**Biology**  
**Chemistry**  
**Physics**  
**Mathematics**  
**Nutrition Science**  
**Health Science Technology**

The following activities can be used alone or in conjunction with the previous objectives. Activities are cross curricular and can be utilized in a variety of lesson plans.

## **Nutritional Information Activity – Teacher Information Page**

### **Use of activity: To determine what a healthy diet consists of and the importance of a healthy diet in managing/preventing type II diabetes**

**Day 1 & 2: 2 class periods depending on reading speed of students. There is a lot of information to sort through.**

1. Use the following three websites to instruct the students in (a) the connection between obesity and diabetes and (b) the components of a healthy diet. Students should be aware that most people with type II diabetes do not have to eat a special diet but should follow the guidelines within these two articles. Healthy diets keep blood glucose levels in the proper range and keep the levels stable. This is crucial to preventing diabetic complications.

<http://www.joslin.harvard.edu/news/obesity02.shtml>

Article: Why is Obesity a Growing Problem in America?  
Discusses the connection between obesity and diabetes

<http://www.fda.gov/fdac/foodlabel/diabetes.html>

Coping with Diabetes – The new food label

Also contains links within

<http://www.health.gov/dietaryguidelines/dga2000/document/contents.htm>

Use the website to learn what a basic healthy diet consists of. This is a huge website.

2. Students should complete the questions on the Healthy Diet Worksheet before beginning the next day's activities. The questions are designed to be completed while viewing the websites. The worksheet should be graded for general content and not word for word answers. There are tons of information in these websites so the questions generally ask the student to summarize or list important points. Students will most likely have different answers depending on their focus as they were reading. More specific assignments could be easily created depending on the objective of the lesson.

### **Day 3 etc.: Dependent on use of curriculum kit**

1. Download the following teacher's kit. Everything is provided: learner outcomes, materials needed, lessons, quizzes, activities.

<http://www.fda.gov/opacom/catalog/teachkit.html>

High school teacher's free kit on how to read food labels – 48 page PDF

Five lessons plus quiz plus extra information

2. Other good materials:

<http://www.cfsan.fda.gov/~dms/flquiz1.html>

Quiz over food labeling

<http://www.cfsan.fda.gov/~lrd/labelwww.html>

Food label video order - \$8.95 per copy

[http://www.accessexcellence.org/AE/AEC/AEF/1996/drake\\_supermarket.html](http://www.accessexcellence.org/AE/AEC/AEF/1996/drake_supermarket.html)

Supermarket science activity – could be modified from cardiovascular diet to diabetes or used for general nutrition information

## Healthy Diet Worksheet

**Answer the following questions as you read through each website.**

1. <http://www.joslin.harvard.edu/news/obesity02.shtml>

### **Article: Why is Obesity a Growing Problem in America?**

Discusses the connection between obesity and diabetes

1. Define obese.
2. What can trigger type 2 diabetes?
3. Read through the “Is it nature or nurture?” section and the “If it’s all in the genes, why so much obesity now?” section. Briefly summarize what scientists believe contributes to obesity.
4. How does lots of visceral fat affect the body?
5. What do scientists recommend in regards to portion control, nutritional value of food, and exercise?

**Move to the next website.**

II. <http://www.fda.gov/fdac/foodlabel/diabetes.html>

**Article: Coping with Diabetes – The new food label**

Begin at Diet for Diabetes section.

1. List the 5 general dietary guidelines for people with diabetes.
  - a.
  - b.
  - c.
  - d.
  - e.
  
2. Read through the rest of the article and list any four facts that are of particular interest to people with diabetes.
  - a.
  - b.
  - c.
  - d.
  - e.

The rest of the article has a nutrient claims guide that you may find of interest.

**Move to the next website.**

III. <http://www.health.gov/dietaryguidelines/dga2000/document/contents.htm>

There are a total of 10 guidelines under the main headings of Aim, Build, and Choose (beginning with Aim for a healthy weight). On a sheet of notebook paper, list each guideline and list 2 important points/facts for each guideline. There is lots of information in each guideline to choose from. Staple your paper to the back of this worksheet when finished.

## **Lab Activities**

<http://www.wardsci.com>

Diabetes – Ward's 36 W 0042 – approximately \$49.95  
Phone: 1-800-962-2660

Excellent lab activity that overviews basic diabetes information and types of diabetes. Students simulate initial diabetic testing and then prepare a treatment program for each patient. Follow up testing is then performed to determine if patient's have followed the treatment program.

<http://www.texashste.com/html/glucose1.htm>

Glucose laboratory investigation for health science students

## **Information for People with Diabetes**

Make this information available to all students to share with family members who have diabetes

[Printable Diabetes Care Card](#) – copy provided – no longer available on website  
List of important tests and review items for diabetic patients

<http://www.washingtonpost.com/wp-dyn/articles/A50871-2002Jan28.html>

Article discusses Medicare's coverage of nutritional counseling for diabetics

<http://clinicaltrials.gov>

website to look up clinical trials by disease, location, etc.

### **General information websites with lots of links to additional information:**

<http://www.intelihealth.com>

choose diabetes under diseases & conditions

<http://www.diabetesnet.com>

<http://www.diabetes.org>

<http://www.niddk.nih.gov/health/diabetes/diabetes.htm>

## **The Genetics of Diabetes: Teacher Information Page**

### **Use of activity: To relate basic genetic information to the study of a specific disease**

Basic genetics should be covered by the class before beginning the activity.

#### **Day 1: Homework**

1. Teacher should read the following website articles prior to class. Websites are given as a suggestion to begin with. Diabetes and genetics research articles are in abundance and can easily be found using a search engine.
2. 2-3 students should be assigned to a group. Each group should be assigned an article or a section of an article to read.
3. Copies of articles should be provided to students prior to class. Students should read articles assigned to their discussion group before coming to class.
4. Each group should answer the following questions (in written form) about their article prior to class.
  - a. What main question(s) does your article answer or attempt to answer?
  - b. For each question, what does your article discuss about the answer?

#### **Day 2: Dependent on class**

Each group is given the opportunity to discuss their article in front of the class. The other groups are to listen and write down how each article relates to the information in their articles. After all groups are through discussing their articles, give them a few minutes to complete their written analysis and then take the paper up.

<http://www.accessexcellence.org/WN/SUA08/diab12.html>

Article discusses the discovery of two diabetes-associated genes

<http://www.diabetes.org.uk/research/feature/reshome.htm>

Series of articles discussing basic genetics, link between diabetes and genes, genetic research, glossary, etc.

<http://www.nmsu.edu/~molbio/diabetes/disease.html>

Human Genome Project and Diabetes article containing excellent visuals and detailed information on both Type I and Type II Diabetes.

Contain the following sections:

Definition

Genetic factors

Genotype by Environment Interaction

Cell Biology of Insulin Response

Major Susceptibility Locus for Type II Diabetes

Economic Impact of Type II Diabetes

## **Recombinant DNA lesson for Biology 1 – Teacher Information Page**

### **Use of activity: Apply the biotechnology process of recombinant DNA to the production of human insulin by bacteria**

Students should be familiar with the basic structure and function of DNA before beginning this lesson.

#### **1-1 ½ class period depending on schedule**

1. Hand out copies of the article: Speaking the Language of Recombinant DNA from: [http://www.accessexcellence.org/AB/BC/Speaking\\_Language\\_rDNA.html](http://www.accessexcellence.org/AB/BC/Speaking_Language_rDNA.html) – this article begins with a DNA review and then a simple discussion of rDNA technology.
2. Read and discuss the article aloud in class prior to the first activity. There are several links with great graphics if you have students read this online.
3. Simulate a DNA recombination using the complete activity from: <http://www.sc2000.net/~czaremba/labs/recombo.html>
4. Use the graphic provided in the website listed to provide an application of rDNA technology. [http://www.accessexcellence.org/AB/GG/transfer\\_and.html](http://www.accessexcellence.org/AB/GG/transfer_and.html)

#### **Extra information:**

<http://www.niddk.nih.gov/health/diabetes/summary/humalog/humalog.htm>

To produce Humalog (the first so-called insulin analog), scientists switched the order of two amino acids in human insulin—lysine and proline. This change allows Humalog to be absorbed and act quicker than regular insulin, the fastest insulin prior to lispro's approval. Due to its quick action, Humalog can cause a more rapid onset of hypoglycemia. Lispro should be taken no more than 5 to 15 minutes before a meal to match the rate at which blood sugar goes up after eating. Whereas, regular insulin needs to be taken at least 30 minutes before a meal to get the same effect. Lispro lowers blood sugar the most 1 hour after it is injected and completes its action in 3 hours. The rapid absorption of Humalog is more like the rapid release of insulin by the pancreas.

#### **Enrichment/Extension:**

1. [http://www.accessexcellence.org/AB/GG/transfer\\_and.html](http://www.accessexcellence.org/AB/GG/transfer_and.html)  
Assign students the task of creating a hands-on activity using only simple household items to simulate the use of recombinant DNA technology using information and links.

**Recombinant DNA lesson for AP Biology – Teacher Information Page**  
**Use of activity: Apply the biotechnology process of recombinant DNA to the production of human insulin by bacteria**

The following website contains a 15 page article titled:

**Recombinant DNA Technology in the Synthesis of Human Insulin**

<http://members.ozemail.com.au/~ilanit/dna.htm>

The information is easily understood and the graphics are excellent.

**Various Activities using Article:**

1. Have students read for enrichment.
2. Enlarge human insulin structure on page 9. White out various parts of diagram and have students fill in the missing information.
  - a. Complementary strand
  - b. Amino acid
  - c. Location of restriction enzyme cut
3. Instruct students to create labels for themselves using the information in the diagrams. The class could then create a skit demonstrating the entire process. Use instead of a lecture to enhance understanding.
4. Have students complete a web search for other applied rDNA technology.

## **Community Service Activities sponsored by your class**

### **1. Diabetes Awareness Week Project**

Diabetes Awareness Week is a project designed to familiarize all students and teachers with an overview of diabetes. During this week, the following will occur:

- a. One announcement per day.
- b. Posters with diabetes type II facts will be hung in the hallways.
- c. Every teacher will present a short lesson about some aspect of diabetes designed to complement their subject area.
- d. Posters will be hung in local restaurants and businesses to advertise a free diabetes screening.

#### **Student Activities**

1. 5 different announcements about diabetes related to teenagers
2. 15 different facts about diabetes – 3 posters each
3. Flyer advertising free diabetes screening

### **2. Fit Ciity/Fit Schools Initiative**

<http://healthcollaborative.net/fitcity/FitCityhome.html>