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**Title**: “Self-Assembly in a Box for Teaching Tissue Organization at the Nanoscale”

**Overview/Annotation**:

This lesson is serves as a review after learning about the different tissues and organs of the body systems; it will also review the level of organization from atoms through organ systems. It will examine the organ systems by having the students study different diseases that affect different body systems. The diseases covered are caused by proteins misassembling at the nanoscale (nano = 10-9).

**Content Standard(s):**

**ALCOS**

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| --- |
| **Science (2005)** |
| **Grade(s): 7** |

3.) Relate major tissues and organs of the skeletal, circulatory, reproductive, muscular, respiratory, nervous, and digestive systems to their functions.

• Arranging in order of the organizational levels of the human body from the cell through organ systems

**Mathematics (2005)**

**Grade(s): 6**

11.) Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. [6-NS8]

**National Standards:**

MS-LS1-3. Use argument supported by evidence for how the body

is a system of interacting subsystems composed of groups of cells.

**Resources:**

**Primary Learning**

**Objective(s):**

* Students will describe the level of organization of organisms from atoms, to molecules, to proteins, to cells, to tissues, to organs, to organ systems, to organisms.
* Students will demonstrate their knowledge of the different body systems by correctly identifying which diseases affect what part of the body.
* Students will be able to discuss the process of proteins self-assembling which successfully leads to the production cells and tissues.
* Students will explain the problems (or diseases) that occur when proteins misassemble in the human body.
* Students will connect level of organization with how proteins self- assembles at the nanometer scale (1 nanometer = 0.000000001 m = 10-9 m).

**Approximate Duration**

**Of the Lesson:** Two Day Lesson – 50 minute class periods

**Materials and**

**Equipment: Important Note:** the total amount of materials needed will depend on the number of groups created by teacher.

* + - 1. **6 Index Cards per group: (Index cards with picture for each: atoms, molecules, proteins, cells, tissues, organs, and organ systems)**
      2. **Level of Organization PowerPoint**
      3. **Disease case studies**
      4. **Protein PowerPoint**
      5. **Self-Assembling Module Kit**
      6. **Self-Assembling Lab Handout**
      7. **Guess my Size nano activity by Lauren Rodriguez**
      8. **Guess my Size PowerPoint**

**All materials can be found on:**

[**http://www.auburn.edu/academic/cosam/departments/chemistry/outreach/MSP\_AU\_web/MSP-AU.htm**](http://www.auburn.edu/academic/cosam/departments/chemistry/outreach/MSP_AU_web/MSP-AU.htm)

**Safety Procedures**

* Teacher should ensure that magnets are secured tightly in the module object before conducting Activity Two.
* Teachers should ensure that all personal items with a magnet strip (i.e. ID cards, credit cards, etc.) do not come into contact with magnets.
* Teachers should remind students not to use magnets appropriately during Activity Two.
* Teachers should ensure that containers are closed tightly and securely when conducting Activity Two.

**Technology Resources**

**Needed: Computer/Internet**

**Overhead Projector/Smart Board**

**Background/Preparation:**

**Student Prerequisites**:

The students should have a basic understanding of the 7 systems of the body.

The students should be able to identify major organs in each of the 7 systems.

**Procedures/Activities:**

**DAY 1:**

**A) Activity 1 “Level of Organization Card Activity” – (15 mins)**

* + The assessment/activity will test the students’ knowledge to see if they know the organizational level of the human body from atoms to organ systems.
  + Teacher will instruct students to gather into groups. \***Suggestion: Teacher could organize groups before class to avoid confusion**\*
  + Teacher will provide instructions to students for Activity 1.
  + Teacher will give each group 6-index cards where each card will have one level of organization.
  + Teacher should give students 3 minutes to organize the pictures into their correct stage or level.
  + Teacher will then instruct the students to flip the card over to read the word identified with each picture and make sure that they have it in the correct order.
  + Teacher will have students write down on their own sheet of paper the correct and final order of organization from cell to organ systems to be turned in\*optional\* (teacher can provide extra points or use for a grade).

*After students have completed the activity, teacher should ask inquiry questions such as:*

* + - What is the level of organization that your group put the card into?
    - Where did atoms, molecules, and proteins go?
    - Why did you put it in that particular order?
  + After inquiry, teacher will begin Level of Organization Prezi PowerPoint. <http://prezi.com/pltok0xau40i/?utm_campaign=share&utm_medium=copy>

**Transition:**

*After teacher completes the Prezi power point on the overhead projector or smart board, ask inquiry questions below to transition into next assignment:*

* How do you think the level of organization activity or information we just discussed connect with diseases?
* What happens at the cellular level that can cause diseases for the human body?
* Are there any kinds of diseases that affect the whole body? What about diseases that affect only certain body systems?

**B) Activity 2 – Disease Case Studies (30 minutes)**

**Teacher Overview:** The disease case study activity will have the students break into groups and rotate stations around the classroom to learn about 3 different diseases. The 3 diseases that will be covered are Sickle Cell Anemia, Muscular Dystrophy, and Parkinson’s disease. The students will have to treat each station like they are treating a patient; they will read each patient’s symptoms and answer several questions. This is a review for the students for the different body systems.

* The teacher will divide the classroom in half and then split up each side into 3 groups.
* There will be 3 stations per side of the classroom
  + The first station will be Sickle Cell Anemia
  + The second station will be Muscular Dystrophy
  + The third station will be Parkinson’s Disease
* Groups will have 10 minutes at each station to read over their patient’s card and answer each question on a separate sheet of paper.

**Closure:**

Teacher should wrap-up the lesson by asking a few inquiry based questions to prepare the students for tomorrow’s lesson and review what they learned for the day such as:

- What body system is affected by Parkinson’s disease? Sickle Cell Anemia? Muscular Dystrophy?

- What do you think caused these diseases? Do you think they are inherited or something that they caught like a cold?

- What do you think is happening at the molecular level?

- How does this relate to level of organization?

- Why is it so important that everything works like it is supposed to?

- Could proteins play a part in all of this since they are smaller than cells?

**Assessments:**

Formative –

* After the students do the level of organization cards, it will be considered a formal assessment by grading their answer, for this should be information that they know already.
* The teacher will also be assessing on how well they answer the questions to the disease case studies. Those should be graded as well, since this is applying the knowledge of the body systems that they previously learned about.

Informal –

* During the Level of Organization Activity there are questions at the end of it to assess the students’ knowledge on the information. Anything still hazy or unclear should be thoroughly discussed in the PowerPoint review.
* There are also closure questions for the end of the day to assess the students’ knowledge on previously learned material, such as the body systems, but also about what could cause the diseases. Teacher should go over anything the next day to ensure the information is learned.

**DAY 2:**

**Warm-up activity ~ 5 minutes**

The teacher should ask a few review questions from yesterday’s previous material.

- Can someone name a disease we “treated” yesterday? What body system did it affect?

- What do you guys think caused these diseases to occur? Why does it happen in some people, but not others?

- Teacher should ask inquiry questions to Transition into protein assembly such as:

* What is a protein?
* What does it mean when something assembles? So if we know what assemble means, what happens when something misassembles?
* So what do you think proteins assemble and protein misassemble mean?

1. **Protein Assembly – 30 minutes**
   * Protein self-assembly PowerPoint
     + Teacher should make sure that students know that the 3 diseases mentioned yesterday are that they are all caused by proteins misassembling. *This could be caused by a mutation on a gene that code for the protein incorrectly.*
     + [**http://prezi.com/34m8yniincex/?utm\_campaign=share&utm\_medium=copy&rc=ex0share**](http://prezi.com/34m8yniincex/?utm_campaign=share&utm_medium=copy&rc=ex0share)
   * Module:
     + Students will break into groups and get the Protein self-assembly handout
     + The shapes in the box are like protein subunits, when at the right temperature proteins can self-assemble together like discussed in the PowerPoint.
     + They will first make a prediction for what will happen when they try to assemble the proteins.
     + Then the group will shake the box for 30-second intervals and after each interval record how many pieces were assembled and any observations on it. They will shake the box for a total of 6 minutes.
     + Then the students will make a graph using the points from the data table and also make a best-fit line.
     + Have one group bring up their self-assembled proteins that formed correctly and have another group bring up their self-assembled proteins that formed incorrectly. Have them write down all observations.
     + Wrap up the module by having the students answer whether or not they supported or rejected their prediction.
   * Make the connection that those misassembled proteins are what causes the diseases discussed the day before.

**Transition: ~ 2-3 minutes**

*Teacher should discuss*: These proteins self-assemble at the nano scale (10-9 m), things that are bigger than that scale do not just randomly form together. If we put a bunch of class desks in a huge box and shake it really hard, they will not form together, BUT things at the nano scale form together on their own quite often. But just how small is nano?

**B) Guess my Size activity ~ 10-12 minutes (by Lauren Rodriguez)**

* + Students will work on the handout to scale down from something on a larger scale all of the way down to a nano scale to understand just how small it is
  + After the Intro to Nano PowerPoint, go through the Guess my Size PowerPoint and activity with the students to correctly answer the actual sizes of the items.
  + NanoScale video
    - [**http://www.youtube.com/watch?v=dTbXedkqMro**](http://www.youtube.com/watch?v=dTbXedkqMro)

**Closure:**

Wrap up the entire lesson by having the students write down on index cards everything that they learned for the day, the teacher can collect all of the index cards and read them out loud to the class and discuss some of the things mentioned on each card. Make sure to go over any material not mentioned.

**Assessments:**

Formative –

* Take up the lab handouts for a grade, make sure that the students make predictions in the correct manner and actually wrote down any observations seen.

Informal –

* The questions at the beginning of class will be used as informal assessment, to assess the student’s memory on everything they did yesterday and any information that should be known
* For the closure activity, it will be an informal assessment to see what the student’s learned for the day – make sure that they students understand what happens when proteins assemble correctly and incorrectly, also the students need to understand that this happens at the nano scale. Anything not mentioned on a notecard, make sure to ask questions about or discuss in further detail.

**Attachments:**

* Level of Organization Card Activity
* Level of Organization Prezi
* Diseases Case Studies
* Protein Assembly Prezi
* Protein Assembly Lab worksheet
* Guess my Size activity
* Guess my Size PowerPoint
* Nano-Activity: Providing Nanotechnology for Third World Countries

**Extension:**

Students can do an extension activity on Nanotechnology and applying it to the real world, by creating different ways to better a third world country’s village by making a brochure.

\*\*\* See Nano-Activity: Providing Nanotechnology for Third World Countries\*\*\*