“Disease Biology”

Teaching Biology Standards Through Disease Modules

Focus Standard: Macromolecules & Vector Borne Disease

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Abstract: The purpose of this action proposal is to increase student understanding and appreciation of the biology curriculum and increase student performance on the Florida Biology End of Course Exam. Student achievement and appreciation of the biology content will be increased by creating disease based modules and lesson plans to teach the biology standards. The disease modules will implement more engaging activities in the classroom, student driven learning, problem based learning, and reading strategies. The lesson included in this action proposal is one of seven unit lessons that will be taught throughout the course of the school year to varying biology students. Each lesson will be taught at different times and with varying length depending on the specific lesson and school course calendar for the instructors in the CATALySES 2017 cohort group. The specific lesson included in this action proposal, entitled "Macromolecules & Vector Borne Disease," as well as the other instructors' lessons will be delivered to about 120 general biology, honors biology, and Advance Placement biology students. The other instructors have varying numbers of students enrolled in general biology and honors biology. Data will be reported to compare the learning gains & biology understanding/perceptions of the students for each lesson developed by the CATALySES 2017 cohort group members. Each group member will have student data on the lesson they developed as well as the lessons developed by the other group members. The EOC data, biology understanding data and biology perception data will be complied and compared in one format. An increase in EOC scores, biology understanding, and biology perception is predicted after the lessons are implemented and the data is collected.

Rationale: Leesburg High School is the only Title I high school in the Lake County school district (http://www.fldoe.org/core/fileparse.php/7767/urlt/0084695-2013-14finaltitleischoolslist.pdf). LHS also has one of highest percentage of student absenteeism in the school district. Student fighting is prevalent and increasing as well. During the 2015 – 2016 school year four fights were reported on campus just with in a 20-minute time period on one school day (http://www.orlandosentinel.com/news/lake/os-lk-lauren-ritchie-leesburg-high-fights-20160424-column.html). The combination of social, economic, and attendance issues has made an impact on student achievement. Over the last 3 school years student performance on standardized assessments including the Biology End of Course Exam has declined and is well below desired proficiency levels. The data shows a large percentage of our student body are not meeting reading or science competency levels. Our data has continued to decline, with a current 52% pass rate for all students taking the Biology End of Course Assessment for 2017. The high truancy rate suggests students have apathy towards their education, and system issues with accountability reinforces this. It is a struggle to get students to feel accountable for their own educational outcomes and take the initiative to stay focused on the content. Every year the Leesburg High Biology department has tried different strategies to address such problems with limited success. The team has continued to seek innovative approaches to get the students interested in Biology and increase their performance despite the lack of support for schooling. The lesson focus of macromolecules was chosen for this specific action proposal because of the low proficiency in achievement on the biochemistry content area.

The following tables display the student performance data on standardized assessments at Leesburg High School:

	Level 1	Level 2	Level 3	Level 4	Level 5	% 3 or above
9th ELA	40%	27%	16%	12%	5%	33%
10th ELA	35%	29%	19%	13%	4%	36%

Algebra I	60%	14%	20%	5%	1%	26%
Geometry	45%	23%	19%	8%	5%	32%
Biology	18%	31%	31%	9%	11%	52%
US History	21%	24%	28%	17%	9%	55%

Figure 1: Student standardized assessment achievement level analysis for the 2016 -2017 school year.

2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2017-2018
39%	55%	60%	41%	40%	42%

Figure 2: LHS General biology student EOC proficiency (level 3 or higher) achievement comparison over the last 6 school years.

2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2017-2018

Figure 3: LHS Honors biology student EOC proficiency (level 3 or higher) achievement comparison over the last 6 school years.

2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2017-2018
38%	62%	69%	56%	55%	52%

Figure 4: LHS Overall biology student EOC proficiency (level 3 or higher) achievement comparison over the last 6 school years.

2014 -2015	2015 – 2016	2016 -2017
37%	48%	14%

Figure 5: LHS AP biology student AP Exam proficiency (level 3 or higher) achievement comparison over the last three years.

	2014 -2015	2015 -2016	2016 -2017
General	50%	50%	44%
Honors	64%	73%	61%
Total			

Figure 6: LHS biology student biochemistry unit assessment achievement comparison over the last 3 school years.

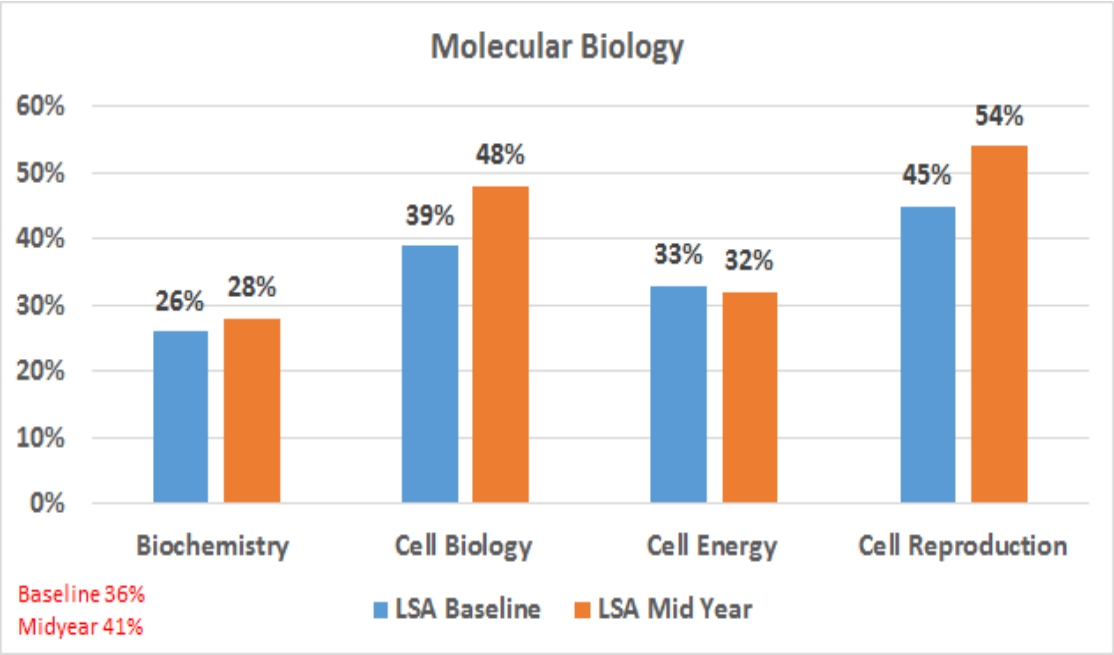


Figure 7: LHS biology student molecular biology achievement comparison from baseline and midyear assessments during the 2016 – 2017 school year.

In addition to absenteeism, student accountability for knowledge of content has declined. Many students do not keep up with the content needed to achieve learning goals. Often, students expect the teacher to supply all of the content within the class period and expect to pass the class based on this alone. Students who rely solely on the teacher for direct instruction are not as successful as students who take initiative to interact with the content and reinforce concepts outside of the classroom and collaborate to apply the content. Many students fail to complete homework unless they feel it will directly impact their grade, which leaves them unprepared for mastery of content. High school teachers also must deal with strict time constraints to cover all required content. This often causes the instructor to resort back to lecture based instruction in order to teach students just the "essential" information. An emphasis of just covering rudimentary information leaves little time for the application based challenges that spark student interest and develop deeper understanding of the content. "While large lecture classes may seem like a simple solution to diminishing resources, this method of teaching has been criticized as resulting in poor attendance, high student apathy, and passive and impersonal learning environments" (Fertig et.al. 2010). Lecture-based instruction identifies essential content and presents it to the students. This is an effective way to communicate pertinent information; however, it does not permit the students to effectively apply the information and as Fertig et al. states, it may contribute to student apathy. The disease module format incorporates the application component which is necessary for student understanding of the content. Also, the students are introduced to the lesson using a different method. The lesson objective is taught through case studies, assigned readings, research and problem based learning. This way students are obtaining the information on their own and applying it in class. Hands on applications are also a great tool for engagement and student understanding. Adding this component will increase the students' desire to participate.

Intervention: The biology course will be taught through a focus on disease in hopes of increasing student performance and engagement. Each standard will be incorporated with modules about specific diseases or diseases will be used to capture student attention and increase student engagement and performance. The focus of the action research will be answer the question "Will teaching biology standards through disease modules increase student performance on formative assessments as well as increase student engagement/participation and attitudes towards science?" The specific lesson included in this action proposal, entitled "Macromolecules & Vector Borne Disease," as well as the other instructors' lessons will be delivered to about 120 general biology, honors biology, and Advance Placement biology students. The other instructors have varying numbers of students enrolled in general biology and honors biology.

Connections to CATALySES: The focus of emerging pathogens, which was the CATALySES theme, is the overarching concept being used as an intervention. This theme combined with the content learned through the lectures and activities will be used to teach the biology standards. For the Macromolecules lesson, the content presented by Roxanne Connelly, PhD, Joseph W. Diclaro II, PhD, and Dr. Emma Weeks will be used to teach the macromolecules standard (SC.912.L.18.1 Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules) through case studies of vector carried diseases. The disease component of the lesson will incorporate the immune system standard (SC.912.L.14.52 Describe the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics).

Data collection and analysis: Student knowledge will be assessed and collected using a standards based multiple choice pretest and posttest. Personal Meaning Mapping will also be performed before and after the lesson to capture student understanding and connections made to the content. Finally, surveys will be completed to collect data on science perceptions – an interest inventory and science attitude survey using a modified Likert scale with emoji's representing the number values 1-5.

Data will be collected on each lesson developed by the CATALySES 2017 cohort group members. Once data collection is complete each group member will have student data on the lesson they developed as well as the lessons developed by the other group members. This data will be complied and compared in one format.

Literature Cited:

Fertig, Jason, Et.al. 2010. "Student Apathy: Public Enemy Number One." Minding the Campus, November. Retrieved June 19, 2016 (http://www.mindingthecampus.org/2010/11/student_apathy_public_enemy)

Stamatel, Janet P., Shawn Bushway, and William Roberson. 2013. "Shaking Up Criminal Justice Education with Team-based Learning." Journal of Criminal Justice Education 24(3):

Permissions: This proposal will be submitted for approval to the principal of Leesburg High School, Mr. Michael Randolph. Parent permissions are not needed because student data is being reported anonymously. The lesson plan and action proposal will be shared with the members of the LHS Biology department as well as the other CATALySES 2017 cohort "Teaching Biology Standards Through Disease Modules" group members so that they can implement the lesson and collect data. The cohort's schools will also need to approve their individual participation in the overall action plan proposal.

5E Lesson Plan CATALySES Action Proposal Lesson Plan Macromolecules - EMERY

Teacher: Elisabeth Emery

Date: 2017 – 2018 school year **Length of Lesson**: 1 – 1.5 weeks of school

Subject / grade level: Biology & Biology Honors 9th – 12th grade (Some items can be modified for AP Biology)

Materials:
Projector
Computer
Printer
Article/Case study/Background information
Scissors
tape
index cards/card stock

Essential Standards:

SC.912.L.18.1 Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.

SC.912.L.14.52 Describe the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics

Lesson objective(s):

Students will understand the basic structures and functions of the four major categories of biological macromolecules as well as the role of enzymes and the effect of environmental factors on enzyme activity through a disease case study. Students will also be able to describe the basic functions of the human immune system.

Differentiation strategies to meet diverse learner needs:

Individuals with lower independent reading level or that are ELL will be given a simplified version of the documents/text as well as assistance in researching material online. The documents for that group will contain a few illustrations to assist understanding. The model/3D visual aspect of the assignment will also help this group demonstrate understanding even though they have a lower understanding vocabulary or the English Language. The strongest readers and writers in the class will be given an enhanced version of the documents and they will be given more complex molecules to research. Groups will be created base on reading level and science knowledge background. They will be heterogenous where high level, low level, and medium level readers will be placed in groups equally.

ENGAGEMENT (2 class days)

1. Students will listen to a podcast to peek their interest http://www.radiolab.org/story/alpha-gal/. The podcast is 36 minutes long telling a story about a woman who became suddenly allergic to meat. Before, during and after the podcase the students will be instructed to answer the following questions: **(45 minutes with discussion)**

BEFORE

- Describe one food that you could not imagine living without and what about that food do you like so much?
- What would you do if you could no longer eat that food anymore because it made you sick?
- What do you know about allegories – what are they, what causes them, and what a few examples?

DURING

- What type of food did the woman in the podcast really like?
- What symptoms did the woman have after she ate this food and what did she find that made her believe she might be allergic to it?
- What did the doctor in the podcast say about this "allergy" and what was his evidence initially?

- How did his initial conclusion change? What evidence made him change his mind?
- What was found in the cancer drug and the meat that seemed to be causing people problems?
- What did she do once she thought she might be allergic? How did she test her hypothesis?

AFTER

- What would you have done if you were the woman who became allergic to red meat?
- Would have done anything differently to test your hypothesis or confront the doctor?

2. Students will then read an article about alpha gal and the lone star tick. **(35 minutes with discussion)**
   - Draw what the molecule Alpha gal looks like.
   - Draw what an immunoglobin molecules looks like

EXPLORATION (1 – 1.5 class periods)

Teacher Notes: Before or during activity be sure to discuss key basic vocabulary related to the content in this lesson. Make sure you have the students identify the following: **Molecules, Covalent bond, Electrons, Polymer, monomer, ratio, structure, function, organic molecules, macromolecules/ biological macromolecules.**

Macromolecules of Disease Jigsaw (15 – 20 minutes)

Students will be put into groups and each group will be assigned a specific biological macromolecule that plays an important role in a disease. The group with research that specific molecule and then share the information with the class in a presentation. The following should be included in their presentation:

- Visual representation of the chemical structure of the molecule
- What elements are present in the structure
- What role it plays in living systems

Macromolecule Jigsaw Discussion (15 minutes)

After the research is complete and the groups have presented the following questions will be asked to the class.

- If you were given some objects to categories in groups what characteristics would you use to classify them?
- What would be the purpose of classifying objects into groups?
- What shapes and structures do you see in the molecules from the jigsaw?
- How do these molecules differ?
- What do they have in common?

Macromolecule Matching (20 minutes)

Students groups will then be given 3-4 macromolecules to sort into groups as a class based on the information they discovered during the jigsaw. The class will come together and discuss the placement of the macromolecules to check accuracy. The following questions will be asked during and after the activity:

- How did you determine where your molecules were placed?
- How many distinct groups/categories of molecules do we have?
- What can we say is a unique quality or characteristic of each group?

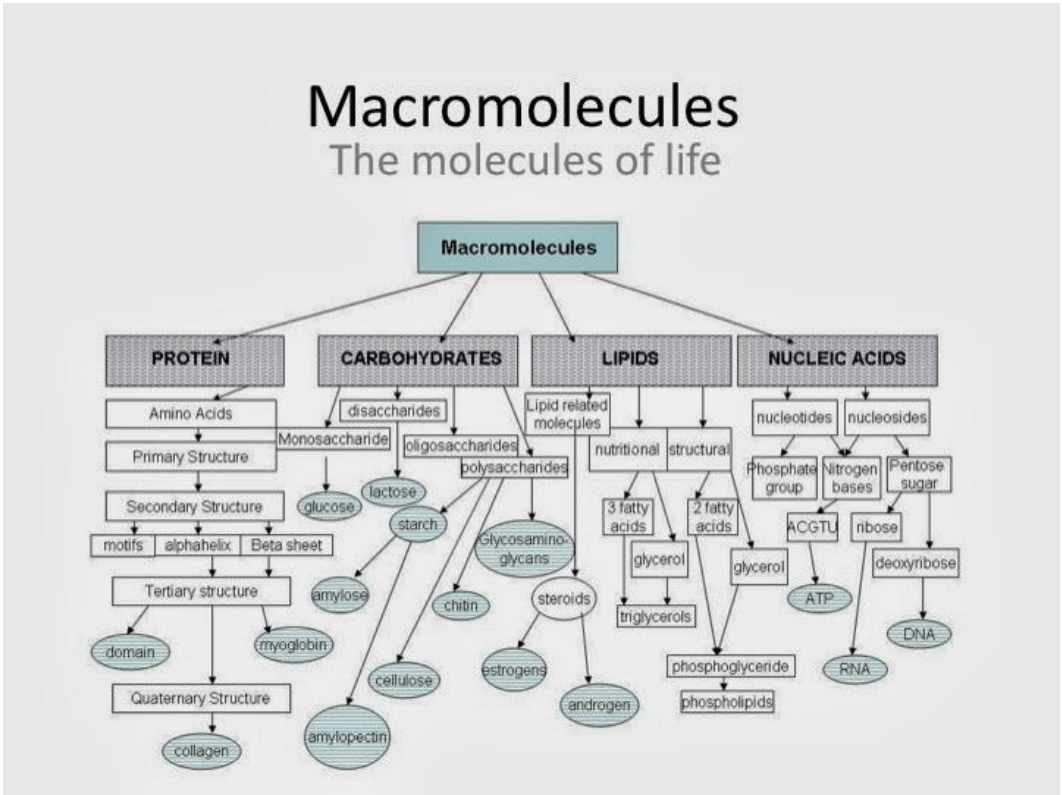
EXPLANATION (20 minutes)

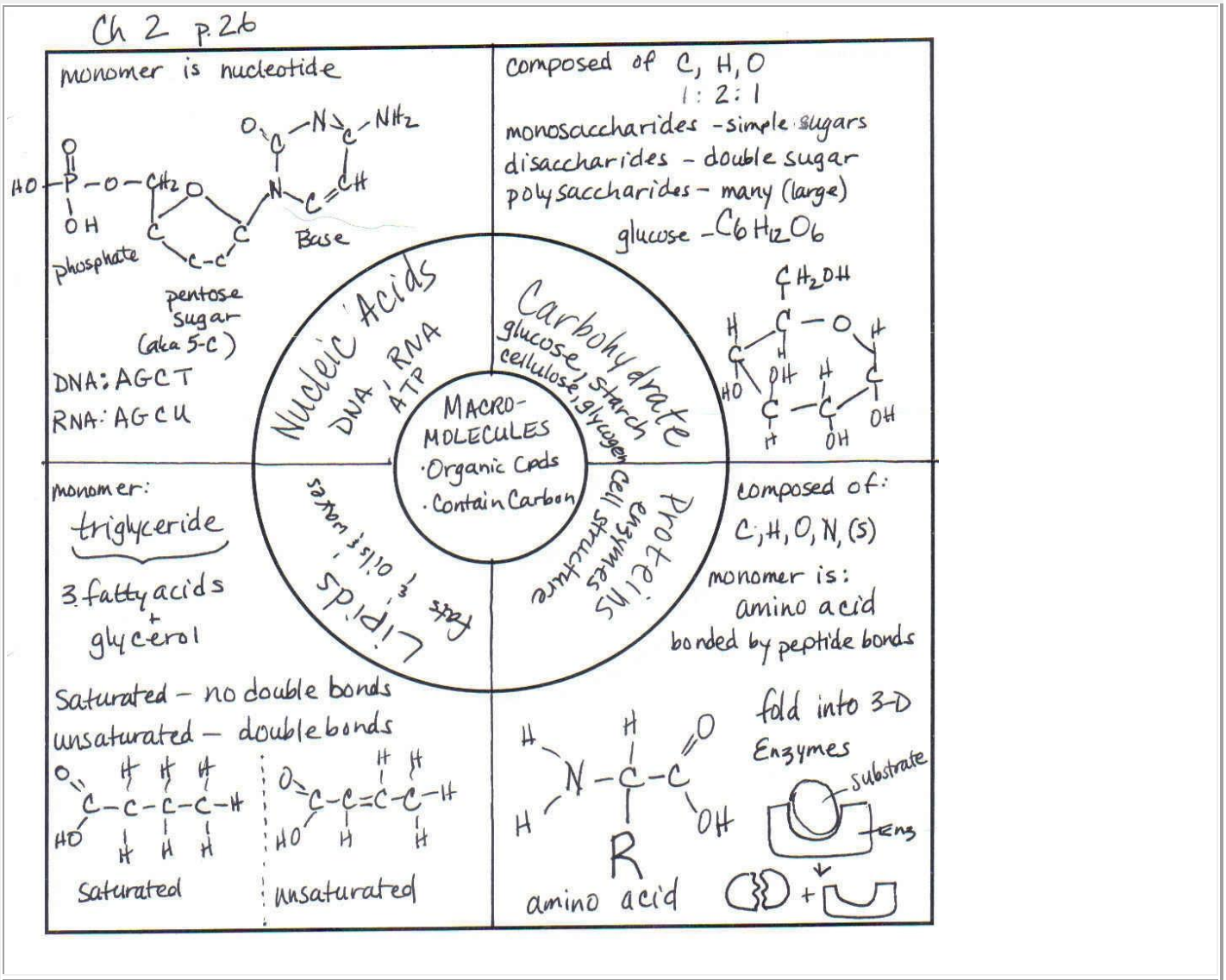
Student Macromolecule Chart Note Taking

Students will then decide based on what they have learned in the jigsaw activity what the core groups of macromolecules are and what are the characteristics of molecules within those groups. They will create notes by using a chart or graphic organizer to compile their information. The following are examples.

Macromolecules Graphic Organizer

Carbohydrates	Lipids	Proteins	Nucleic Acids
Elements that Compose:	Elements that Compose:	Elements that Compose:	Elements that Compose:
function	function	function	function
Monomer Units: 3 Classes and Example of Each	Structure of Triglyceride (Fats) Saturated vs Unsaturated Fats	Monomer Units Two Functional Groups found in all Amino Acids	Monomer Units: Three parts of monomer: Nucleic Acids
Lab Test – Two Types	Lab Test	Lab Test	Comparison of DNA and RNA
Positive Negative	Positive Negative	Positive Negative	





ELABORATION

Students will research one specific vector borne/spread disease and the students will then present their information with a visual display (PowerPoint, poster, etc.). The following information should be included:

1. Name of the disease & name of the pathogen that causes the disease.
2. Type of pathogen- Virus, bacteria, protozoa/parasite etc.
3. The name & type of vector that spreads the disease.
4. Identify the effect of the pathogen on the body/why it causes disease. What key specific macromolecules play a role in the disease
3. Why is knowledge of the macromolecules involved in the disease important? How could this knowledge be applied/beneficial in our daily lives?
4. Include visuals – photos/graphs/diagrams that help show the pathogen/disease and its affects.
5. Work sited/ source of all information

EVALUATION (80 minutes total – pre-& post)

Students will be given a pretest and a post test. There will also be a formative and summative assessment

1. Students will be given a blank sheet of paper and will be told to write everything they know about macromolecules on one side and disease on the other. They will be encouraged to do a personal meaning map or concept map. (15 minutes)
2. Students will then be asked to write a written response to the question "Why do you think learning about macromolecules is important? Justify with supporting details why an understanding of macromolecules should be taught in biology class." (10 minutes)
3. Students will finally be given a 10-question multiple choice assessment that evaluates their understanding of the standards taught in the lesson. (15 minutes)

Biological macromolecule Jigsaw & Marching Disease Case Study List

Jigsaw: Choose one molecule per group – groups could be 2 - 4 individuals

Protein/Enzymes

1. Leptin (LEP-R)
2. Rubisco (Ribulose-1,5-bisphosphate carboxylase) (AP or HONORS use chemical name)
3. Hemoglobin
4. Insulin
5. Catecholamines (AP or HONORS students)

Carbohydrates

1. Aspartame
2. Sucralose
3. Chitin

Lipids

1. Estrogen
2. Testosterone
3. Dexamethasone
4. Vitamin A

Nucleic Acids

1. ATP
2. mRNA
3. DNA
4. plasmid

Sorting/Matching: Give multiple different ones to the groups – 3 or 4 per group to match with its correct biological macromolecule category.

Carbohydrates

1. Sucrose
2. Starch
3. Glucose
4. Fructose
5. Glycogen
6. Amylose
7. Cellulose
8. Lactose

Nucleic Acids

1. siRNA
2. RNAi
3. dsRNA
4. Cyclic adenosine monophosphate (cAMP) (AP BIO)
5. Chromosome

Lipids

1. Cholesterol
2. Unsaturated fatty Acids
3. Saturated fatty Acids
4. Glycerol
5. Phospholipid

Proteins

1. Lactase
2. Catalase
3. Adenyl cyclase (AP BIO)
4. Immunoglobulin (antibodies)
5. Keratin

6. Collagen
7. Valine

Vector Spread Disease List: CATALySES Action Proposal Macromolecules Lesson Supplement

Tick Carried

1. Lyme disease.
2. Rocky Mountain spotted fever.
3. Tularemia.
4. Ehrlichiosis.
5. Relapsing fever.
6. Colorado tick fever.
7. Babesiosis.
8. South African Tick-Bite Fever

Mosquito Carried

1. malaria,
2. dengue,
3. West Nile virus,
4. chikungunya,
5. yellow fever,
6. filariasis,
7. Japanese encephalitis,
8. Saint Louis encephalitis,
9. Western equine encephalitis,
10. Eastern equine encephalitis,

Flea Carried

1. typhus
2. plague
3. “cat scratch disease”

Vector Spread to Plants

1. Citrus greening
2. BBTV (Banana bunchy top virus)- Aphid Vector – Pentalonia nigronervosa
3. Xylella fastidiosa
4. Spiroplasma spp.
5. Liberibacter spp.,
6. ‘Candidatus Phytoplasma spp.’