

Fall 12-12-2015

# Incorporating Problem Based Learning into a Secondary International Baccalaureate Biology Curriculum

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Incorporating Problem Based Learning into a Secondary International  
Baccalaureate Biology Curriculum

By:

Katie Smith

December, 2015

A culminating project submitted to the Department of Education and Human Development of  
The College at Brockport, State University of New York in partial fulfillment of the  
requirements for the degree of Master of Science in Education

Incorporating Problem Based Learning into a Secondary International  
Baccalaureate Biology Curriculum

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## **Acknowledgement**

**This thesis is dedicated to my late grandmother, who always felt that a quality education was of the most importance. Upon her death, I made a promise to do whatever it took to finish my Master's Degree in Education. It is with her pure encouragement to pursue my dreams, and by providing me with the love and support throughout my life that has given me the strength to never give up. Her advice and wisdom will live on forever in my heart. Love you, think of you, and miss you always.**

## **Abstract**

As expressed in the 21<sup>st</sup> century skills framework, the goal of education is to create lifelong learners who can contribute to society. To accomplish this task, students must be exposed to real world problems providing students the opportunity to retain knowledge for future acquisition and application. Problem based learning (PBL) is distinct from other learning philosophies and strategies because it centers content and skills on problems instead of providing a list of concepts and then trying to make them applicable to the real world (Jonassen & Hung, 2008).

Most PBL research and curriculums have been created at the college level, in particular, in medical related programs. Implementing PBL activities at the secondary level can be challenging due to the content required to solve real world problems and the complexity of these problems usually involving multiple solution pathways. This capstone project will address the challenges associated with implementation by using different components of PBL (worked examples, structural analogues, case studies, and simulations), utilizing a problem difficulty rating scale (level of complexity and structuredness), and incorporating scaffolding techniques (analogical encoding, causal relationships, argumentation, questioning, and modeling) to help students become successful at the secondary level. Within the project, the human body unit was chosen to show how using a variety of implementation strategies discussed above can make college level content accessible to secondary level students. Also, the unit allows students to act like real life doctors by using each patient's history, symptoms, and test results to determine a diagnosis. Essentially, this capstone project will show how a teacher can take a traditional unit such as human body systems and turn it into a PBL unit filled with authentic, mind-challenging but supported learning tasks.

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## **Chapter I - Introduction**

### **Rationale**

The goal of problem based learning (PBL) is to create lifelong learners who can apply specific thinking strategies to a variety of situations. This type of learning encourages students to become self-directed learners who can use their background knowledge to connect to new ideas in the real world (Marra, Jonassen, Palmer, & Luft, 2014). This idea of problem based learning was first developed in the 1950's to help medical school students learn science content for long term use and help develop their clinical skills in a medical setting (Marra, Jonassen, Palmer, & Luft, 2014). Research suggests that problem based learning is not only beneficial to medical school students but to all learners of all ages (Marra, Jonassen, Palmer, & Luft, 2014). Since problem solving is used in the work place and in everyday life on a consistent basis, it really should be the focal point of education (Jonassen & Hung, 2008). PBL centers content and skills on problems instead of providing a list of concepts and then trying to make them applicable to the real world (Jonassen & Hung, 2008).

Most PBL research has been conducted at the college level in particular the medical field including nursing and doctor programs. Research suggests that PBL activities enhance higher level thinking skills such as creativity (Ersoy & Baser, 2014; Marra, Jonassen, Palmer, & Luft, 2014), knowledge acquisition (Gurpinar, Musal, Aksakoglu, & Ucku, 2005; Hwang & Kim, 2006; Meo, 2013), and intrinsic motivation (Willems & Gonzalez-DeHass, 2012; Hwang & Kim, 2006). Furthermore, research also suggests that PBL activities not only increase knowledge acquisition but also improve knowledge retention, comprehension, and application abilities (Akca, 2009). Implementing PBL activities at the secondary level can be challenging due to the content required to solve real world problems and the complexity of these problems usually involving multiple solution pathways. The ultimate goal of this project is to develop a PBL

module that addresses the challenges associated with implementation by using different components of PBL (worked examples, structural analogues, case studies, and simulations), utilizing a problem difficulty rating scale (level of complexity and structuredness), and incorporating scaffolding techniques (analogical encoding, causal relationships, argumentation, questioning, and modeling) to help students become successful at the secondary level.

### **Significance of Project**

Designing a curriculum based on PBL principles plays a key role in creating lifelong learners who can contribute to society as expressed in the 21<sup>st</sup> century skills framework. The goal of these learning tasks are to connect content with real world problems. In order for students to understand and appreciate science concepts, they must make this connection to be able to retain knowledge for future application and acquisition and transfer knowledge to different contexts. Many PBL curriculums have been created at the college level generating a lack of PBL tasks for secondary science students to utilize. Due to this finding alone, this project becomes even more significant for the future of science education and enhancing learning for a lifetime.

This project will address the challenges associated with implementation by using different components of PBL (worked examples, structural analogues, case studies, and simulations), utilizing a problem difficulty rating scale (level of complexity and structuredness), and incorporating scaffolding techniques (analogical encoding, causal relationships, argumentation, questioning, and modeling) to help students become successful at the secondary level. This project is unique because all three of these factors will be addressed in each lesson plan. The different components of PBL will be chosen based on the content and goal of the lesson. Within the unit, the problem difficulty level will begin at a level 1 and slowly work up to a level 3 as the unit progresses. Since the module is constructed for secondary level students, the highest problem difficulty level 4 will not be used. The human body unit will allow students to



play an authentic role as a doctor observed in the real world. Not only does the content become relevant but also the authentic role heightens student curiosity in the field of medicine and healthcare hence increasing motivation. Also within the unit, PBL will heighten conceptual understanding of the different processes using problems to highlight content, relationships such as cause and effect, and relevancy. This project is special because most PBL modules have been created at the college level. This PBL module will be accessible for secondary level students through the implementation of scaffolds, PBL components, and by addressing the problem difficulty level of each problem.

## **Definition of Terms**

**PROBLEM BASED LEARNING:** A curriculum or task centered on a real world problem for students to gain content knowledge, reasoning skills, and problem solving skills.

**THEORY OF CONSTRUCTIVISM:** A theory that focuses on having students make meaning of concepts and ideas by interacting and collaborating with a real environment.

**SITUATED LEARNING THEORY:** Learning takes place in a social and physical context focusing on knowledge being acquired in a fixed setting.

**METACOGNITION:** A process that encourages students to become independent learners by thinking and reflecting on their learning process and becoming aware of their own learning style, background knowledge, and curiosities.

**CASE STUDY:** A component of PBL that consists of a short narrative followed by a list of guided questions that permits students to analyze the conditions presented to solve the problem using supporting evidence.

**STRUCTURAL ANALOGUES:** A component of PBL that allows students to compare two similar problems side by side in an effort to highlight similarities and differences.

**WORKED EXAMPLES:** A component of PBL that allows students to view the problem in smaller parts or steps.

**SIMULATIONS:** A component of PBL that encourages students to identify cause and effect relationships and manipulate different variables to see alternative outcomes.

**PROBLEM COMPLEXITY:** This idea is broken down into four subcomponents and addresses how likely the problem is going to be solved according to what is known in the problem.

**PROBLEM STRUCTUREDNESS:** This idea is broken down into five subcomponents and addresses how likely the problem is going to be solved according to what is unknown in the problem.

**SCAFFOLDING:** Instructional techniques used to help support student learning.

**ANALOGICAL ENCODING:** A scaffolding technique that allows students to identify similarities and differences between two problems including pattern recognition and problem solving approach.

**CAUSAL RELATIONSHIPS:** A scaffolding technique that helps students identify the cause and effect in a given problem.

**ARGUMENTATION:** A scaffolding technique permitting students to explain and justify an idea or solution to a problem using reasoning and evidence from research.

**INTERNATIONAL BACCALAUREATE PROGRAM:** A program designed for high achieving students aimed at developing inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

## **Chapter II – Literature Review**

### **Overview**

In order for students to thrive in the real world after high school or college, students need exemplary thinking strategies and problem solving skills that they can apply to different situations as an independent learner. This is where problem based learning comes into play. The goal of problem based learning is to create lifelong learners who can apply specific thinking strategies to a variety of situations. This type of learning encourages students to become self-directed learners who can use their background knowledge to connect to new ideas in the real world (Marra, Jonassen, Palmer, & Luft, 2014).

This idea of problem based learning was first developed in the 1950's to help medical school students learn science content for long term use and help develop their clinical skills in a medical setting (Marra, Jonassen, Palmer, & Luft, 2014). Research suggests that problem based learning is not only beneficial to medical school students but to all learners of all ages (Marra, Jonassen, Palmer, & Luft, 2014). Since problem solving is used in the work place and in everyday life on a consistent basis, it really should be the focal point of education (Jonassen & Hung, 2008). PBL centers content and skills on problems instead of providing a list of concepts and then trying to make them applicable to the real world (Jonassen & Hung, 2008).

Problem based learning (PBL) is very similar to authentic learning tasks; however, an authentic task does not necessarily have students solve a real world problem (Willems & Gonzalez-DeHass, 2012). Problem based learning is usually used before students master the content, which contradicts the typical education classroom that has students master content first and then apply their learning to a situation or problem (Hmelo-Silver, 2004). With problem based learning, students learn the content, thinking strategies, and problem solving skills as they

work through the problem. Learning takes place when students work on a problem themselves, making mistakes along the way, eventually reaching a possible solution (Jonassen, 2011). This idea to some educators may be very difficult to grasp. Research suggests that by having students work through a problem using their background knowledge, they will be better equipped to be lifelong learners, in contrast to learners who memorize and forget content.

Most PBL research has been conducted at the college level in particular the medical field including nursing and doctor programs. Research suggests that PBL activities enhance higher level thinking skills such as creativity (Ersoy & Baser, 2014; Marra, Jonassen, Palmer, & Luft, 2014), knowledge acquisition (Gurpinar, Musal, Aksakoglu, & Ucku, 2005; Hwang & Kim, 2006; Meo, 2013), and intrinsic motivation (Willems & Gonzalez-DeHass, 2012; Hwang & Kim, 2006). Furthermore, research also suggests that PBL activities not only increase knowledge acquisition but also improve knowledge retention, comprehension, and application abilities (Akçay, 2009). Implementing PBL activities at the secondary level can be challenging due to the content required to solve real world problems and the complexity of these problems usually involving multiple solution pathways. The ultimate goal of this project is to develop a PBL module that addresses the challenges associated with implementation by using different components of PBL (worked examples, structural analogues, case studies, and simulations), utilizing a problem difficulty rating scale (level of complexity and structuredness), and incorporating scaffolding techniques (analogical encoding, causal relationships, argumentation, questioning, and modeling) to help students become successful at the secondary level.

### **Problem Based Learning**

Problem based learning occurs when a curriculum is centered on a real world problem for students to gain content knowledge and develop critical thinking skills. Within this context,

students can ask their own questions, collaborate with peers, and conduct their own research to solve the problem. This approach is considered a hands-on, minds-on step by step way to engage students in meaningful learning that develops critical thinking and problem solving skills (Akca, 2009). This idea of problem based learning was first developed in the 1950's to help medical school students learn science content for long term use and help develop their clinical skills in a medical setting (Marra, Jonassen, Palmer, & Luft, 2014). Actually, some PBL principles go back as early as 1938. Back then, "Dewey had already emphasized the necessity of teaching science through problems that were relevant to students, using problem solving instructional strategies" (Wong & Day, 2009). Today PBL is mostly used in college programs associated with the healthcare profession. However, research suggests that PBL is just as effective at the secondary level as well (Wong & Day, 2009).

For problem based learning to be effective in the classroom, there are two theories that educators should become familiar with before implementing it. The first, is the theory of constructivism which focuses on having students make meaning of concepts and ideas by interacting and collaborating within a real environment (Marra, Jonassen, Palmer, & Luft, 2014). This exposure to a real context will entice curiosity and encourage students to ask questions. The questions students ask are based on their own experiences and interests. By having students ask their own questions they are not only going to be intrinsically motivated but also will become independent learners. The theory is that students are more apt to retain new knowledge since it was acquired during their own explorations based on their own curiosities (Wong & Day, 2009). Also, this theory encourages the notion that knowledge is transferable to different contexts because it focuses on how to think and understand the natural world (Wong & Day, 2009).

The second theory educators need to consider is the situated learning theory. This theory

suggests that learning takes place in a social and physical context (Marra, Jonassen, Palmer, & Luft, 2014). This is very similar to the theory of constructivism; however, the situated learning theory focuses on knowledge being acquired in a fixed setting. Like the theory of constructivism, this theory also focuses on the social aspect of learning. By having students work together and collaborate daily; a deeper conceptual understanding is achieved. Within this environment, values and beliefs are shared among learners allowing each learner to rectify or discard their prior understanding (Marra, Jonassen, Palmer, & Luft, 2014). This collaborative environment allows students to learn from each other within an anchored, knowledge rich setting (Marra, Jonassen, Palmer, & Luft, 2014).

It is important to note that both of the theories described above emphasize that the mind does not function in isolation but rather needs to be connected to the world (Marra, Jonassen, Palmer, & Luft, 2014). The mind is such a powerful tool that fosters each learner's ability to expand their current knowledge. Since problem based learning requires learners to become more independent thinkers, metacognitive principles will need to be explored prior to problem based learning implementation. Metacognition plays a key role in a learner's ability to develop valuable problem solving skills (Marra, Jonassen, Palmer, & Luft, 2014). Learners must be aware of one's strengths and weaknesses, learning style, knowledge, and curiosities to excel at solving real world problems to gain content knowledge (Marra, Jonassen, Palmer, & Luft, 2014). Metacognition encourages students to "think about one's thinking" using self-reflection daily. This reflection process allows students to monitor and evaluate their progress toward the completion of solving a problem.

### **Benefits of Problem Based Learning**

Many of the research studies associated with PBL show how this approach enhances

learning for a lifetime. This learning approach achieves this goal by increasing students' intrinsic motivation, higher level thinking skills, and knowledge acquisition. Furthermore, research also suggests that PBL activities not only increase knowledge acquisition but also improve knowledge retention, comprehension, and application abilities (Akçay, 2009).

Hmelo-Silver (2004) concluded at the end of her article that more research needed to be conducted on whether the effectiveness of PBL was associated with the intrinsic motivation of the learner. Years later, Willems & Gonzalez-DeHass (2012) found that authentic tasks increased intrinsic motivation of learners. By placing students in authentic settings, not only will increase their motivation to learn but also will permit successful transfer of student knowledge to the real world (Willems & Gonzalez-DeHass, 2012). In addition, in a study conducted by Hwang and Kim (2006), there was no statistical difference between the PBL and lecture based learning (LBL) group in attitudes; however, motivation was significantly higher in the PBL group (Hwang & Kim, 2006). Essentially, PBL increases motivation by engaging students in a problem related to the real world (Morrison, 2003).

As discussed by Ersoy & Baser (2014) and Marra, Jonassen, Palmer, & Luft (2014), problem based learning fosters higher level thinking skills such as creative thinking and metacognition. Ersoy & Baser's (2014) study broke down creative thinking into three subcomponents including fluency, flexibility, and originality. To evaluate the students' creative thinking skills, the students participated in a Torrance Test of Creative Thinking Verbal A-B Form test (Ersoy & Baser, 2014). Fluency referred to the subjects' ability to produce new ideas and order valuable information. While flexibility focused more on the subjects' ability to assess events and adapt to changing circumstances. Originality dealt with the subjects' ability to think inquisitively and produce new data. The findings found that the average score on each post-test



increased substantially compared to the pre-test results (Ersoy & Baser, 2014). Problem based learning had a greater impact on increasing originality compared to fluency and flexibility. While Marra, Jonassen, Palmer, & Luft (2014) found that learners become better problem solvers if they are able to use the principles of metacognition. Metacognition is considered a higher level thinking skill that promotes a deeper learning of content to utilize for future use. So one can conclude, that problem based learning increases creativity which is a higher level thinking skill along with metacognition that is needed to thrive in the real world.

PBL tasks enhance intrinsic motivation and foster higher level thinking skills as discussed above; however, do content knowledge scores (knowledge acquisition) improve using PBL compared to a traditional lecture based approach? A study conducted by Gurpinar, Musal, Aksakoglu, & Ucku (2005), compared knowledge scores of medical students on public health topics in a PBL curriculum to a traditional lecture based learning (LBL) curriculum. The study used 135 students with a gender ratio of 55.4% males to 44.6% females (Gurpinar, Musal, Aksakoglu, & Ucku, 2005). The assessment tool used was a 25 question multiple choice test. The curriculum focused on teaching students about nine of the most common health problems within a local community including how to prevent them and how to treat them. The results of the study showed a mean score on all topics for the PBL group to be 65.0 compared to 60.5 for the LBL group (Gurpinar, Musal, Aksakoglu, & Ucku, 2005). The PBL group had higher knowledge scores in seven out of the nine topics. Two of the public health topics, health management and chronic diseases, had significantly higher test scores for the PBL group compared to the LBL group. Therefore, the study concluded that PBL increases knowledge acquisition.

Another study conducted by Hwang and Kim (2006), compared the effects of knowledge

acquisition in PBL to a LBL approach using knowledge scores within a cardiorespiratory unit in a specific nursing program. The study consisted of 71, second year nursing students in Korea in which 35 were placed in a PBL group while 36 were placed in a LBL group (Hwang & Kim, 2006). A 32 question survey was used to assess learning attitudes and student motivation, while a separate multiple choice test was used to assess knowledge. Within the PBL curriculum, seven different case studies or scenarios were used. Students in the PBL group worked in small groups to identify proper cues within each case study to generate a hypothesis (Hwang & Kim, 2006). Students then worked individually to present a solution to the problem to the class. At the end, students reflected on their learning experience and performance. The LBL group experienced lectures, ability to ask questions as needed, and used reference books periodically (Hwang & Kim, 2006).

Within the study, pre-tests were conducted on cardiac and respiratory nursing knowledge and attitudes (Hwang & Kim, 2006). Post-tests were used to assess cardiac and respiratory nursing knowledge, attitudes, and motivation (Hwang & Kim, 2006). The findings showed that the level of knowledge was significantly higher in the PBL group compared to the LBL group using the post-test scores as a comparison. It is important to note that all students with high or low scores in the pre-test still showed an increase in post-test scores in the PBL group (Hwang & Kim, 2006). In the LBL group, only students with high pre-test scores showed an increase in post-test knowledge scores (Hwang & Kim, 2006). This study also confirms that PBL increases knowledge acquisition.

Another study conducted by Meo (2013), compared knowledge acquisition and skill ability test scores in a problem based learning (PBL) curriculum to a traditional lecture styled curriculum. The study focused on one respiratory physiology course within two different medical

schools. One medical school implemented PBL tasks while the other used a traditional lecture styled curriculum. There were 30 male students who participated from each school within the same age, nationality, demographics, and cultural background (Meo, 2013). The study was conducted over a two week period. A multiple choice exam was used to measure each student's knowledge and a structured lab practical was used to assess skill ability levels (Meo, 2013).

Within this PBL curriculum, students were given a case study such as "I am still coughing" in which students had to make the connection to certain parts of the respiratory tract and identify each part's function (Meo, 2013). Then using anatomy and physiology knowledge, students had to connect a condition or illness such as chronic obstructive pulmonary disease (COPD) to this particular part of the respiratory tract (Meo, 2013). Next, students were given tasks to perform, which enabled them to interpret and explain the different tests used such as the pulmonary function test, to determine the probable diagnosis. Furthermore, students were challenged with the ability to decipher between two closely related diseases such as COPD and restrictive lung disease (Meo, 2013). The findings of the study showed that the students who were exposed to the PBL curriculum scored significantly higher on the multiple choice test and lab practical exam compared to the traditional lecture styled curriculum group (Meo, 2013). In conclusion, by having students acquire critical thinking skills, self-monitoring abilities, and effective problem solving strategies using PBL tasks, students will attain an increased acquisition of knowledge and skill and an ability to successfully apply learning in different context.

As indicated above, much of the research conducted on the benefits of PBL have taken place at the college level in particular in medical schools. Akcay (2009), decided to conduct a study comparing PBL to LBL in two groups of secondary high school students in Hong Kong. Akcay (2009) questioned whether or not PBL is just as useful in secondary science classrooms.

The study focused on whether PBL or LBL was more effective at producing learning gains and sustaining learning overtime. The two groups consisted of 12-13 year old boys and girls in which 38 students were chosen for the PBL group while 40 students were placed in the LBL group (Akçay, 2009). The topics used in the study were based on student interest including human reproduction (high interest) and density (low interest). Within the PBL group, students were first presented with a problem in which no previous content knowledge was provided from the teacher (Akçay, 2009). Then, students had to identify the problem, brainstorm ideas, discuss ideas as a group, determine what they needed to know to solve it, and determine what to research. Next, students within each small group had to conduct research and build a model if applicable (Akçay, 2009). Lastly, students reported their findings to their classmates. Within the topic of density, students had to determine how density was related to mass and volume. On the flip side, the students in the LBL group had the teacher tell them the relationship prior to performing practice problems.

Within this study, students were assessed using a multiple choice test and short answer constructed response test. Pre and post tests were used to compare knowledge, comprehension, and application (Akçay, 2009). A delayed post-test was also given two months later to assess conceptual understandings with respect to long term knowledge acquisition, comprehension, and application. Results of the study showed that PBL and LBL are just as effective in the knowledge category; however, the PBL group showed significant learning gains in comprehension and application compared to the LBL group (Akçay, 2009). More impressive, the study showed that long term knowledge acquisition, comprehension, and application significantly increased in the PBL group compared to the minimal increase achieved in the LBL group (Akçay, 2009). In conclusion, retention of knowledge, comprehension, and application are significantly improved

using PBL techniques as opposed to LBL strategies. Also, it is important to note that not only is PBL effective at the college level but it is also just as valuable at the secondary level.

Overall the greatest benefits of PBL tasks is that they support student learning beyond the classroom. PBL is not necessarily all about solving problems but rather it allows these problems to help students gain content knowledge and conceptual understanding for a lifetime (Morrison, 2003). This idea relates to the phrase, “Learning is all about the process and not necessarily the end product”. There are many advantages of PBL including its student centered approach that increases retention of knowledge and acquisition of skills (Morrison, 2003). The constructivist approach of PBL activates each student’s background knowledge, allowing each student to build on the solid foundation previously formed from prior experiences and knowledge. More profound, the focus on generic competencies allows students to acquire basic skills and achieve a deeper learning by interacting with multiple resources and connecting content to the world (Morrison, 2003).

### **Issues with Implementing Problem Based Learning**

According to research, PBL is a very effective education approach; however, implementation can be challenging. First and foremost, most real world problems are highly complex in nature making it difficult for secondary students to readily acquire the knowledge and skills to be able to solve the problem. Also, the transition from a teacher-centered, lecture-based approach to a student-centered, problem-based approach is extremely difficult for the student and teacher to adjust to. Lastly, teachers find it very challenging to create an entire curriculum based on an authentic problem.

As noted above, the content required to solve real world problems substantially exceeds students’ ability levels. Some supports may be required to help students succeed by closing the

high level, content knowledge gap. Topics may need to be broken down into parts so students can learn content in smaller pieces instead of having to break down a difficult concept on their own. Also, problem difficulty needs to be addressed while choosing a problem for students to solve. Design problems would be extremely advanced for secondary students due to their ill-structured nature (multiple solution pathways). One must consider the complexity and structuredness of a problem to determine its difficulty level. It would be best to strive for a moderate difficulty level based on the criteria above. These implementation strategies addressing the limitations as described above, will be discussed in more detail in the next section.

Transitioning away from a traditional teacher-centered, lecture-based approach to a student-centered, problem-based approach can be difficult for students to manage. Problem based learning stresses the importance of using self-monitoring skills on a daily basis, which can be challenging for some students. Teachers can implement “learning conversations” with the student individually or as a class to help discuss different thinking perspectives (Marra, Jonassen, Palmer, & Luft, 2014). Also teachers can use “daily metacognitive memos” that allow students to organize their thinking on paper in an informal format (Marra, Jonassen, Palmer, & Luft, 2014). Both of these formats allow feedback from the teacher and/or other learners, as well as, guidance from the facilitator. In addition, reflection and planning stages of problem based learning seem to be the most challenging for students to comprehend (Willems & Gonzalez-DeHass, 2012). According to Marra, Jonassen Palmer, & Luft (2014), teachers can address this issue by modeling the way to solve an authentic problem. The teacher can perform a “think aloud” while solving the problem in front of the class. This allows students to hear and see each step that the teacher uses to solve the problem.

Not only is it difficult for students to adjust to an independent style of learning, but

teachers also struggle with giving more control to the students. Since the transition from a teacher-centered classroom to a student-centered classroom is drastic, teachers must gradually withdraw student support. To address this problem, Spronken-Smith and Harland (2009) developed a community of practice (COP) that allowed teachers to meet to share experiences and resolve problems associated with implementing problem based learning in the classroom. Over the course of the study, data was collected for one full year. Findings showed that teachers struggled with the rules of problem based learning, knowing when to intervene, and conflicting teacher opinions (Spronken-Smith & Harland, 2009). Teachers expressed that they wanted to experience problem based learning themselves first before trying to implement it (Spronken-Smith & Harland, 2009). These concerns will be addressed using various scaffolding techniques to make the transition easier for the teacher and students, which will be discussed in the next section in greater detail.

As Willems & Gonzalez-DeHass (2012) discussed, teachers struggle with re-designing an entire curriculum centered on problem based learning. The authors suggested using “post-holes” which are small problems that can be used daily (Willems & Gonzalez-DeHass, 2012). The idea is that students are still acquiring content knowledge and thinking strategies by using problem based learning daily; however, a deeper level of understanding may not be achieved. It may also be beneficial to start with “post-holes” and then gradually create more difficult, in depth problems as time proceeds. This not only makes it easier for the teacher to adjust to this new style of teaching, it makes the transition for the students easier as well.

## **Implementation Strategies for Problem Based Learning**

### Components of PBL

The components of PBL vary from case studies to worked examples, structural analogues

and prior experiences to simulations. Most problems constructed in PBL tasks are pre-authenticated, allowing students to practice solving problems in a particular field (Jonassen, 2011). Emergent problem types are less used since students have to be placed in the actual field or situation (Jonassen, 2011). Worked examples are used to show how a problem is solved, which works well with well-structured problems that possess limited solutions. Worked examples break down the problem into smaller parts and steps, allowing the learner to see the process step by step.

Using structural analogues are another way to incorporate PBL into the classroom. Structural analogues allow students to compare two similar problems (Jonassen, 2011). This encourages students to make connections between the two problems and articulate it in written format. By identifying similarities and differences, students can use different or similar approaches to solve the problems. This leads into another component of PBL which is using prior experiences to solve problems. Students can use prior experiences to solve a new problem that looks similar (Jonassen, 2011). If the solution does not work that was previously used, the new problem must then be analyzed again.

The most common types of PBL tasks used are made up of case studies. Within each case study or scenario students read a short narrative and then answer guided questions (Jonassen, 2011). Next, the students analyze the conditions described in the case study allowing them to develop possible solutions. Case studies tend to focus on the students' ability to apply prior knowledge rather than acquire new knowledge (Jonassen, 2011). It is all about "engaging in what-if-thinking". For example, "what if we did this or changed that?" Class discussions are then used to analyze how other students solved the problem (Jonassen, 2011).

Another component of PBL is the use of simulations. Simulations can be used in isolation or in conjunction with case studies by encouraging students to analyze causal relationships



(cause and effect). Simulations allow students to manipulate elements of the problem to be able to draw inferences and conclusions of each variable effect (Jonassen, 2011). By having students test causal relationships, it allows them to rectify or discard prior understandings; therefore, promoting conceptual change. Some examples of simulations include online medical simulations that allow students to analyze a patient's medical record, examine the patient, order tests, make a diagnosis, and treat the patient. Flight simulators are also used in pilot training programs to mimic catastrophic events such as engine fire, loss of pressurization, and electric failure (Jonassen, 2011). This allows the airline industry to know if a pilot can react quickly and efficiently if these situations occur in real flight.

### Problem Difficulty

Problem difficulty focuses on how likely the problem is going to be solved correctly. There are a variety of internal and external factors that can effect problem difficulty; however, Jonassen & Hung (2008) chose to focus mainly on two external factors, complexity (known portion of the problem) and structuredness (unknown portion of the problem). The complexity of the problem is determined by the knowledge required to solve it (knowledge), the difficulty level of the concepts involved (domain of knowledge), the skills needed (intricacy of procedure), and the amount of nonlinear relationships represented (relationship complexity) (Jonassen & Hung, 2008). The knowledge required refers to the number of interrelationships that need to be known, cognitive demand, and number of pieces of information that need to be considered (Jonassen & Hung, 2008). The domain of knowledge relates to the conceptual difficulty such as using concrete (more simple) or abstract concepts (more difficult, ex. legal problems). The intricacy of the procedure implies to the length of the solution produced or the number of steps needed (Jonassen & Hung, 2008). The amount of time required to solve the problem is also addressed

here. Relationship complexity refers to the number of conceptual relationships within the problem and whether they are one directional or bi-directional (Jonassen & Hung, 2008). It is important to note that real world problems are usually highly complex because there is not one single solution pathway.

The structuredness of the problem focuses on the ideas in the problem that are unknown to the learner. These factors include the problem identifiers (intransparency), use of rules (heterogeneity of interpretations), constraints (heterogeneity of interpretations), predictability (dynamicity), and the number of possible solutions (legitimacy of competing alternatives) (Jonassen & Hung, 2008). Intransparency refers to the degree of what is known. Heterogeneity of interpretations discusses how much the problem is open to different perspectives and interpretations with respect to the nature of the problem, goal, or constraints (Jonassen & Hung, 2008). For example, the topic of abortion would be open to a variety of perspectives due to its controversial nature. Interdisciplinarity refers to the number of disciplines involved to solve the problem. Dynamicity refers to the problems ability to change (Jonassen & Hung, 2008). For example, during a chess match a player cannot make a decision of what chess piece to move until the opponent moves first. The player's decision is dependent on the opponent's move each time. Legitimacy of competing alternatives deals with well-structured problems that have one single solution pathway while ill-structured problems possess multiple solution pathways (Jonassen & Hung, 2008). Logically, the more solutions possible make it more difficult to choose the best solution, in which more time is needed to evaluate all options increasing the difficulty level of the problem.

### Scaffolding Techniques

There are a variety of scaffolding techniques that can be used in the classroom when

implementing PBL tasks. These scaffolds will help students comprehend, think critically, and apply new understandings effectively. The first strategy used is analogical encoding. This strategy presents two similar problems to students allowing them to then identify structural similarities (Jonassen, 2011). This will allow students to highlight common features and structural arrangements between the two problems (Jonassen, 2011). It is also beneficial to have students compare two problems that are dissimilar in nature. Allowing students to identify differences and similarities gives them the ability to recognize patterns and why different or similar solution pathways are required. In addition, students can fully comprehend the problem, learn how to address it, and transfer learning across various contexts (Jonassen, 2011). Research suggests that analogical encoding is more beneficial than modeling the process of solving a problem, since analogical encoding promotes transfer of understanding to different contexts and creation of mental models of different kinds of problems (Jonassen, 2011).

The second technique commonly used is using causal relationships to enhance reasoning and comprehension skills. Having students engage in identifying the cause and effect of each problem allows students to make predictions and draw inferences using the conditions provided (Jonassen, 2011). Students can use reasoning skills to infer a possible effect of the conditions specified in the problem (Jonassen, 2011). This is similar to how a doctor diagnoses a patient using a list of symptoms, medical history, lab tests, and imaging results. The cause is the actual diagnosis while the effect is the symptoms, medical history, lab tests, and imaging results. For example, a patient has trouble breathing (effect) because he has chronic obstructive pulmonary disease (cause).

The third most beneficial strategy is using questioning to enhance comprehension, thinking, and reasoning skills. Questions should be guided to get students to think about other

aspects of the problem rather than the most obvious (Jonassen, 2011). These types of questions can be embedded within the activity or verbalized while students are working on the problem (Jonassen, 2011). Questions should also be configured in a way that encourages students to ask their own questions stimulating their own curiosities. These types of questions will be required less and less as students become more self-directed and engaged in metacognitive principles (Jonassen, 2011).

The fourth technique that should be used in PBL tasks is argumentation. This is essential to get students to be able to solve well and ill-structured problems. Research suggests that reasoning skills are enhanced when students are forced to construct an argument in a well-structured problem (Jonassen, 2011). For example, a student explains and justifies why a correct answer is correct after initially answering the question incorrectly (Jonassen, 2011). Ill structured problems are much more difficult to solve due to varied solutions, unspecified goals, unspecified constraints, and multiple solution pathways (Jonassen, 2011). These types of problems are extremely important because they are encountered in everyday life. This technique allows students to construct an argument to justify their solution pathway and recommended solution as well as address a counterclaim. Students should be able to answer the following questions: What is your solution?, What is the best solution?, What evidence supports the claim?, and What other solutions are possible? (Jonassen, 2011). This justification process will enhance student reasoning skills and a student's ability to refute his or her own misconceptions.

The last scaffolding technique is the use of modeling. It is important to note that models come in very different forms. Mental models tend to be more useful if they are constructed externally as well (Jonassen, 2011). There are quantitative models such as equations and qualitative models such as causal relationship maps, concept maps, and graphic tools (Jonassen,

2011). All of these types of models are essential for enhancing comprehension and problem solving skills; therefore they should not be used in isolation. Models are a great way to represent relationships among components of a problem and help students confirm solutions (Jonassen, 2011).

### Best Problems to Use

As indicated by Jonassen & Hung (2008), the best problems to use in PBL are ones that have moderate complexity and structuredness. Some of these would include decision making, situated case/policy problems, and diagnosis-solution problems. Diagnosis-solution problems usually involve troubleshooting and a treatment protocol (Jonassen & Hung, 2008). For example, a patient comes into a doctor's office with a list of symptoms in which the goal for the patient is to feel healthy. The doctor must use these symptoms to identify what is causing the symptoms and provide the proper treatment. These types of problems have high levels of intransparency and heterogeneity of interpretations (multiple causes of a set of symptoms) (Jonassen & Hung, 2008). Decision making problems refer to making the best choice to address a problem. The focus should be on attaining the most viable solution based on the circumstances provided (Jonassen & Hung, 2008). These types of problems are more difficult when many variables have to be considered. For example, a doctor wants to perform knee surgery on a patient but before he can do this he must consider the age and economic situation of the patient. Situated case/policy problems (ex. legal problems) can also be challenging because different perspectives of all parties have to be considered, as well as, various issues such as religion and morality (Jonassen & Hung, 2008). Design problems fall into the highly complex and ill structured category because goals are vague, constraints are unknown, and multiple solution paths are possible (Jonassen & Hung, 2008). These may not be useful in the classroom due to their complexity until students

gain more practice with PBL tasks. On the contrary, well-structured story problems may not be challenging enough.

### Roles of Teacher and Student

According to Wong & Day (2009), when designing a PBL task six aspects should be considered including the role of the problem, the teacher's role, the student's role, thinking skills involved, social interaction, and assessment of learning. The role of the problem addresses the "need to know" problem type meaning "what do the students need to know to do the problem" (Wong & Day, 2009). The teacher should act as a tutor, coach, or resource but not a knowledge holder (Wong & Day, 2009). Students should be active problem solvers, decision makers, take ownership of their learning, and construct their own understanding. The thinking skills will allow students to consider alternative solutions, develop analytical skills, and have an ability to make decisions based on adequate justifications (Wong & Day, 2009). The social interaction will allow students to reflect on peers work and own problem solving skills. Assessment tools used should include items like peer reviews, self-rating scales, journals, and lab notes (Wong & Day, 2009). It is important to note that the final product and the process should both be assessed.

### **Summary**

Research suggests that PBL is effective at increasing motivation, developing higher level thinking skills, and enhancing knowledge acquisition, retention, application, and comprehension. All of these attributes of learning are essential to create 21<sup>st</sup> century learners; however, as suggested by Jonassen & Hung (2008), most real world problems are extremely challenging for students to solve at the secondary level. The content required to solve real world problems substantially exceeds secondary students' ability levels. Components of PBL and scaffolding techniques can be used to help students succeed by closing this high level, content knowledge

gap. Worked examples, a component of PBL, can be used to breakdown a problem into smaller parts so students can learn content in smaller pieces instead of having to break down a difficult concept on their own. In addition, structural analogues, another component of PBL, can be used to compare two problems side by side. This allows students to identify similarities and differences between the two problems. This idea is very similar to analogical encoding, a scaffolding technique, which allows students to compare two problems side by side to recognize patterns and create a mental model of each problem. Another scaffolding technique encourages students to use causal relationships (cause and effect) to make predictions and inferences. Helping students identify the cause and effect within a problem, allows students to develop a solution more readily by enhancing student reasoning skills.

The most important factor to address when creating a PBL module is the difficulty level of the problem. Design problems would be extremely advanced for secondary students due to their ill-structured nature (multiple solution pathways). One must consider the complexity and structuredness of a problem to determine its difficulty level. It would be best to strive for a moderate difficulty level based on the criteria above. Of course all of these factors noted above are important to creating a PBL curriculum; however, the real importance lies in creating authentic problems for students to indulge in to become learners of tomorrow. Billie McConnell, director of the K-12 Digital Learning Institute at Abilene Christian University, once said “we’re preparing (students) for a world that’s rapidly changing. The jobs they’re going to have don’t even exist yet.” As a teacher it is our duty to keep content relevant to real world problems so students can thrive long after high school and contribute to society.

## **Chapter III – Capstone Project**

### **Overview**

This project is composed of a collection of case studies all involving the human body unit utilizing the International Baccalaureate (IB) Biology curriculum. Each case study addresses specific components of PBL, problem difficulty, and special scaffolding techniques. All of these factors combined have allowed each case study to be applicable for secondary level science students.

### **Project Outline**

This project will include the development of one large human body unit consisting of six body systems within the International Baccalaureate Biology curriculum. The goal of this unit is to have students learn the different human body systems through case studies and simulations (PBL components) based on authentic, real world problems. Prior to beginning each case study, students will use an online website to obtain general knowledge concerning the human body system yet to be studied. Students will learn content in more detail by working through the case study. Students will analyze patient symptoms, history, and test results to determine a possible diagnosis. Students will be required to connect the patient's symptoms to an organ or body system to justify their proposed diagnosis. These types of activities allow students to act like real life doctors. As suggested in literature, many PBL medical school tasks are too difficult for secondary level students. To address this issue, content will be simplified in comparison to content at the college level using worked examples to break down concepts, problem difficulty will range on a scale from one to four, and additional supports such as analogical encoding will be used to accommodate this difference in ability level between the secondary and college level. The unit will also utilize metacognitive strategies such as visualization and PBL scaffolding techniques such as modeling



and argumentation to achieve this learning task. Beginning activities will be of less difficulty, then gradually becoming more difficult as the unit progresses using the complexity and structuredness difficulty rating scale. It is important to scaffold the difficulty level to allow students to adjust to this new type of thinking and learning.

Each lesson plan will include the following:

Topic	PBL Components
Time	Problem Difficulty Level
Objectives	Scaffolds Used
IB Biology Standards	Materials
Overall Learning Focus	Learning Tasks
Driving Question/Problem	Assessment Plan
Metacognitive Strategy Focus	

Case Study	Body System	Lesson #
1	Respiratory	1 - 4
2	Digestive	5, 6
3	Urinary	7 - 10
4	Circulatory	11, 12
5	Immune	13 - 17
6	Nervous	18 -20

# IB Biology Lessons 1, 2, & 3

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Respiratory System (Upper Respiratory)	<b>Time:</b> Three 40 minute periods
<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>-Students will be able to describe the gas exchange process in detail.</li> <li>-Students will be able to identify the parts of the respiratory system and describe each part's function.</li> <li>-Students will be able to define respiratory diseases such as lung cancer along with identifying causes and symptoms of each disease.</li> <li>-Students will be able to use a patient's medical history, symptoms, and physical findings to determine an accurate diagnosis.</li> </ul> <p><b>International Baccalaureate Standards:</b>  <u>6.4 Gas Exchange</u>            Understandings:            Ventilation maintains concentration gradients of oxygen and carbon dioxide between air in alveoli and blood flowing in adjacent capillaries.</p> <p>Air is carried to the lungs in the trachea and bronchi and then to the alveoli in bronchioles.</p> <p><u>6.4 Gas Exchange</u>            Application:            Causes and consequences of lung cancer.</p>	<p><b>Overall Learning Focus:</b></p> <p>First, students will explore the respiratory system on their own using a website to answer critical questions. This introduction will provide students with enough background knowledge of the respiratory system. The overall goal of this three lesson module is to have students act like real doctors using a website possessing various simulated patients' medical histories, symptoms, and physical findings to arrive at a diagnosis. Students will first be exposed to a brief description of 9 different upper respiratory illnesses. Students will then be exposed to real questions a doctor would ask a patient using the website tutorial. The website tutorial will walk students through each patient step by step allowing them to collect information along the way. Using their prior and acquired knowledge, students will determine a diagnosis using evidence provided from each patient. This activity will help students identify the challenges of diagnosing illnesses due to the similarities in symptoms and physical findings among illnesses. In addition, students will learn how to use causal relationships to solve real world problems.</p>
<p><b>Driving Question:</b></p> <p>Using each patient's symptoms, medical history, and physical findings what is their diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Making Connections</li> <li><input type="checkbox"/> Asking questions</li> <li><input type="checkbox"/> Visualizing</li> <li><input checked="" type="checkbox"/> Drawing Inferences/Predictions</li> <li><input checked="" type="checkbox"/> Determining Important Ideas</li> <li><input checked="" type="checkbox"/> Synthesizing Information</li> </ul>

	__ Monitoring and Repairing Understanding
<b>PBL Components Used:</b> __ Worked Examples <input checked="" type="checkbox"/> Case Studies <input checked="" type="checkbox"/> Structural Analogues <input checked="" type="checkbox"/> Simulations	<b>Problem Difficulty Level (1-4):</b> Complexity 1 2 3 4 Structuredness 1 2 3 4
<b>Scaffolds Used:</b> <input checked="" type="checkbox"/> Analogical Encoding <input checked="" type="checkbox"/> Questioning <input checked="" type="checkbox"/> Causal Relationships    __ Modeling __ Argumentation	<b>Materials:</b> -Website Quick Reference Sheet -Problem Solving Steps Cheat Sheet -Introduction Respiratory Packet -Respiratory Case Study Packet -Websites: <a href="http://www.livescience.com/22616-respiratory-system.html">http://www.livescience.com/22616-respiratory-system.html</a> <a href="http://www.learningnurse.org/elearning/nasal-sim/player.html">http://www.learningnurse.org/elearning/nasal-sim/player.html</a>
<b>Learning Tasks:</b> -Complete the Introduction Respiratory Packet using the website provided -Complete the Respiratory Case Study Packet using the website provided	<b>Assessment Plan:</b> SUMMATIVE -Introduction Respiratory Packet -Respiratory Case Study Packet  FORMATIVE -Periodically check to see if all members of group are contributing

## **WEBSITE QUICK REFERENCE SHEET FOR UNIT**

### **BMI Calculator**

[http://www.cdc.gov/healthyweight/assessing/bmi/adult\\_bmi/english\\_bmi\\_calculator/bmi\\_calculator.html](http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html)

### **Lab Test/Disease Lookup**

<https://labtestsonline.org/>

### **Symptom Checker/Disease Lookup**

<http://symptoms.webmd.com/#introView>

### **Heart, Lung, and Blood Disease Lookup**

<http://www.nhlbi.nih.gov/>

### **Respiratory System**

Information: <http://www.livescience.com/22616-respiratory-system.html>

Nasal Simulations: <http://www.learningnurse.org/elearning/nasal-sim/player.html>

### **Digestive System**

Information: <http://www.livescience.com/22367-digestive-system.html>

<http://www.innerbody.com/image/digeov.html>

### **Urinary System**

Information: <http://www.innerbody.com/image/urinov.html#full-description>

<http://www.livescience.com/27012-urinary-system.html>

### **Circulatory System**

Information: <http://www.livescience.com/22486-circulatory-system.html>

<http://www.innerbody.com/image/cardov.html>

### **Immune System**

Information: <http://www.livescience.com/26579-immune-system.html>

<http://www.innerbody.com/image/lymphov.html>

### **Diabetes Information**

<http://www.webmd.com/diabetes/tc/diabetes-differences-between-type-1-and-2-topic-overview>

<http://www.northshore.org/diabetes/gestational-diabetes-type-1-type-2-diabetes/>

<http://www.mayoclinic.org/diseases-conditions/diabetes/basics/causes/CON20033091>

### **Nervous System**

Information: <http://www.livescience.com/22665-nervous-system.html>

<http://www.innerbody.com/image/nervov.html>

## **PROBLEM SOLVING STEPS CHEAT SHEET FOR UNIT**

1. **Underline** key words or phrases that are unfamiliar to you starting with Part 1.  
(NOTE: Complete steps 1-5 in each part before moving on to the next.)
2. Use one of the websites on the “Website Quick Reference Sheet” to help you define each unknown term. Jot down a few words next to the term.
3. **Highlight** any information provided that you think is important or stands out as concerning.
4. If you are comparing two case studies, **circle** differences and **star** similarities between the case studies.
5. Use the analysis questions from each part to help guide you through the problem solving process.

Name \_\_\_\_\_

### **Introduction: The Respiratory System**

**Directions:** Using the website below answer the following questions to help you gain a better understanding of the function of the respiratory system and the organs involved in the process.  
<http://www.livescience.com/22616-respiratory-system.html>

1. What is the primary goal of the respiratory system?
  
2. How do red blood cells (RBC) play a role in the respiratory system?
  
3. What is the average resting respiratory rate for adults per minute? What factors can cause this number to increase?
  
4. Identify the role or function of each of the components of the respiratory system:
  - a. Sinuses –
  - b. Trachea –
  - c. Bronchi –
  - d. Cilia –
  - e. Mucus –
  - f. Lobes of the Lungs –
  - g. Capillaries –
  - h. Pulmonary Arteries –
  - i. Pulmonary Vein –
  - j. Diaphragm –
  
5. In your own words, describe the gas exchange process.
  
  
  
  
  
  
  
  
  
  
6. What are the two categories of respiratory diseases? Provide an example of each.
  
  
  
  
  
  
  
  
  
  
7. Are viral infections treated with antibiotics? What are antibiotics used for?
  
  
  
  
  
  
  
  
  
  
8. Please fill out the chart below using the information from the website and additional resources if necessary:

	<u>COPD</u>	<u>Asthma</u>	<u>Lung Cancer</u>
<b>Definition</b>			
<b>Symptoms</b>			
<b>Cause</b>			
<b>Tests Used to Diagnose</b>			

9. What type of doctor diagnoses and treats respiratory diseases?

10. What common tests are used to diagnose respiratory disorders?

11. Label the diagram below: *Nasal cavity, Nose, Mouth, Bronchi, Pharynx, Larynx, Trachea, Bronchioles, Lungs, Diaphragm, Upper, Lower*

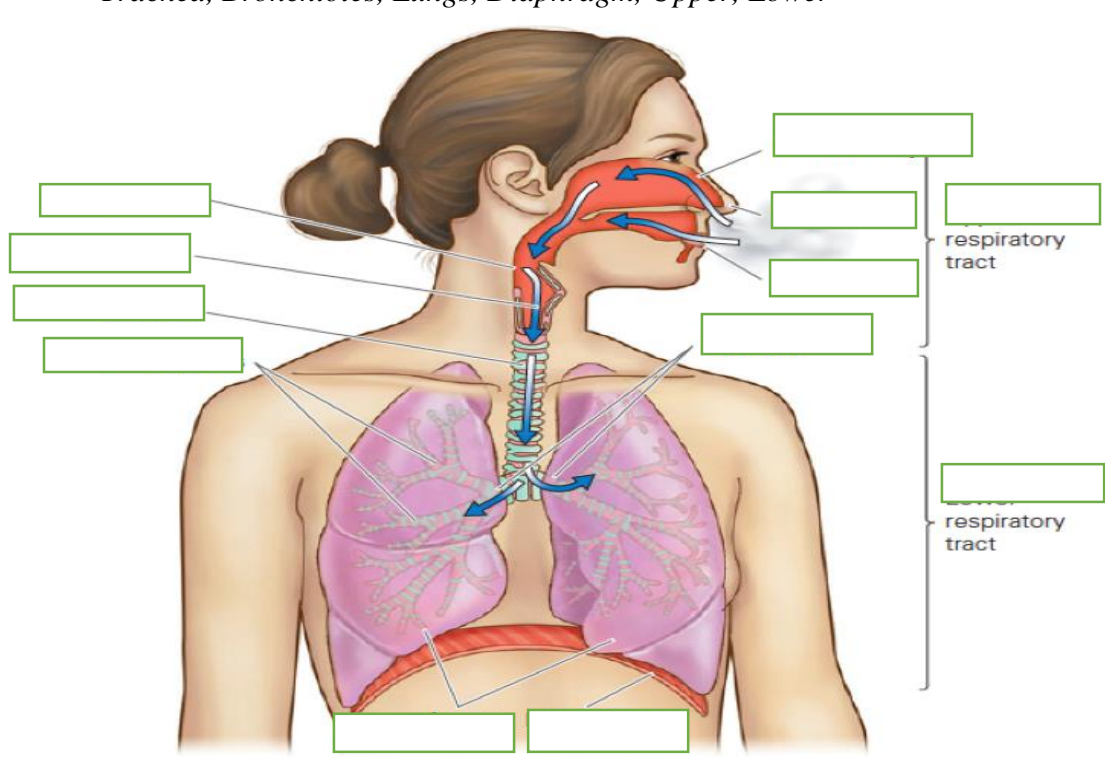


Image taken from and altered: [anatomyarea.com](http://anatomyarea.com)

## Respiratory Case Study

Name \_\_\_\_\_

**Directions:** Please use the website below to assess each patient's symptoms, medical history, and examination findings to determine a diagnosis for each patient. Follow the instructions provided on the website carefully. Before assessing each patient, please read through each disorder description by clicking on the “**view disorders**” icon. Be sure to write down a few key points under each disorder.

<http://www.learningnurse.org/elearning/nasal-sim/player.html>

Infectious Rhinitis

Allergic Rhinitis

Non-allergic Rhinitis

Rhinitis Medicamentosa

Acute Sinusitis

Chronic Sinusitis



Nasal Obstruction

Nasal Polyposis

Osteomyelitis

**Case 1: Thelma**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

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***Diagnosis:***

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**Case 2: George**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

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***Diagnosis:***

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**Case 3: Betty**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

***Diagnosis:***

\_\_\_\_\_

**Case 4: Harry**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

***Diagnosis:***

\_\_\_\_\_

**Case 5: Rose**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

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***Diagnosis:***

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**Case 6: Winston**

***Discussion with Patient:***

Length of symptoms: \_\_\_\_\_

History of respiratory problems: \_\_\_\_\_

Symptoms occur: \_\_\_\_\_

Family history: \_\_\_\_\_

Are symptoms effecting one side or both sides? \_\_\_\_\_

Pain and location: \_\_\_\_\_

Do symptoms improve or get worse in different positions? \_\_\_\_\_

Other symptoms: \_\_\_\_\_

Do you smoke or around smoke? \_\_\_\_\_

History of head or face trauma \_\_\_\_\_

Medications \_\_\_\_\_

***Examination Findings:***

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*Diagnosis:*

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**Analysis Questions:**

1. The four different types of Rhinitis present different physical findings. Fill in the chart below using your knowledge of the four disorders.

	<b>Infectious Rhinitis</b>	<b>Allergic Rhinitis</b>	<b>Non-allergic Rhinitis</b>	<b>Rhinitis Medicamentosa</b>
<b>Color of Mucosa</b>				
<b>Color of Discharge</b>				

2. What is a key difference between **acute** and **chronic sinusitis** according to the website?
3. In the medical community, **cause (disorder)** and **effect (symptoms)** relationships are used on a daily basis using a patient's symptoms, history, and physical findings to determine a possible diagnosis. In each case above identify the cause and the effect.

	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>	<b>Case 5</b>	<b>Case 6</b>
<b>Cause</b>						
<b>Effect</b>						

4. Of the 6 cases discussed above, which case was the most difficult to diagnosis? Why?
5. Which cases had similar symptoms and/or findings? How did you come up with the correct diagnosis?
6. What parts of this activity did you find challenging? How did it feel acting like a real doctor?
7. What piece of evidence did you find the most beneficial in choosing the correct diagnosis: the patient's history, physical findings, or symptom description? Why?
8. How could this activity become more authentic? What would you change?

## IB Biology Lesson 4

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Respiratory System (Emphysema & Lung Cancer Comparison)	<b>Time:</b> 40 minute period
<p><b>Objectives:</b></p> <ul style="list-style-type: none"><li>-Students will be able to describe the gas exchange process in detail.</li><li>-Students will be able to identify the parts of the respiratory system and describe each part's function.</li><li>-Students will be able to define respiratory diseases such as lung cancer and emphysema along with identifying causes and symptoms of each disease.</li><li>-Students will be able to use a patient's medical history, symptoms, and physical findings to determine an accurate diagnosis.</li></ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>6.4 Gas Exchange</u></p> <p>Understandings:</p> <p>Ventilation maintains concentration gradients of oxygen and carbon dioxide between air in alveoli and blood flowing in adjacent capillaries.</p> <p>Air is carried to the lungs in the trachea and bronchi and then to the alveoli in bronchioles.</p> <p><u>6.4 Gas Exchange</u></p> <p>Application:</p>	<p><b>Overall Learning Focus:</b></p> <p>In this lesson, the teacher will guide the students through a comparative case study analysis. Two similar case studies will be analyzed looking for similarities and differences as a class. The teacher will conduct what is called a "worked example", when the teacher breaks the problem down into smaller parts highlighting key pieces of evidence and differences in the case studies. Prior to solving the problem as a class, students will underline unknown terms in the case study and look up their definition using resources provided. The teacher will perform a "think aloud", which is when the teacher solves the problem in front of the class while verbalizing his or her thought process along the way. Students will be encouraged to participate in the "think aloud" as well. The teacher will show students how to use the patient history, symptoms, and test results to come up with a diagnosis. The teacher will also discuss the normal values for blood pressure and pulse rate. Most importantly, the teacher will also show students how to use the following websites: <a href="https://labtestsonline.org/">https://labtestsonline.org/</a>, BMI calculator, and <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>. The teacher will then allow each student to determine a diagnosis for case study 1 and 2 independently. Essentially by the end of the lesson, students will be able to compare Emphysema and Lung Cancer symptoms, causes, test results, and treatments.</p>



<p>Causes and consequences of lung cancer. Causes and treatments of emphysema.</p>	
<p><b>Driving Question:</b> By comparing two case studies side by side using each patient's symptoms, medical history, and physical findings what is their diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/> Making Connections  <input type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input checked="" type="checkbox"/> Drawing Inferences/Predictions  <input checked="" type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input checked="" type="checkbox"/> Worked Examples  <input checked="" type="checkbox"/> Case Studies  <input checked="" type="checkbox"/> Structural Analogues  <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 <b>2</b> 3 4  Structuredness 1 <b>2</b> 3 4</p>
<p><b>Scaffolds Used:</b>  <input checked="" type="checkbox"/> Analogical Encoding  <input type="checkbox"/> Questioning  <input checked="" type="checkbox"/> Causal Relationships  <input type="checkbox"/> Modeling  <input type="checkbox"/> Argumentation</p>	<p><b>Materials:</b>  -Respiratory Case Study Comparative Analysis  -Websites:  <a href="https://labtestsonline.org/">https://labtestsonline.org/</a>  <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>  <a href="http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html">http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html</a>  NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>  -Complete the Respiratory Case Study Comparative Analysis Packet using the websites provided to assist you</p>	<p><b>Assessment Plan:</b>  SUMMATIVE  -Respiratory Case Study Comparative Analysis Packet   FORMATIVE  -Periodically check to see if all members of group are contributing</p>

## CASE STUDY 1

### PART ONE

#### Patient Information:

**Patient name:** Eli    **Age:** 48  
**Current symptoms:** Shortness of breath,  
decreased appetite, cough  
**Blood pressure:** 140/85    **Pulse:** 80  
**Weight:** 190 lbs.    **Height:** 5'11"  
**BMI:** \_\_\_\_\_    **BMI Classification:** \_\_\_\_\_

### PART TWO

#### Eli's Responses and Patient History:

##### Family History

Mom – Osteoporosis

Dad – COPD

##### Medications

None

##### Patient Responses

1. Do you have any other symptoms?  
**I have trouble breathing during physical activity.**
2. Do you have chest tightness when exercising? **Yes.**
3. Do you have a history of asthma or bronchitis? **Not that I know of.**
4. Do you smoke? **Yes.** How long have you smoked for? **30 years.**
5. Does cancer run in your family? **Yes.** What kind? **Colon cancer.**
6. When did your symptoms start? **I have noticed them gradually get worse overtime.**

#### Physician Orders the Following Tests

Chest x-ray  
Sputum Cytology  
CO<sub>2</sub> Blood Test  
Pulmonary Function Tests

## CASE STUDY 2

### PART ONE

#### Patient Information:

**Patient name:** Sara    **Age:** 46  
**Current symptoms:** Shortness of breath,  
fatigue, cough  
**Blood pressure:** 125/70    **Pulse:** 65  
**Weight:** 140 lbs.    **Height:** 5'9"  
**BMI:** \_\_\_\_\_    **BMI Classification:** \_\_\_\_\_

### PART TWO

#### Sara's Responses and Patient History:

##### Family History

Mom – Systemic Lupus

Dad – Emphysema

##### Medications

None

##### Patient Responses

1. Do you have any other symptoms?  
**No, I don't think so.**
2. Do you have any chest pain? **No.**
3. Do you have a history of asthma or bronchitis? **I have had bronchitis three times this past year.**
4. Do you smoke? **No.** Have you ever? **No.**
5. Does cancer run in your family? **Yes.** What kind? **Breast and stomach cancer.**
6. When did your symptoms start? **I have noticed them in the past month.**

#### Physician Orders the Following Tests

Chest x-ray  
Sputum Cytology  
CO<sub>2</sub> Blood Test  
Pulmonary Function Tests

## CASE STUDY 1 & 2 COMPARATIVE ANALYSIS

1. Before moving on to Part 3, circle or highlight differences between the case studies.
2. Could these slight differences lead to two different diagnoses? Why?
3. Do you expect differences in test results? If so explain.
4. What was the most important difference between the two case studies?

### **CASE STUDY 1: PART THREE**

Eli's Test Results:

#### **PULMONARY FUNCTION**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL RANGE</u>
FEV/FVC	50%	>70%
FV Curve	Scooped	Not scooped
TLC	Increased	Normal
Compliance	Increased	Normal
DLCO	Decreased	Normal

Findings show decreased lung capacity consistent with damaged bronchioles and alveoli.

#### **SPUTUM CYTOLOGY**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL</u>
Sputum (mucus that is coughed up)	No abnormal cells present	No abnormal cells present

#### **CHEST X-RAY**

Findings show hyper inflated lungs with reduced vascular markings. Pulmonary hila are also prominent, indicative of a minimal case of pulmonary hypertension. No abnormal masses are visible.

#### **CO<sub>2</sub>**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
CO <sub>2</sub>	20	HIGH

## CASE STUDY 2: PART THREE

Sara's Test Results:

### **PULMONARY FUNCTION**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL RANGE</u>
FEV/FVC	90%	>70%
FV Curve	Not scooped	Not scooped
TLC	Normal	Normal
Compliance	Normal	Normal
DLCO	Normal	Normal

### **SPUTUM CYTOLOGY**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL</u>
Sputum (mucus that is coughed up)	Abnormal mass of cells present	No abnormal cells present

### **CHEST X-RAY**

Findings show small mass on right lung. Biopsy encouraged to determine specificity of mass of cells.

### **CO<sub>2</sub>**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
CO <sub>2</sub>	12	

5. Circle or highlight differences in test results.
6. What is the probable diagnosis for case study 1? (Use the following websites to help you: <https://labtestsonline.org/> and <http://www.nhlbi.nih.gov/>)
7. What is the probable diagnosis for case study 2? (Use the following websites to help you: <https://labtestsonline.org/> and <http://www.nhlbi.nih.gov/>)
8. How do the treatments between the two diagnoses differ?

## IB Biology Lessons 5 & 6

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Digestive System (Celiac's Disease)	<b>Time:</b> Two 40 minute periods
<p><b>Objectives:</b></p> <ul style="list-style-type: none"><li>-Students will be able to identify and describe each digestive organ's function.</li><li>-Students will be able to explain the digestion pathway starting with the mouth and ending with the colon emphasizing the importance of the small intestines.</li><li>-Students will be able to identify the enzymes secreted by each organ and describe its involvement in the digestion process.</li><li>-Students will be able to describe the role of villi within the small intestines.</li><li>-Students will be able to use a patient's medical history, symptoms, and physical findings to determine an accurate diagnosis.</li></ul> <p><b>International Baccalaureate Standards:</b> <u>6.1 Digestion and Absorption</u></p> <p>Understandings:</p> <p>The contraction of circular and longitudinal muscle of the small intestine mixes the food with enzymes and moves it along the gut.</p> <p>The pancreas secretes enzymes into the lumen of the small intestine.</p> <p>Enzymes digest most macromolecules in food into monomers in the small intestine.</p> <p>Villi increase the surface area of epithelium over which absorption is carried out.</p>	<p><b>Overall Learning Focus:</b></p> <p>First, students will explore the digestive system on their own using two websites to answer critical questions. This introduction will provide students with enough background knowledge of the digestive system. The overall goal of this two lesson module is to have students act like real doctors with the assistance of the teacher and by collaborating with peers. This case study will be completed as a worked example which allows the teacher to work through the example slowly identifying key facts and evidence, asking questions, and encouraging critical thinking. By working through the example step by step, students will be able to comprehend how to solve a challenging problem using many pieces of evidence including the patient's medical history, symptoms, and physical findings. Solving a case study is similar to putting a puzzle together to visually see the picture created in the end. The pieces of the puzzle represent the evidence (medical history, test results, physical findings, and symptoms) while the final product represents the diagnosis. The case study is composed of three parts permitting students to make predictions before test choices, possible diagnoses, and questions asked by the doctor are revealed. Students will not be able to proceed to the next part until the previous part is completed. This allows students to monitor and repair their predictions and prior understandings. Using their prior and acquired knowledge, students will determine a diagnosis using a collection of evidence provided from the patient and test findings. In addition, students will learn how to use</p>

<p>Villi absorb monomers formed by digestion as well as mineral ions and vitamins.</p>	<p>argumentation (evidence) to support their diagnosis.</p>
<p><b>Driving Question:</b> Using the patient's symptoms, medical history, and test results what is the diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/> Making Connections  <input checked="" type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input checked="" type="checkbox"/> Drawing Inferences/Predictions  <input checked="" type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input checked="" type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input checked="" type="checkbox"/> Worked Examples    <input checked="" type="checkbox"/> Case Studies  <input type="checkbox"/> Structural Analogues    <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 <b>2</b> 3 4</p>
<p><b>Scaffolds Used:</b>  <input type="checkbox"/> Analogical Encoding    <input checked="" type="checkbox"/> Questioning  <input type="checkbox"/> Causal Relationships    <input type="checkbox"/> Modeling  <input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b>  -Introduction Digestive System Packet  -Digestive System Case Study Packet  -Websites:  <a href="http://www.livescience.com/22367-digestive-system.html">http://www.livescience.com/22367-digestive-system.html</a>  <a href="http://www.innerbody.com/image/digeov.html">http://www.innerbody.com/image/digeov.html</a>  <a href="http://symptoms.webmd.com/#introView">http://symptoms.webmd.com/#introView</a>  <a href="http://www.cbsnews.com/news/gluten-free-diet-fad-are-celiac-disease-rates-actually-rising/">http://www.cbsnews.com/news/gluten-free-diet-fad-are-celiac-disease-rates-actually-rising/</a>  NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>  -Complete the Introduction Digestive System Packet using the websites provided  -Complete the Digestive System Case Study Packet together as a class using the website provided</p>	<p><b>Assessment Plan:</b>  SUMMATIVE  -Introduction Digestive System Packet  -Digestive System Case Study Packet   FORMATIVE  -Periodically check to see if all members of group are contributing</p>

Name \_\_\_\_\_

### Introduction: The Digestive System

**Directions:** Use the websites below to answer the following questions.

Website 1: <http://www.livescience.com/22367-digestive-system.html>

Website 2: <http://www.innerbody.com/image/digeov.html>

1. What is the main goal or function of the digestive system?
2. Using website 2, what are the six functions that take place within the digestive system? Write a brief description of each one.

3. Where does digestion begin? How does saliva help facilitate the process?

4. Use website 2 to complete the chart below:

	<b>Teeth</b>	<b>Tongue</b>	<b>Salivary Glands</b>
<b>Description</b>			
<b>Purpose</b>			

5. Explain the pharynx's dual role within the human body?
  
6. What action is responsible for moving food to the esophagus from the mouth?
  
7. What is the function of the esophagus? What is peristalsis?
  
8. What is the role of the stomach? How large is the stomach?
  
9. What gastric juices are involved in the stomach and what is produced after?
  
10. What happens in the duodenum?
  
11. Where does the majority of nutrient absorption take place? Describe this organ in great detail.
  
  
  
  
  
  
  
  
  
  
12. By the time food leaves the organ above, what percentage of nutrients have been extracted? \_\_\_\_\_
  
  
  
  
  
  
  
  
  
  
13. What is an accessory organ?



14. Complete the chart below:

	<u>Liver</u>	<u>Gall Bladder</u>	<u>Pancreas</u>
<b>Description</b>			
<b>Function</b>			

15. Where does the food go after the small intestines? What is the role of this organ? What is another name for this organ?

16. What are some symptoms of digestive diseases?

17. What is the third most diagnosed cancer in the US? How can it be detected?

18. What other diseases of the digestive tract are mentioned on website 1?

19. Using the two websites, list the digestive tract organs in order including accessory organs.

20. Label the diagram below: *Pharynx, Salivary Glands, Tongue, Esophagus, Stomach, Liver, Gallbladder, Pancreas, Bile Duct, Colon, Small Intestine*

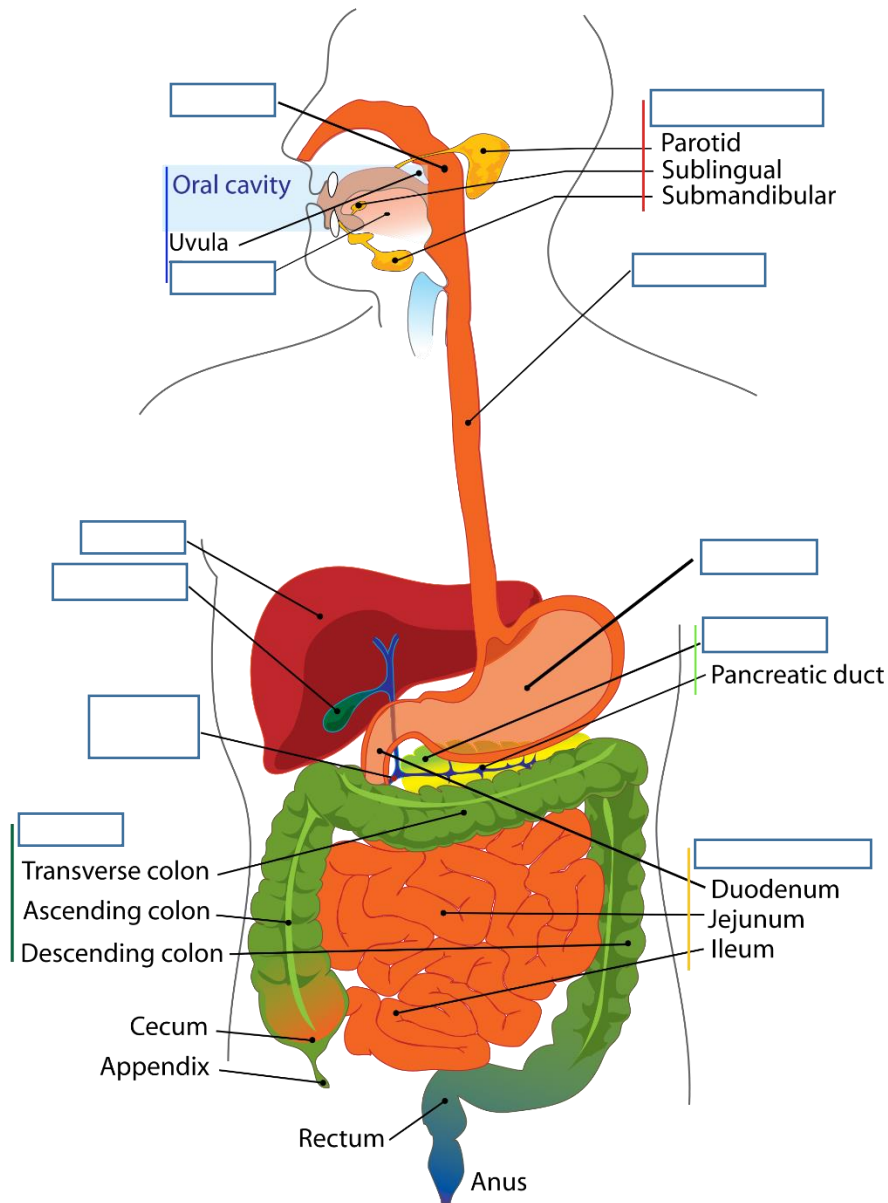


Image retrieved and altered from [en.wikipedia.org](http://en.wikipedia.org).

**BONUS:** What is the hardest substance in the body? \_\_\_\_\_ Where is it located?  
 \_\_\_\_\_

**Digestive Disorder Case Study – Worked Example**  
**PART ONE**

**Directions:** We will work through this together as a class. Do not go ahead.

Name \_\_\_\_\_

Patient Information:

**Patient name:** Miranda

**Age:** 28

**Current symptoms:** Diarrhea, Bloating, Joint Pain

**Blood pressure:** 112/85 (Normal: 120/80)

**Pulse:** 70 (Normal: 60-100)

**Weight:** 140 lbs. (prior) 120 lbs. (current)

**Height:** 5'5"

Analysis Questions:

1. Based on the information provided above create a list of digestive disorders that could be causing Miranda's symptoms using the symptom checker website:  
<http://symptoms.webmd.com/#introView> Place a **star** next to the one you hypothesize Miranda has.

- |    |    |    |    |     |
|----|----|----|----|-----|
| 1. | 2. | 3. | 4. | 5.  |
| 6. | 7. | 8. | 9. | 10. |

2. What further questions would you want to ask Miranda to achieve an accurate diagnosis?

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3. Which type of tests should you order to help develop a diagnosis? (*Use the symptom checker website to help you.*)

-

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-

4. What organs are most likely involved with Miranda's symptoms?

## **PART TWO**

### Miranda's Responses and Patient History:

#### Family History

Mom – Osteoporosis

Dad – Multiple Sclerosis

#### Medications

Birth Control

#### Patient Responses

1. Do you have any other symptoms? **I feel fatigued too.**
2. Is the diarrhea constant? **I have diarrhea every day at least once a day.**
3. Is it worse after certain meals? **I am not sure but after I eat it is the worst.**
4. Do you have any abdominal pain? **Yes.**
5. Are you taking any antibiotics? **No.**

#### Physician Orders the Following Tests

Colonoscopy                      Endoscopy

CBC Blood Test                      BMP Blood Test

**Analysis Questions:** *(NOTE: You may use the symptom checker website to look up key terms or tests. Use the search bar at the top of the page.)*

1. Is there anything within the patient information, family history, or medication list that you should be concerned with?
2. Why do you think the doctor asked if she took antibiotics?
3. Why did the physician order a colonoscopy and endoscopy? What are they? Which organs are involved?
4. Why did the physician order a CBC and BMP blood test? What do these tests look for?

### PART THREE

#### Miranda's Test Results:

##### **Colonoscopy**

No mucosal abnormality was identified. No evidence of Irritable Bowel Disease was found. No polyps were present. No current findings of diverticulitis was present.

##### **Endoscopy**

No evidence of infectious esophagitis was seen. Body and antrum of the stomach and duodenum up to second part revealed no abnormality. Biopsies were obtained from gastric antrum and distal duodenal to rule out malabsorption. Small bowel (duodenum) biopsy revealed damaged villi indicative of malabsorption of nutrients.

##### **CBC**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
WBC	5.9	
RBC	4.61	
HGB	13.6	
HCT	40	
MCV	87	
MCH	29.5	
MCHC	33.7	
RDW	12.4	
Platelet Count	152	

##### **BMP**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose	117	
BUN	11	
Creatinine	.68	
BUN/Creatinine Ratio	16	
Sodium	141	
Potassium	4.0	
Chloride	105	
Carbon Dioxide	29	
Calcium	8.7	

##### **Analysis Questions:**

1. Based on the patient's medical history, symptoms, and test results what do you think is the correct diagnosis? Why?

2. This disease can also fall under another human body system category, if so, which one?

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3. Pick a disease from question 1 on the first page and compare its symptoms and test findings to the actual diagnosed disease in the study.

**Similarities**

**Differences**

4. What was the most beneficial information used in this case study: medical history, patient symptoms, or test results? Why?

\_\_\_\_\_ because \_\_\_\_\_

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5. Besides the patient’s medical history, symptoms, and test results, what other information or knowledge was useful in determining a possible diagnosis?

6. Doctors misdiagnose patients every day, how will the doctor be able to know for sure if the patient was diagnosed correctly?

7. According to the article, “Gluten-free diet fad: Are celiac disease rates actually rising?” (<http://www.cbsnews.com/news/gluten-free-diet-fad-are-celiac-disease-rates-actually-rising/>), Celiac Disease is 4 times more prevalent than it was 50 years ago. Why do you think this is? How could we solve this vast increase in this disease?

## IB Biology Lessons 7 & 8

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Urinary System (Overhydration & Dehydration)	<b>Time:</b> Two 40 minute period
<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>-Students will be able to define and explain the term homeostasis.</li> <li>-Students will be able to describe how the organs, body systems, and cells function together.</li> <li>-Students will be able to explain how osmosis occurs and why.</li> <li>-Students will be able to compare and contrast overhydration and dehydration.</li> </ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>1.4 Membrane Transport</u></p> <p>Understandings:</p> <p>Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport.</p> <p><u>11.3 The Kidney and Osmoregulation</u></p> <p>Application:</p> <p>Consequences of dehydration and overhydration.</p> <p><b>NYS Living Environment Standards:</b></p> <p><u>Standard 4, Key Idea 1, 1.2e</u> The organs and systems of the body help to provide all the cells with their basic needs. The cells of the body are of different kinds and are grouped in ways that enhance how they function together.</p> <p><u>Standard 4, Key Idea 1, 1.2g</u> Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of</p>	<p><b>Overall Learning Focus:</b></p> <p>First students will learn the key components and functions of the urinary system using the websites provided. This learning task will provide students with a solid overview of the urinary system to be able to apply it to a real world problem later in the lesson. Water consumption heavily effects the kidneys. Too little or excessive water consumption can be fatal validating this authentic, real world issue. The overall goal of the water consumption pamphlet/letter activity is to get students to understand that too much or too little of something can be detrimental to the body. This activity will encourage students to comprehend how the cells and organs in the human body work together to keep the body in homeostasis. Also, students will be able to relate the process of osmosis and the urinary system to dehydration and overhydration. Students will also be able to answer the following questions:</p> <ol style="list-style-type: none"> <li>1. How does excessive water consumption effect the human body?</li> <li>2. Why is too much or too little water problematic?</li> </ol>

<p>chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.</p> <p><u>Standard 4, Key Idea 5, 5.2a Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.</u></p>	
<p><b>Driving Question</b></p> <p><b>PROBLEM:</b></p> <p>A classmate is in trouble with drugs and has told you that he/she is planning to try to avoid a positive drug test by drinking an excessive amount of water.</p> <p><b>ESSENTIAL TASK:</b></p> <p>Write this classmate a letter OR create a pamphlet about what you have learned about water consumption and explain to this person why they should or should not follow through with their plan.</p>	<p><b>Metacognitive Strategy Focus:</b></p> <p><input type="checkbox"/> Making Connections</p> <p><input checked="" type="checkbox"/> Asking questions</p> <p><input checked="" type="checkbox"/> Visualizing</p> <p><input type="checkbox"/> Drawing Inferences/Predictions</p> <p><input type="checkbox"/> Determining Important Ideas</p> <p><input checked="" type="checkbox"/> Synthesizing Information</p> <p><input type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b></p> <p><input type="checkbox"/> Worked Examples    <input checked="" type="checkbox"/> Case Studies</p> <p><input type="checkbox"/> Structural Analogues    <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b></p> <p>Complexity <b>1 2 3 4</b></p> <p>Structuredness <b>1 2 3 4</b></p>
<p><b>Scaffolds Used:</b></p> <p><input type="checkbox"/> Analogical Encoding    <input type="checkbox"/> Questioning</p> <p><input checked="" type="checkbox"/> Causal Relationships    <input type="checkbox"/> Modeling</p> <p><input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b></p> <p>-Websites:</p> <p><a href="http://www.innerbody.com/image/urinov.html#full-description">http://www.innerbody.com/image/urinov.html#full-description</a></p> <p><a href="http://www.livescience.com/27012-urinary-system.html">http://www.livescience.com/27012-urinary-system.html</a></p> <p>-How too much water can be detrimental (article):</p> <p><a href="http://www.scientificamerican.com/article/strange-but-true-drinking-too-much-water-can-kill/">http://www.scientificamerican.com/article/strange-but-true-drinking-too-much-water-can-kill/</a></p> <p>-What is overhydration? (article):</p> <p><a href="http://www.healthline.com/health/overhydration#Overview1">http://www.healthline.com/health/overhydration#Overview1</a></p> <p>-What is dehydration? (article):</p> <p><a href="http://www.growyouthful.com/remedy/water-drinking-dehydration.php">http://www.growyouthful.com/remedy/water-drinking-dehydration.php</a></p>



	<ul style="list-style-type: none"> <li>-Facts, Questions, and Summary Article Sheets</li> <li>-Water Consumption Letter or Pamphlet Guidelines</li> <li>-Problem taken from <a href="http://slideplayer.com/slide/4056851/">http://slideplayer.com/slide/4056851/</a></li> </ul>
<p><b>Learning Tasks:</b></p> <ul style="list-style-type: none"> <li>-Read three articles provided by the teacher</li> <li>-Complete “Facts, Questions, and Summary Article Sheet” for each article</li> <li>-Work in groups of 3 or 4 to research 3 additional articles on water consumption</li> <li>-In groups, use your research to create a letter or pamphlet representing whether or not the student should drink an excessive amount of water prior to taking a drug test (use guidelines sheet to determine what to include)</li> </ul>	<p><b>Assessment Plan:</b></p> <p><u>SUMMATIVE</u></p> <ul style="list-style-type: none"> <li>-Letter or Pamphlet</li> </ul> <p><u>FORMATIVE</u></p> <ul style="list-style-type: none"> <li>-Facts, Questions, and Summary Article Sheets</li> <li>-Periodically check to see if all members of group are contributing</li> </ul>



7. Describe 4 ways the kidneys maintain homeostasis within the body? (website 1)

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8. What is the process of filtration? What structure within the kidney allows this to take place?

9. Explain the process of the storage and excretion of wastes?

10. Label the diagram below: *Kidney, Bladder, Urethra, Ureter*

**Components of the Urinary System**

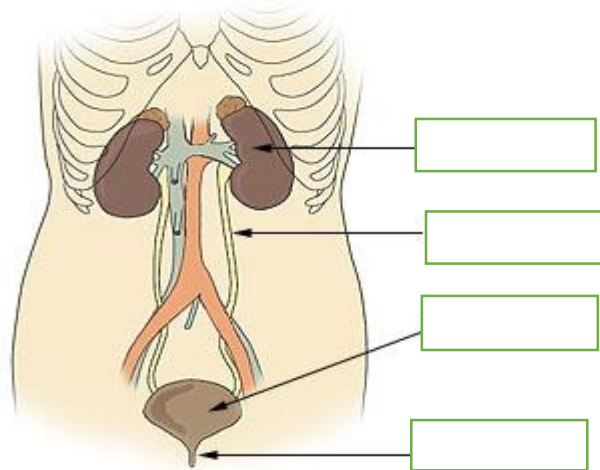


Image retrieved and altered from [en.wikibooks.org](http://en.wikibooks.org).

Name \_\_\_\_\_

**ARTICLE ANALYSIS - FACTS, QUESTIONS, & SUMMARIES**

**How too much water can be detrimental (article 1):**

<http://www.scientificamerican.com/article/strange-but-true-drinking-too-much-water-can-kill/>

FACTS

QUESTIONS

SUMMARY

**What is overhydration? (article 2):**

<http://www.healthline.com/health/overhydration#Overview1>

FACTS

QUESTIONS

## SUMMARY

**What is dehydration? (article 3):**

<http://www.growyouthful.com/remedy/water-drinking-dehydration.php>

## FACTS

## QUESTIONS

## SUMMARY

Name \_\_\_\_\_

## **PART ONE: Water Consumption Letter/Pamphlet Guidelines**

### **PROBLEM:**

A classmate is in trouble with drugs and has told you that he/she is planning to try to avoid a positive drug test by drinking an excessive amount of water.

### **ESSENTIAL TASK:**

Write this classmate a letter OR create a pamphlet about what you have learned about water consumption and explain to this person why they should or should not follow through with their plan.

### **INSTRUCTIONS:**

- You will work in groups of 3 or 4 to brainstorm ideas on how to address the problem and determine further questions that you may have.
- You will then conduct research on the topic of water consumption.
- You will then construct a final product (pamphlet or letter).
- You will then present your findings to the class as a group.

### **BE SURE TO ADDRESS THE FOLLOWING IN YOUR FINAL PRODUCT:**

- Definition of overhydration
- What are possible reasons for overhydration
- What are the symptoms of overhydration
- What are possible treatments for overhydration
- Why is this topic important
- Explain what happens within the human body when too much water is consumed (be sure to indicate which organ is heavily impacted)
- Your position based on your research (Do you think the student should consume a lot of water before the drug test?)
- Compare overhydration to dehydration using the same criteria above
- Would you rather be dehydrated or overhydrated (use research to support claim)

### **ARTICLES:**

In addition to the 3 articles provided you must find at least 3 more articles discussing water consumption.

## IB Biology Lesson 9

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Urinary System (Water Consumption Formula)	<b>Time:</b> 40 minute period
<p><b>Objectives:</b> -Students will be able to use their knowledge of osmosis and kidney function to create a mathematical formula representing a person's daily water needs using a variety of factors such as exercise, body weight, medical conditions, and weather.</p> <p><b>International Baccalaureate Standards:</b> <u>1.4 Membrane Transport</u> Understandings: Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport.</p> <p><u>11.3 The Kidney and Osmoregulation</u> Application: Consequences of dehydration and overhydration.</p> <p><b>NYS Living Environment Standards:</b> <u>Standard 4, Key Idea 1, 1.2e</u> The organs and systems of the body help to provide all the cells with their basic needs. The cells of the body are of different kinds and are grouped in ways that enhance how they function together.</p> <p><u>Standard 4, Key Idea 1, 1.2g</u> Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.</p>	<p><b>Overall Learning Focus:</b> Students will use their prior knowledge concerning water consumption acquired from lessons 7 &amp; 8 on dehydration and overhydration to create a formula that individuals can use to determine their daily water needs. Students will be expected to research factors that can alter water consumption needs including but not limited to exercise, weather, body weight, medical conditions, fruit consumption, and pregnancy. Students will then use these factors to create an equation or mathematical model. Students will use mathematical relationship skills and ordering skills based on importance. The overall goal of the activity is to get students to understand that many factors affect water consumption and that each individual will require a different daily amount. The main focus is having students make connections between all of these relationships to create a generic mathematical formula for everyone to use to determine daily water consumption needs.</p>

<p><u>Standard 4, Key Idea 5, 5.2a</u> Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.</p>	
<p><b>Driving Question</b>  <u>PROBLEM:</u>  How much water should each person consume daily?  <u>ESSENTIAL TASK:</u>  Develop a formula that can help determine specific daily water consumption levels needed. Use your own ideas from research to produce this formula. There are many possible formulas. Each group formula should be different. Be sure to focus on at least 3 factors.</p>	<p><b>Metacognitive Strategy Focus:</b>  __ Making Connections  _X Asking questions  __ Visualizing  __ Drawing Inferences/Predictions  _X Determining Important Ideas  _X Synthesizing Information  __ Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  __ Worked Examples    _X Case Studies  __ Structural Analogues    __ Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 2 <b>3</b> 4</p>
<p><b>Scaffolds Used:</b>  __ Analogical Encoding    _X Questioning  _X Causal Relationships    _X Modeling  _X Argumentation</p>	<p><b>Materials:</b>  -Part Two: Water Consumption Formula Worksheet</p>
<p><b>Learning Tasks:</b>  -Create a formula that can help determine specific daily water consumption levels needed using at least 3 factors from research (work in groups of 3)</p>	<p><b>Assessment Plan:</b>  <u>SUMMATIVE</u>  -Water consumption formula   <u>FORMATIVE</u>  -Periodically check to see if all members of group are contributing</p>



Name \_\_\_\_\_

## **PART TWO: Water Consumption Formula**

### **FURTHER QUESTIONS**

**How much water should each person consume daily?**

(NOTE: There are recommended generic values; however, we want to know how to calculate each individual's required daily water consumption.)

- **What factors have to be considered?**
- **What do we need to know?**

### **GROUP TASK:**

Develop a formula that can help determine specific daily water consumption levels needed. Use your own ideas from research to produce this formula. There are many possible formulas. Each group formula should be different. Be sure to focus on **at least 3 factors**.

## IB Biology Lesson 10

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Urinary System (Effects of Salt Water Consumption)	<b>Time:</b> 40 minute period
<p><b>Objectives:</b></p> <ul style="list-style-type: none"><li>-Students will be able to make predictions and apply what they already know to a given situation based on their conceptual understandings of cellular transport.</li><li>-Students will be able to ask their own questions regarding a situation or event and then answer them using evidence from the text.</li><li>-Students will be able to explain the effects saltwater (sea water) has on the human body and the consequences of dehydration.</li><li>-Students will be able to justify using evidence from the text why and how saltwater (sea water) effects the human body in particular how the kidneys are effected.</li><li>-Students will be able to determine meaning of vocabulary words from the text and make connections among vocabulary terms to explain a phenomena.</li></ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>1.4 Membrane Transport</u></p> <p>Understandings: Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport.</p> <p><u>11.3 The Kidney and Osmoregulation</u></p> <p>Application: Consequences of dehydration and overhydration.</p> <p><b>NYS Living Environment Standards:</b></p> <p><u>Standard 1-Key Idea 1-Performance Indicator 1.1a</u> Scientific explanations are</p>	<p><b>Overall Learning Focus:</b></p> <p>Students will apply their prior understanding of dehydration and osmosis to a saltwater case study concerning two people growing weary from dehydration because they are stranded on a raft in the Pacific Ocean for days. The main focus of the case study is to have students determine whether or not saltwater should be consumed in the given situation and provide a reason for their claim. As previously learned in lessons 7 and 8, dehydration can be detrimental to the human body; however, the question is whether saltwater can help or exacerbate dehydration. Students will be able to make predictions prior to reading literature regarding saltwater consumption. Students will then be able to rectify or discard their prediction using evidence from the article. In addition, students will be able to ask questions such as “How long can a human survive without water?” or “Is there a device that can turn saltwater into drinkable water?” Students will then be expected to act like real scientists and research the answers to their own questions. Students will display their findings in a PowerPoint presentation. Overall, students will make connections between the idea of dehydration and the process of osmosis. Students will also be expected to attempt to solve the problem, “What if you were stranded on a raft in the ocean, what would you do to survive?”</p>

built by combining evidence that can be observed with what people already know about the world.

Standard 1-Key Idea 1-Performance

Indicator 1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.

Standard 1-Key Idea 2-Performance

Indicator 2.3a Hypotheses are predictions based upon both research and observation.

Standard 4-Key Idea 1-Performance

Indicator 1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.

Standard 4-Key Idea 5-Performance

Indicator 5.2a Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.

**Common Core State Standards:**

CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.

CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

<p><b>Driving Question</b></p> <p><u>PROBLEM:</u>  Kayla and Zack’s plane goes down in the Pacific Ocean. After two days on the rescue raft in the scorching sun Kayla and Zack began to feel weak, tired, and disorientated. Due to their symptoms, Zack thought it would be wise to drink the sea water (salt water) to replenish their body. Kayla was reluctant to drink the sea water (salt water). Should they drink the saltwater?</p> <p><u>ESSENTIAL TASK:</u>  Using prior knowledge, predict whether or not Kayla and Zack should drink the saltwater and explain why. After reading the article “What if you drink saltwater” by Vicki M. Giuggio, confirm or discard your prediction and monitor and repair your previous understanding by answering questions provided. Also, explain how saltwater effects the human body. Lastly, ask and answer your own questions using research to support your claim. Findings will be displayed in a PowerPoint presentation.</p>	<p><b>Metacognitive Strategy Focus:</b></p> <p><input type="checkbox"/> Making Connections  <input checked="" type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input checked="" type="checkbox"/> Drawing Inferences/Predictions  <input type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input checked="" type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b></p> <p><input type="checkbox"/> Worked Examples    <input checked="" type="checkbox"/> Case Studies  <input type="checkbox"/> Structural Analogues    <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b></p> <p>Complexity <b>1 2 3 4</b>  Structuredness <b>1 2 3 4</b></p>
<p><b>Scaffolds Used:</b></p> <p><input type="checkbox"/> Analogical Encoding    <input type="checkbox"/> Questioning  <input checked="" type="checkbox"/> Causal Relationships    <input type="checkbox"/> Modeling  <input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b></p> <p>-Saltwater Case Study Packet  -Curiosity PowerPoint Worksheet</p>
<p><b>Learning Tasks:</b></p> <p>-Complete Saltwater Case Study Packet in pairs  -Complete Curiosity PowerPoint in pairs</p>	<p><b>Assessment Plan:</b></p> <p><u>SUMMATIVE</u>  -Saltwater Case Study Packet  -Curiosity PowerPoint</p> <p><u>FORMATIVE</u>  - Answering teacher questions and participating in class discussion will help</p>

	monitor student learning during instruction -Periodically check to see if all members of group are contributing
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Name \_\_\_\_\_

### **SALTWATER CASE STUDY**

**(each question is worth 2 pts unless specified-20 pts total)**

Kayla and Zack decided to leave cold Boston for Hawaii. Once in Hawaii, they decided to island hop and board a small plane to Maui from Kauai. After the plane took off, both engines failed and the plane ended up in the Pacific Ocean. Luckily, Kayla and Zack survived the crash and were able to find an inflatable rescue raft within the plane. They hoped to get rescued soon. After two days on the raft in the scorching sun Kayla and Zack began to feel weak, tired, and disorientated. Due to their symptoms, Zack thought it would be wise to drink the sea water (salt water) to replenish their body. Kayla was reluctant to drink the sea water (salt water).

1. **State two facts: (4 pts)**
  
2. **List two questions you have: (4 pts)**
  
3. **Make a prediction: Using your knowledge of osmosis do you think Kayla and Zack should drink the saltwater? Why or why not?**
  
4. Zack decided to drink the sea water (salt water). Shortly after, he began to feel delirious, weak, and nauseous. **Using the article, “What happens if you drink saltwater?”, explain in your own words in detail what is going on in Zack’s body.** Use the following vocabulary words in your answer: **osmosis, kidney, isotonic, homeostasis or equilibrium, and semipermeable.** **INCLUDE THE LINE NUMBER(S) FROM THE ARTICLE.**

5. Is it better to become dehydrated naturally over time or to drink sea water (salt water) in an effort to replenish fluids? Explain your answer using evidence from the article and case study. **INCLUDE THE LINE NUMBER(S) FROM THE ARTICLE.**

6. Was your prediction correct? Explain.

7. What questions do you still have?

8. How do you think fish can survive in saltwater?

**DON'T FORGET TO ANSWER YOUR OWN QUESTIONS YOU CREATED ABOVE (INCLUDE THE LINE NUMBER(S) FROM THE ARTICLE WITH YOUR ANSWER!)**

## ARTICLE

### What if you drink saltwater?

By: Vicki M. Giuggio

1When it comes to diffusion and saltwater, human cells have biological membranes,  
2which can prevent salt from freely waltzing into our cells. Although our bodies can  
3normalize sodium and chloride concentrations to an extent, dealing with extremely  
4high concentrations of salt in the blood is challenging. That's because a cell's  
5membrane is **semipermeable** -- although sodium, chloride and other substances may  
6not be able to easily diffuse in and out of the cell, water can. When the salt  
7concentration is higher on the outside of our cells than on the inside, water moves from  
8the inside to the outside of the cells to correct the imbalance. The attempt to equalize  
9the concentrations of matter on both sides of a semipermeable membrane is called  
10**osmosis**.

11If you're consuming seawater, the results of osmosis are spectacularly disastrous.  
12Remember the salinity of seawater is almost four times that of our bodily fluids. If  
13gone unchecked, the net transfer of water from the inside of your cells to the outside  
14will cause the cells to shrink considerably -- and shrinkage is never good.

15Unless you drink a lot of freshwater, the body's regulatory mechanism in this situation  
16is potentially fatal. With seawater, the change in sodium concentration outside our  
17cells is the main culprit. In order to regain an **isotonic state**, a must for cell survival,  
18the body attempts to eliminate the excess sodium from its extracellular fluids. It  
19secretes urine. However, human **kidneys** can only produce urine that's slightly less  
20salty than saltwater. So, in order to remove the extreme amount of sodium taken in  
21by saltwater, we urinate more water than we actually drank. And dehydration sets in.

22So, if you're guzzling seawater, you actually aren't taking in any water but are  
23incurring a net loss, leading to depleted body fluids, muscle cramps, dry mouth, and  
24yes, thirst.

25The body tries to compensate for fluid loss by increasing the heart rate and  
26constricting blood vessels to maintain blood pressure and flow to vital organs. You're  
27also most likely to feel nausea, weakness and even delirium. As you become more  
28dehydrated, the coping mechanism fails. If you still don't drink any water to reverse  
29the effects of excess sodium, the brain and other organs receive less blood, leading  
30to coma, organ failure and eventually death.

31Of course, consuming small amounts of saltwater won't kill you. The take home  
32message is clear, though: Salt and water are best consumed separately -- and any  
33salt intake should be accompanied by plenty of freshwater.



## **CURIOSITY POWERPOINT**

### **NOW IT IS TIME FOR YOU TO BE THE SCIENTIST!**

It is your job to answer the additional questions you now have about the effects of saltwater on the body. To do this you must do your own research and provide evidence to support your claim. Be sure to cite sources. You will create a short PowerPoint depicting your thoughts and research. Feel free to be creative and research what comes to your mind regarding this topic.

#### **YOUR TASK:**

- Research answers to your own questions
- Provide a list of sources
- Create 5-10 minute PowerPoint discussing your

Questions

Thought process

Research findings

What would you do if this happened to you? (Imagine you are stranded on a raft in the Pacific Ocean.)

# IB Biology Lessons 11 & 12

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Circulatory System (Coronary Heart Disease)	<b>Time:</b> Two 40 minute periods
<b>Objectives:</b> <ul style="list-style-type: none"><li>-Students will be able to identify specific features of veins, arteries, and capillaries along with describing the role of each within the process of blood pressure regulation.</li><li>-Students will be able to describe the specific components of blood.</li><li>-Students will be able to identify the effects of coronary heart disease and hypertension on the human body.</li><li>-Students will be able to describe the circulation of the heart and the key components involved.</li><li>-Students will be able to use a patient's medical history, symptoms, and physical findings to determine an accurate diagnosis.</li></ul> <b>International Baccalaureate Standards:</b> <u>6.2 The Blood System</u> Understandings: Arteries convey blood at high pressure from the ventricles to the tissues of the body.  Blood flows through tissues in capillaries.  Capillaries have permeable walls that allow exchange of materials between cells in the tissue and the blood in the capillary.  Veins collect blood at low pressure from the tissues of the body and return it to the atria of the heart.  <u>D.1 Human Nutrition</u>	<b>Overall Learning Focus:</b> First, students will explore the circulatory system on their own using two websites to answer critical questions. This introduction will provide students with enough background knowledge of the circulatory system. The overall goal of this two lesson module is to have students act like real doctors using a simulated patient's medical history, symptoms, and test results to arrive at a diagnosis. The case study will be completed in three parts or broken down into three sections to allow students who are struggling to gain a better understanding of problem solving. Students will be expected to work through the problem more independently than previous case studies. Student collaboration will be encouraged after completion of each part. After completion of each part, the teacher will go over the analysis questions and patient information provided to keep students on track. Again, the case study is composed of three parts allowing students to make predictions before test choices, possible diagnoses, and questions asked by the doctor are revealed. This allows students to monitor and repair their predictions and prior understandings. Using their prior and acquired knowledge, students will determine a diagnosis using a collection of evidence provided from the patient and test findings. In addition, students will learn how to use argumentation (evidence) to support their diagnosis.

<p>Application: Cholesterol in blood as an indicator of the risk of coronary heart disease.</p> <p><u>D.4 The Heart</u> Application: Causes and consequences of hypertension and thrombosis.</p>	
<p><b>Driving Question:</b> Using the patient’s symptoms, medical history, and physical findings what is the diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/> Making Connections  <input checked="" type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input checked="" type="checkbox"/> Drawing Inferences/Predictions  <input checked="" type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input checked="" type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input type="checkbox"/> Worked Examples    <input checked="" type="checkbox"/> Case Studies  <input type="checkbox"/> Structural Analogues    <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 <b>2</b> 3 4</p>
<p><b>Scaffolds Used:</b>  <input type="checkbox"/> Analogical Encoding    <input checked="" type="checkbox"/> Questioning  <input checked="" type="checkbox"/> Causal Relationships    <input type="checkbox"/> Modeling  <input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b>  -Introduction Circulatory Packet  -Circulatory Case Study Packet  -Websites:  <a href="http://www.livescience.com/22486-circulatory-system.html">http://www.livescience.com/22486-circulatory-system.html</a>  <a href="http://www.innerbody.com/image/cardov.html">http://www.innerbody.com/image/cardov.html</a>  <a href="http://symptoms.webmd.com/#introView">http://symptoms.webmd.com/#introView</a>  <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>  <a href="http://www.webmd.com/heart-disease/guide/heart-disease-coronary-artery-disease">http://www.webmd.com/heart-disease/guide/heart-disease-coronary-artery-disease</a>  NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>  -Complete the Introduction Circulatory Packet using the websites provided  -Complete the Circulatory Case Study Packet using the websites provided</p>	<p><b>Assessment Plan:</b>  SUMMATIVE  -Introduction Circulatory Packet  -Circulatory Case Study Packet   FORMATIVE  -Periodically check to see if all members of group are contributing</p>

Name \_\_\_\_\_

### **Introduction: The Circulatory System**

**Directions:** Use the websites below to answer the following questions.

Website 1: <http://www.livescience.com/22486-circulatory-system.html>

Website 2: <http://www.innerbody.com/image/cardov.html>

1. What is the main goal or function of the circulatory system?
2. What is another name for this system? \_\_\_\_\_
3. What are the three independent systems including the components of each that work together to make up the circulatory system?
4. On average how many liters of blood does a human adult have? \_\_\_\_\_
5. What four components make up blood?
6. What is the hardest working organ? What is its size?
7. What are the two circulatory loops involved? Provide a detailed description of each.
8. What is the function of blood vessels? What is the lumen?

9. What tissue within the blood cell prevents clots from forming? How?

10. What are the types of blood vessels? Give a brief description of each.

11. Using Website 2, fill in the chart below.

	<u>Arteries</u>	<u>Veins</u>	<u>Capillaries</u>
<b>Carries blood AWAY or TOWARD the heart</b>			
<b>Blood is mostly OXYGENATED or DEOXYGENATED</b>			
<b>Wall structure</b>			
<b>Pressure in vessels (LOW or HIGH)</b>			
<b>Has valves (Y or N)</b>			

12. Which of the three are the smallest? \_\_\_\_\_

13. Which type runs through almost every tissue in the human body? \_\_\_\_\_

14. What do veins heavily rely on to push blood? \_\_\_\_\_

15. Using Website 2, fill in the chart below.

	<u>Red Blood Cells</u>	<u>White Blood Cells</u>	<u>Platelets</u>	<u>Plasma</u>
<b>Also known as</b>				
<b>% make up of blood</b>				
<b>Description</b>				

<b>Function</b>				
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16. Describe what hemoglobin is made up of and what it does?

17. Identify and describe the two classes of White Blood Cells?

18. How much of plasma is water? \_\_\_\_\_

19. What types of substances are found in the plasma?

20. Identify and describe the three functions of the cardiovascular system?

21. Explain the regulation of blood pressure?

22. What is arteriosclerosis?

23. What can hypertension lead to if left untreated?

24. What is an EKG?

25. Label the heart diagram using the following terms: *Superior Vena Cava, Pulmonary Artery, Pulmonary Vein, Aorta, Inferior Vena Cava, Right Ventricle, Left Atrium*

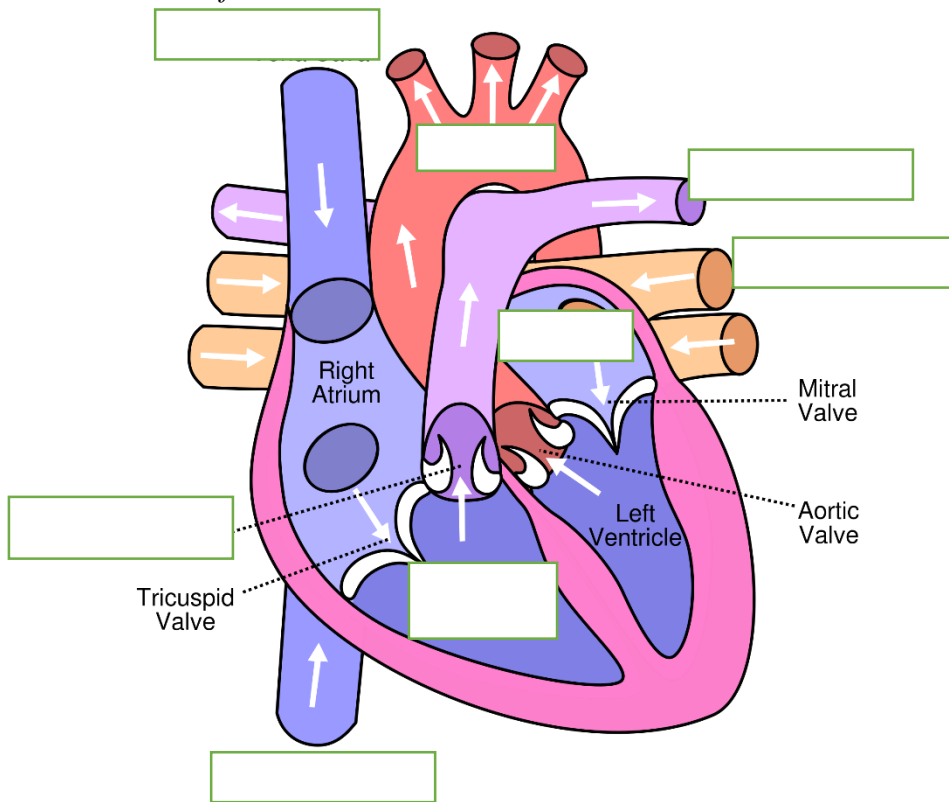


Image retrieved and altered from [commons.wikimedia.org](https://commons.wikimedia.org).

# Circulatory System Case Study

## PART ONE

Name \_\_\_\_\_

### Patient Information:

**Patient name:** John

**Age:** 60

**Current symptoms:** Chest Pain, Chest Pressure, Shortness of Breath

**Blood pressure:** 160/110 (Normal: 120/80)

**Pulse:** 80 (Normal: 60-100)

**Weight:** 320 lbs.

**Height:** 5'7"

### Analysis Questions:

1. Based on the information provided above create a list of circulatory system disorders that could be causing John's symptoms using the symptom checker website:

<http://symptoms.webmd.com/#introView> Place a **star** next to the one you hypothesize John has.

- |    |    |    |    |     |
|----|----|----|----|-----|
| 1. | 2. | 3. | 4. | 5.  |
| 6. | 7. | 8. | 9. | 10. |

2. What further questions would you want to ask John to achieve an accurate diagnosis?

-

-

-

3. Which type of tests should you order to help develop a diagnosis? (Use this website to help you <http://www.nhlbi.nih.gov/> - type in the disease in the search bar on the page.)

-

-

-

4. What organs are most likely involved with John's symptoms?



## **PART TWO**

### John's Responses and Patient History:

#### Family History

Mom – Lupus

Dad – Diabetes

#### Medications

None

#### Patient Responses

1. Do you have any other symptoms? **No, I don't think so.**
2. Do you have any nausea? **No.**
3. What does the chest pain feel like: stabbing, burning, sharp, squeezing, or aching?  
**It feels more like a squeezing feeling.**
4. Are you a smoker? **Yes.**
5. Is it worse in different positions? **I am not sure.**
6. Have you ever been treated for high blood pressure? **Yes.**
7. Was medication prescribed? **Yes, but then my script ran out and I never got a new script.**

#### Physician Orders the Following Tests

Glucose/Cholesterol Blood test (CMP/Lipid Panel) Stress Test

Echocardiogram EKG

**Analysis Questions:** *(NOTE: You may use the symptom checker website or <http://www.nlm.nih.gov/> to look up key terms or tests. Use the search bar at the top.)*

5. Is there anything within the patient information, family history, or medication list that you should be concerned with?
6. Why do you think the doctor asked if the pain was worse in different positions?
7. Why did the physician order an EKG, Stress Test, and Echocardiogram? What are they? Which organs are involved?
8. Why did the physician order a glucose/cholesterol blood test?

### PART THREE

#### John's Test Results:

#### EKG

No heart damage detected insinuating no heart attack occurred. The heart beat was steady and of normal speed.

#### Echocardiogram

Size and shape of heart is normal. Blood flow through right atrium and left ventricle is sufficient. Blood flow through left ventricle to the aorta is abnormal. Decreased blood flow is noted here.

#### CMP

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose	150	HIGH

#### LIPID PANEL

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Cholesterol	300	HIGH
HDL	100	HIGH
Triglycerides	200	HIGH
LDL	200	HIGH

#### Analysis Questions:

9. Based on the patient's medical history, symptoms, and test results what do you think is the correct diagnosis? Why?

10. The patient's information and blood test results showed a variety of concerns. What other conditions may this patient possibly have?

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11. Pick a disease from question 1 on the first page and compare its symptoms and test findings to the actual diagnosed disease in the study.

**Similarities**

**Differences**

12. What was the most beneficial information used in this case study: medical history, patient symptoms, or test results? Why?

\_\_\_\_\_ because \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

13. Besides the patient's medical history, symptoms, and test results, what other information or knowledge was useful in determining a possible diagnosis?

14. Doctors misdiagnose patients every day, how will the doctor be able to know for sure if the patient was diagnosed correctly?

15. According to the website <http://www.webmd.com/heart-disease/guide/heart-disease-coronary-artery-disease>, coronary heart disease or coronary artery disease is the number one killer in America affecting more than 13 million people. Is this disease preventable? If so, what are some ways it can be prevented?

16. If John's disease is left untreated, what are two possible conditions that may result?

## IB Biology Lessons 13, 14, & 15

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Immune System (Diabetes)	<b>Time:</b> Three 40 minute periods
<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>- Students will be able to identify specific features of the immune system including but not limited to lymphatic vessels, lymph nodes, spleen, and leukocytes along with describing the importance of each component.</li> <li>-Students will be able to identify and describe the different types of leukocytes.</li> <li>-Students will be able to identify and describe causes and possible treatments for type I and type II diabetes.</li> <li>-Students will be able to associate obesity and hypertension to increasing an individual’s risk for developing type II diabetes.</li> <li>-Students will be able to use a patient’s medical history, symptoms, and physical findings to determine an accurate diagnosis.</li> </ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>6.6 Hormones, Homeostasis and Reproduction</u> Application: Causes and treatment of Type I and Type II diabetes.</p> <p><u>D.1 Nutrition</u> Understandings:</p>	<p><b>Overall Learning Focus:</b></p> <p>First, students will explore the immune system on their own using two websites to answer critical questions. This introduction will provide students with enough background knowledge about the immune system. The overall goal of this three lesson module is to have students act like real doctors using a simulated patient’s medical history, symptoms, and test results to arrive at a diagnosis. The case study will be completed in three parts or broken down into three sections to allow students who are struggling to gain a better understanding of problem solving. Students will complete each part of the case study independently before collaborating with a partner on conclusions and inferences made. The teacher will act as a guided mentor rather than an instructor. Students will be expected to work through the case study by collaborating with peers to achieve a proper diagnosis. Again, the case study is composed of three parts allowing students to make predictions before test choices, possible diagnoses, and questions asked by the doctor are revealed. This allows students to monitor and repair their predictions and prior understandings. Using their prior and acquired knowledge, students will determine a diagnosis using a collection of evidence provided from the patient and test findings. In addition, students will learn how to use argumentation (evidence) to support their diagnosis. Students will also be expected to compare and contrast the three different types of diabetes. The focus of this lesson is to create a more student-centered classroom as opposed to a teacher-centered environment.</p>

<p>Overweight individuals are more likely to suffer hypertension and type II diabetes.</p>	
<p><b>Driving Question:</b> Using the patient’s symptoms, medical history, and physical findings what is the diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/>_X_ Making Connections  <input checked="" type="checkbox"/>_X_ Asking questions  <input type="checkbox"/>_ Visualizing  <input checked="" type="checkbox"/>_X_ Drawing Inferences/Predictions  <input checked="" type="checkbox"/>_X_ Determining Important Ideas  <input checked="" type="checkbox"/>_X_ Synthesizing Information  <input checked="" type="checkbox"/>_X_ Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input type="checkbox"/>_ Worked Examples  <input checked="" type="checkbox"/>_X_ Case Studies  <input type="checkbox"/>_ Structural Analogues  <input type="checkbox"/>_ Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 <b>2</b> 3 4</p>
<p><b>Scaffolds Used:</b>  <input type="checkbox"/>_ Analogical Encoding  <input checked="" type="checkbox"/>_X_ Questioning  <input checked="" type="checkbox"/>_X_ Causal Relationships  <input type="checkbox"/>_ Modeling  <input checked="" type="checkbox"/>_X_ Argumentation</p>	<p><b>Materials:</b>  -Introduction Immune System Packet  -Immune System Case Study Packet  -Websites:  <a href="http://www.livescience.com/26579-immune-system.html">http://www.livescience.com/26579-immune-system.html</a>  <a href="http://www.innerbody.com/image/lymphov.html">http://www.innerbody.com/image/lymphov.html</a>  <a href="http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html">http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html</a>  <a href="http://symptoms.webmd.com/#introView">http://symptoms.webmd.com/#introView</a>  <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>  <a href="https://labtestsonline.org/">https://labtestsonline.org/</a>  <a href="http://www.cnn.com/2011/HEALTH/expert.q.a/11/20/male_urination.frequency.shu/">http://www.cnn.com/2011/HEALTH/expert.q.a/11/20/male_urination.frequency.shu/</a>  <a href="http://www.webmd.com/urinary-incontinence-oab/features/the-truth-about-urine?page=2">http://www.webmd.com/urinary-incontinence-oab/features/the-truth-about-urine?page=2</a>  <a href="http://www.webmd.com/diabetes/tc/diabetes-differences-between-type-1-and-2-topic-overview">http://www.webmd.com/diabetes/tc/diabetes-differences-between-type-1-and-2-topic-overview</a>  <a href="http://www.northshore.org/diabetes/gestational-diabetes-type-1-type-2-diabetes/">http://www.northshore.org/diabetes/gestational-diabetes-type-1-type-2-diabetes/</a>  <a href="http://www.diabetes.org/diabetes-basics/statistics/?loc=db-slabnav">http://www.diabetes.org/diabetes-basics/statistics/?loc=db-slabnav</a>  NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>  -Complete the Introduction Immune System Packet using the websites provided</p>	<p><b>Assessment Plan:</b>  SUMMATIVE  -Introduction Immune System Packet  -Immune System Case Study Packet</p>

<p>-Complete the Immune System Case Study Packet using the websites provided</p>	<p>FORMATIVE -Periodically check to see if all members of group are contributing</p>
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## Introduction: The Immune System

**Directions:** Use the websites below to answer the following questions.

Website 1: <http://www.livescience.com/26579-immune-system.html>

Website 2: <http://www.innerbody.com/image/lymphov.html>

1. What is the main goal or function of the immune system?
2. The immune system is closely related to which system? \_\_\_\_\_
3. What are the six main components of the immune system?

4. Fill in the table below:

	<b>DESCRIPTION</b>	<b>FUNCTION</b>
<b>Lymph Nodes</b>		
<b>Spleen</b>		
<b>Bone Marrow</b>		
<b>Lymphocytes</b>		
<b>Thymus</b>		
<b>Leukocytes</b>		

5. Besides monocytes, what are the other six leukocytes called?

6. Fill in the chart below:

<b>LEUKOCYTES</b>	<b>FUNCTION</b>
<b>Eosinophils</b>	
<b>Basophils</b>	
<b>Neutrophils</b>	
<b>T Lymphocytes</b>	
<b>B Lymphocytes</b>	
<b>Natural Killer Cells</b>	
<b>Monocytes</b>	

7. How are asthma and allergies associated with the immune system?

8. What does immunodeficiency mean? Provide an example of a disease with this.



9. What does the term autoimmune mean? List four autoimmune diseases.

10. Which tests typically help diagnose diseases of the immune system?

11. How are diseases of the immune system treated?

12. Using Website 2, fill in the chart below.

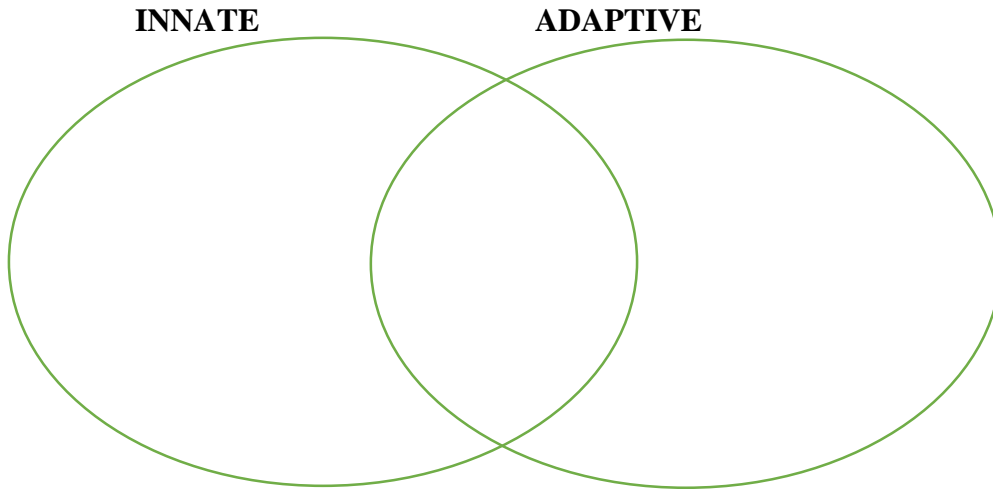
	<b><u>WHAT IS IT?</u></b>	<b><u>WHAT IS ITS ROLE?</u></b>
<b>Lymph Capillaries</b>		
<b>Lymph</b>		
<b>Lymphatic Vessels</b>		
<b>Lymph Nodes</b>		
<b>Lymph Ducts</b>		
<b>Lymph Nodules</b>		

13. Lymph consists of \_\_\_\_\_ % water and \_\_\_\_\_ % solutes.
14. Lymph may also contain \_\_\_\_\_ and \_\_\_\_\_ cells.
15. How is lymph related to cancer?
16. Lymphatic vessels closely resemble what? \_\_\_\_\_
17. How is lymph transported through lymphatic vessels?
18. What are the two main regions where lymph nodes are found? \_\_\_\_\_ and \_\_\_\_\_
19. Where are the highest concentrations of lymph nodes present? \_\_\_\_\_ and \_\_\_\_\_
20. What is within the lymph node that acts as a “net” to catch debris? \_\_\_\_\_
21. Where do the lymphatic vessels carry the lymph to? \_\_\_\_\_
22. Describe the thoracic duct path.
23. Describe the right lymphatic duct.
24. Using website 2, fill in the lymphatic nodule chart below:

	<u><b>Tonsils</b></u>	<u><b>Peyer's Patches</b></u>	<u><b>Spleen</b></u>	<u><b>Thymus</b></u>
<b>Description</b>				
<b>Location</b>				
<b>Types of Cells it Contains</b>				

<b>Type of Response</b>				
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25. Explain the difference between innate and adaptive immunity?



26. Identify and describe two external defenses?

27. Briefly describe each internal defense below:

**Fever –**

**Inflammation –**

**Natural Killer Cells –**

**Phagocytes –**

**Cell Mediated Specific Immunity –**

## Antibody Mediated Specific Immunity –

## Acquired Immunity –

28. Label the diagram using the following terms: *Bone Marrow, Adenoids, Peyer's Patches, Tonsil, Thymus, Spleen, Right Lymphatic Duct, Thoracic Duct, Lymph Nodes*

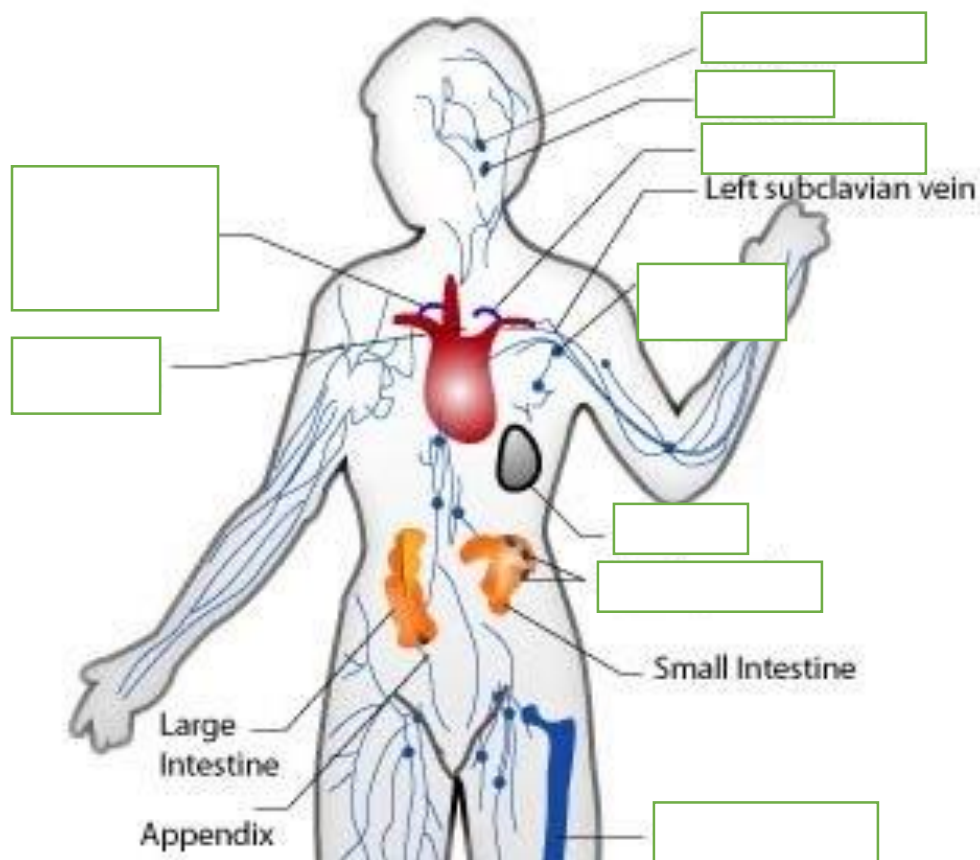


Image retrieved and altered from [life-inspired.blogspot.com](http://life-inspired.blogspot.com).

# Immune System Case Study

## PART ONE

Name \_\_\_\_\_

### Patient Information:

**Patient name:** Claire

**Age:** 40

**Current symptoms:** Frequent urination, increased thirst, extreme fatigue

**Blood pressure:** 120/75

**Pulse:** 75

**Weight:** 170 lbs.

**Height:** 5'5"

**BMI:** \_\_\_\_\_

**BMI Classification:** \_\_\_\_\_

(Use the following website:

[http://www.cdc.gov/healthyweight/assessing/bmi/adult\\_bmi/english\\_bmi\\_calculator/bmi\\_calculator.html](http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html) to help you)

### Analysis Questions:

1. Based on the information provided above create a list of immune system disorders that could be causing Claire's symptoms using the symptom checker website: <http://symptoms.webmd.com/#introView> Place a **star** next to the one you hypothesize Claire has.

- |    |    |    |    |     |
|----|----|----|----|-----|
| 1. | 2. | 3. | 4. | 5.  |
| 6. | 7. | 8. | 9. | 10. |

2. What further questions would you want to ask Claire to achieve an accurate diagnosis?

-

-

-

3. Which type of tests should you order to help develop a diagnosis? (Use this website to help you <http://www.nlm.nih.gov/> - type in the disease in the search bar on the page.)

-

-

4. What organs are most likely involved with Claire's symptoms?

## **PART TWO**

### Claire's Responses and Patient History:

#### Family History

Mom – Multiple Sclerosis, Psoriasis

Dad – Diabetes

#### Medications

None

#### Patient Responses (compare to question 10 answer)

1. Do you have any other symptoms? **No, I don't think so.**
2. Do you have pain when urinating? **No.**
3. How much water are you consuming daily? **About 15 eight ounce glasses.**
4. How many times a day are you urinating? **20.** At night? **3.**
5. Does your urine have a distinct smell? **Yes.**
6. Have you noticed that your breath smells different? **Not sure.**

#### Physician Orders the Following Tests (compare to question 11 answer)

Glucose Blood Test (fasting)

Urinalysis

A1C Blood Test

Oral Glucose Tolerance Test

#### **Analysis Questions:** *(NOTE: You may use the symptom checker website or*

*<http://www.nhlbi.nih.gov/> to look up key terms or tests. Use the search bar at the top.)*

1. Is there anything within the patient information, family history, or medication list that you should be concerned with?
2. Why do you think the doctor asked if the patient has pain when urinating?
3. What does the term “fasting” mean?
4. On average, how many eight ounce glasses of water does an adult need to consume daily? (HINT: Use your water consumption case study results) \_\_\_\_ Is 15 considered a lot? \_\_\_\_\_

5. On average, how many times a day does an adult urinate? (HINT: <http://www.cnn.com/2011/HEALTH/expert.q.a/11/20/male.urination.frequency.s hu/>) \_\_\_\_\_ Is 20 considered a lot? \_\_\_\_\_
6. Why do you think the physician asked if the patient's urine smelled?
7. Why do you think the physician asked if the patient's breathe smelled?
8. Why did the physician order a Fasting Blood Glucose Test (FBGT), Urinalysis, A1C Blood test, and an Oral Glucose Tolerance Test (OGTT)? What are they? Which organs are associated with these tests? (Use the following website to help you: <https://labtestsonline.org/>) NOTE: You can enter the test in the search bar on the right.

FBGT:

Urinalysis:

A1C:

OGTT:

**PART THREE**  
Claire's Test Results:

**URINALYSIS**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL RANGE</u>
Glucose	Positive (present)	Negative (not present)
Protein	5	0 – 30
Leukocyte Screen	Negative	Negative
Hemoglobin Screen	Negative	Negative
White Blood Cells	0	0 - 9
Red Blood Cells	0	0 - 4
Granular Casts	0	0
Hyaline Casts	0	0
Specific Gravity	1.015	1.003 – 1.035
Creatinine	69	27 - 260

**OGTT**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	215	HIGH
Glucose (2 hours after consuming 75 grams of glucose dissolved in water)	300	HIGH

**FBGT**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	200	HIGH

**A1C**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
A1C	8.0	HIGH

**Analysis Questions:**

- Using the test results above, circle all abnormal test results.
- Based on the patient's medical history, symptoms, and test results what do you think is the correct diagnosis? Why?

**NOTE: Do not move on to the next page until the instructor has told you to do so.**



- The patient's information and blood test results showed a variety of concerns. What other conditions may this patient be diagnosed with in the future that are related to the diagnosed disease?

- Fill in the urine smell chart below using the website <http://www.webmd.com/urinary-incontinence-oab/features/the-truth-about-urine?page=2> (scroll down to the "odor changes" subheading):

**URINE SMELL CHART**

	<b>PROBABLE CAUSE</b>	<b>DISEASE ASSOCIATION</b>
Smells like ammonia	_____ is present	
Smells sweet	_____ is present	
Smells like sulfur	_____ _____	

- How would a person with diabetes breath smell if he or she did not receive treatment?
- Pick a disease from question 1 on the first page and compare its symptoms and test findings to the actual diagnosed disease in the study.

**Similarities**

**Differences**

- What was the most beneficial information used in this case study: medical history, patient symptoms, or test results? Why?

\_\_\_\_\_ because \_\_\_\_\_

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8. Besides the patient's medical history, symptoms, and test results, what other information or knowledge was useful in determining a possible diagnosis?

9. Doctors misdiagnose patients every day, how will the doctor be able to know for sure if the patient was diagnosed correctly?

10. Fill in the diabetes comparison chart below using the following websites:  
<http://www.webmd.com/diabetes/tc/diabetes-differences-between-type-1-and-2-topic-overview> and <http://www.northshore.org/diabetes/gestational-diabetes-type-1-type-2-diabetes/>

	<b>TYPE 1 DIABETES</b>	<b>TYPE 2 DIABETES</b>	<b>GESTATIONAL DIABETES</b>
<b>Definition</b>			
<b>Typical Onset Age</b>			
<b>Prevalence</b>			
<b>Insulin Dependent (Yes or No)</b>			
<b>Gradual or Quick Onset of Symptoms</b>			
<b>Prevention Tips</b>			

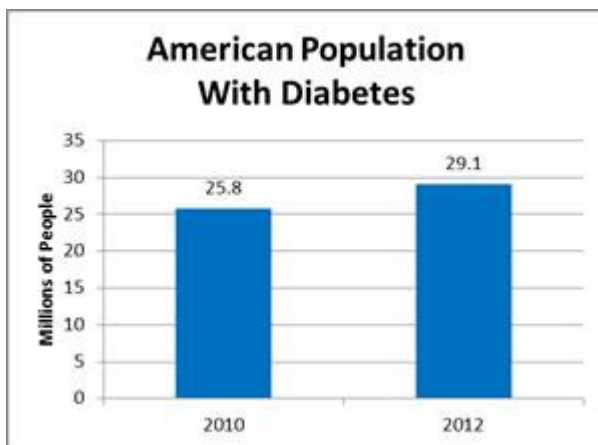
11. After filling in the chart above, how do you know what type of diabetes Claire has?

12. What additional tests should the physician have ordered to confirm the diagnosis?

13. What additional questions should the physician have asked Claire?

14. Statistics retrieved from the American Diabetes Association website:

<http://www.diabetes.org/diabetes-basics/statistics/?loc=db-slabnav>



**Prevalence:** In 2012, 29.1 million Americans, or 9.3% of the population, had diabetes. Approximately 1.25 million American children and adults have type 1 diabetes.

**Undiagnosed:** Of the 29.1 million, 21.0 million were diagnosed, and 8.1 million were undiagnosed.

**Deaths:** Diabetes remains the 7<sup>th</sup> leading cause of death in the United States in 2010, with 69,071 death certificates listing it as the underlying cause of death, and a total of

234,051 death certificates listing diabetes as an underlying or contributing cause of death.

According to the statistics above, 29.1 million Americans had diabetes in 2012. Due to the growing prevalence of the disease from 2010 to 2012 how can this disease be prevented?

15. If Claire's disease is left untreated, what are two possible conditions that may result?

## IB Biology Lessons 16, 17

Grade Level: 10

Unit: Human Body Systems

<b>Topic:</b> Immune System (Diabetes & UTI Comparison)	<b>Time:</b> Two 40 minute periods
<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>-Students will be able to explain why type II diabetes is now being classified as an autoimmune disease.</li> <li>-Students will be able to identify and describe causes, symptoms, and possible treatments for type I and type II diabetes.</li> <li>-Students will be able to associate obesity and hypertension to increasing an individual's risk for developing type II diabetes.</li> <li>-Students will be able to compare and contrast two case studies using each patient's medical history, symptoms, and physical findings to determine an accurate diagnosis for each case study.</li> </ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>6.6 Hormones, Homeostasis and Reproduction</u> Application: Causes and treatment of Type I and Type II diabetes.</p> <p><u>D.1 Nutrition</u> Understandings: Overweight individuals are more likely to suffer hypertension and type II diabetes.</p>	<p><b>Overall Learning Focus:</b></p> <p>First, students will read a recent research article explaining how type II diabetes is now being classified as an autoimmune disease. Students will then compare and contrast type I and type II diabetes. Next, students will work independently or in groups of three to work through a comparative case study analysis. Two similar case studies will be analyzed looking for similarities and differences. Students will be expected to use the "Problem Solving Steps Cheat Sheet" to help them work through the problem. The students will also be expected to use various websites to properly analyze and determine a diagnosis for case study 1 and 2. The teacher will help struggling students use the patient history, symptoms, and test results to come up with a diagnosis. After each group has reached a diagnosis, the teacher will facilitate a class discussion by having each group share their thought process and justification of the diagnosis reached. By the end of the two lesson module, students will be able to compare Diabetes and Urinary Tract Infection (UTI) symptoms, causes, test results, and treatments.</p>

<p><b>Driving Question:</b> By comparing two case studies side by side using each patient’s symptoms, medical history, and physical findings what is their diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/> Making Connections  <input checked="" type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input checked="" type="checkbox"/> Drawing Inferences/Predictions  <input checked="" type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input checked="" type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input checked="" type="checkbox"/> Worked Examples  <input checked="" type="checkbox"/> Case Studies  <input checked="" type="checkbox"/> Structural Analogues  <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 2 <b>3</b> 4</p>
<p><b>Scaffolds Used:</b>  <input checked="" type="checkbox"/> Analogical Encoding  <input type="checkbox"/> Questioning  <input checked="" type="checkbox"/> Causal Relationships  <input type="checkbox"/> Modeling  <input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b>  -Diabetes Research Packet  -Immune System Comparative Analysis Case Study Packet  -Websites:  <a href="http://www.medicalnewstoday.com/articles/222766.php">http://www.medicalnewstoday.com/articles/222766.php</a>  <a href="http://www.mayoclinic.org/diseases-conditions/diabetes/basics/causes/CON20033091">http://www.mayoclinic.org/diseases-conditions/diabetes/basics/causes/CON20033091</a>  <a href="http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html">http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html</a>  <a href="http://symptoms.webmd.com/#introView">http://symptoms.webmd.com/#introView</a>  <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>  <a href="https://labtestsonline.org/">https://labtestsonline.org/</a>  NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>  -Complete the Diabetes Research Packet using the websites provided  -Complete the Immune System Comparative Analysis Case Study Packet using the websites provided</p>	<p><b>Assessment Plan:</b>  SUMMATIVE  - Diabetes Research Packet  - Immune System Comparative Analysis Case Study Packet   FORMATIVE  -Periodically check to see if all members of group are contributing</p>

# Is Type 2 Diabetes an Autoimmune Disease?

Written by: Catharine Paddock PhD

Part of Article Retrieved from: <http://www.medicalnewstoday.com/articles/222766.php>

Type 2 [diabetes](#) is in the process of being redefined as an autoimmune disease rather than just a metabolic disorder, said an author of a new study published in *Nature Medicine* this week, the findings of which may lead to new diabetes treatments that target the immune system instead of trying to control blood sugar.

As part of the study the researchers showed that an antibody called anti-CD20, which targets and eliminates mature B cells in the immune system, stopped diabetes type 2 developing in lab mice prone to develop the disease, and restored their blood sugar level to normal.

Anti-CD20, available in the US under the trade names Rituxan and MabThera, is already approved as a treatment for some autoimmune diseases and blood [cancers](#) in humans, but more research is needed to see if it will work against diabetes in humans.

The researchers believe that [insulin](#) resistance, the hallmark of [type 2 diabetes](#) (unlike [type 1 diabetes](#) where it is the insulin-producing cells that are destroyed), is the result of B cells and other immune cells attacking the body's own tissues.

Co-first author Daniel Winer, now an endocrine pathologist at the University Health Network of the University of Toronto in Ontario, Canada, started working on the study as a postdoctoral scholar at Stanford University School of Medicine in California, USA. He told the press that:

"We are in the process of redefining one of the most common diseases in America as an autoimmune disease, rather than a purely metabolic disease."

"This work will change the way people think about [obesity](#), and will likely impact medicine for years to come as physicians begin to switch their focus to immune-modulating treatments for type-2 diabetes," he added.

The discovery brings type 2 diabetes, until now considered to be more of a metabolic disease, closer to type 1 diabetes, where the immune systems attacks and destroys the insulin-producing cells in the pancreas.

Type 2 diabetes occurs when the tissues of the body gradually become more and more resistant to insulin, the hormone that mops up dietary glucose and transports it to cells to convert into energy.

We don't know what causes the tissues to become resistant to insulin in type 2 diabetes, but we know it is linked to obesity and often runs in families.

### **Type 2 Diabetes Article Analysis Questions**

1. According to the article, what was type 2 diabetes considered as?
2. What does new research show that type 2 diabetes could be considered as?
3. Explain how the study showed this link.
4. Why is this research finding important?
5. Explain what happens in type 1 and type 2 diabetes.
6. What is type 2 diabetes still linked to?

**Use the following website to answer questions 7 & 8:**

**<http://www.mayoclinic.org/diseases-conditions/diabetes/basics/causes/CON20033091>**

7. What are the causes of Type 1 and Type 2 Diabetes?
  - Type 1 -
  - Type 2 –
8. What are the symptoms of Type 1 and Type 2 Diabetes?
  - Type 1 & 2 –

## CASE STUDY 1

### PART ONE

#### Patient Information:

**Patient name:** Claire      **Age:** 40  
**Current symptoms:** Frequent urination,  
increased thirst, extreme fatigue  
**Blood pressure:** 120/75      **Pulse:** 75  
**Weight:** 170 lbs.      **Height:** 5'5"  
**BMI:** \_\_\_\_\_ **BMI Classification:** \_\_\_\_\_

### PART TWO

#### Claire's Responses and Patient History:

##### Family History

Mom – Multiple Sclerosis, Psoriasis

Dad – Diabetes

##### Medications

None

##### Patient Responses

1. Do you have any other symptoms?  
**No, I don't think so.**
2. Do you have pain when urinating?  
**No.**
3. How much water are you consuming  
daily? **About 15 eight ounce  
glasses.**
4. How many times a day are you  
urinating? **20.** At night? **3.**
5. Does your urine have a distinct  
smell? **Yes.**
6. Have you noticed that your breath  
smells different? **Not sure.**

##### Physician Orders the Following Tests

Glucose Blood Test (fasting)  
Urinalysis  
A1C Blood Test  
Oral Glucose Tolerance Test

## CASE STUDY 2

### PART ONE

#### Patient Information:

**Patient name:** Karen      **Age:** 35  
**Current symptoms:** Frequent urination,  
fatigue  
**Blood pressure:** 130/85      **Pulse:** 69  
**Weight:** 160 lbs.      **Height:** 5'9"  
**BMI:** \_\_\_\_\_ **BMI Classification:** \_\_\_\_\_

### PART TWO

#### Karen's Responses and Patient History:

##### Family History

Mom – Interstitial Cystitis

Dad – Diabetes

##### Medications

None

##### Patient Responses

1. Do you have any other symptoms?  
**No, I don't think so.**
2. Do you have pain when urinating?  
**Yes.**
3. How much water are you consuming  
daily? **About 8 eight ounce glasses.**
4. How many times a day are you  
urinating? **15.** At night? **2.**
5. Does your urine have a distinct  
smell? **Yes.**
6. Have you noticed that your breath  
smells different? **Not sure.**

##### Physician Orders the Following Tests

Glucose Blood Test (fasting)  
Urinalysis  
A1C Blood Test  
Oral Glucose Tolerance Test



## CASE STUDY 1 & 2 COMPARATIVE ANALYSIS

1. Before moving on to Part 3, circle or highlight differences between the case studies.
2. Could these slight differences lead to two different diagnoses? Why?
3. Do you expect differences in test results? If so explain.
  
4. What was the most important difference between the two case studies?

### **CASE STUDY 1: PART THREE**

Claire's Test Results:

#### **URINALYSIS**

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL RANGE</u>
Glucose	Positive (present)	Negative (not present)
Protein	5	0 – 30
Leukocyte Screen	Negative	Negative
Hemoglobin Screen	Negative	Negative
White Blood Cells	0	0 - 9
Red Blood Cells	0	0 - 4
Granular Casts	0	0
Hyaline Casts	0	0
Specific Gravity	1.015	1.003 – 1.035
Creatinine	69	27 - 260

#### **OGTT**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	215	HIGH
Glucose (2 hours after consuming 75 grams of glucose dissolved in water)	300	HIGH

#### **FBGT**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	200	HIGH

#### **A1C**

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
A1C	8.0	HIGH

## CASE STUDY 2: PART THREE

Karen's Test Results:

### URINALYSIS

<u>TEST</u>	<u>RESULT</u>	<u>NORMAL RANGE</u>
Glucose	Negative	Negative (not present)
Protein	5	0 – 30
Leukocyte Screen	Positive	Negative
Hemoglobin Screen	Negative	Negative
White Blood Cells	20	0 - 9
Red Blood Cells	3	0 - 4
Granular Casts	0	0
Hyaline Casts	0	0
Specific Gravity	1.020	1.003 – 1.035
Creatinine	130	27 - 260

### OGTT

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	90	
Glucose (2 hours after consuming 75 grams of glucose dissolved in water)	100	

### FBGT

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
Glucose (fasting)	90	

### A1C

<u>TEST</u>	<u>RESULT</u>	<u>LOW/HIGH</u>
A1C	6.0	

5. Circle or highlight differences in test results.
  
6. What is the probable diagnosis for case study 2? (Use the following websites to help you: <https://labtestsonline.org/> and <http://www.nhlbi.nih.gov/>)
  
7. How do the treatments between the two diagnoses differ?

## IB Biology Lessons 18, 19, 20

Grade Level: 10

Unit: Human Body Systems

Topic: Nervous System (Stroke)	Time: Three 40 minute periods
<p><b>Objectives:</b></p> <ul style="list-style-type: none"><li>-Students will be able to describe and identify the role of each component of the nervous system including but not limited to nerves, axons, neurons, and glial cells.</li><li>-Students will be able to identify the four major systems within the nervous system.</li><li>-Students will be able to identify the everyday functions that the brain controls.</li><li>-Students will be able to understand and explain various nerve disorders including but not limited to epilepsy and multiple sclerosis.</li><li>-Students will be able to explain how neurons transmit signals using electrical impulses along the axons of neurons.</li><li>-Students will be able to explain the role of myelin.</li><li>-Students will be able to describe what a synapse is.</li><li>-Students will be able to explain the effects on the brain after suffering a stroke.</li></ul> <p><b>International Baccalaureate Standards:</b></p> <p><u>6.5 Neurons and Synapses</u></p> <p>Understandings: Neurons transmit electrical impulses.</p> <p>The myelination of nerve fibres allows for saltatory conduction.</p>	<p><b>Overall Learning Focus:</b></p> <p>First, students will explore the nervous system on their own using two websites to answer critical questions. This introduction will provide students with enough background knowledge about the nervous system. The overall goal of this three lesson module is to have students act like real doctors using a simulated patient’s medical history, symptoms, and test results to arrive at a diagnosis. Students will work in groups of three to work through the problem one part at a time. Students will be encouraged to collaborate with their peers. Students will be expected to use the “Problem Solving Steps Cheat Sheet” to help them work through the problem. The students will also be expected to use various websites to properly analyze and determine a diagnosis for the case study. The teacher will help struggling students use the patient history, symptoms, and test results to come up with a diagnosis. After each group has reached a diagnosis, the teacher will facilitate a class discussion by having each group share their thought process and justification of the diagnosis reached. By the end of the three lesson module, students will be able to work through a PBL case study independent from the teacher and arrive at a justified diagnosis.</p>

<p>Nerve impulses are action potentials propagated along the axons of neurons.</p> <p>Synapses are junctions between neurons and between neurons and receptor or effector cells.</p> <p><u>A.1 Neural Development</u> Application: Events such as strokes may promote reorganization of brain function.</p>	
<p><b>Driving Question:</b> Using the patient’s symptoms, medical history, and test results what is the diagnosis?</p>	<p><b>Metacognitive Strategy Focus:</b>  <input checked="" type="checkbox"/> Making Connections  <input checked="" type="checkbox"/> Asking questions  <input type="checkbox"/> Visualizing  <input type="checkbox"/> Drawing Inferences/Predictions  <input type="checkbox"/> Determining Important Ideas  <input checked="" type="checkbox"/> Synthesizing Information  <input checked="" type="checkbox"/> Monitoring and Repairing Understanding</p>
<p><b>PBL Components Used:</b>  <input type="checkbox"/> Worked Examples  <input checked="" type="checkbox"/> Case Studies  <input type="checkbox"/> Structural Analogues  <input type="checkbox"/> Simulations</p>	<p><b>Problem Difficulty Level (1-4):</b>  Complexity 1 2 <b>3</b> 4  Structuredness 1 2 <b>3</b> 4</p>
<p><b>Scaffolds Used:</b>  <input type="checkbox"/> Analogical Encoding  <input checked="" type="checkbox"/> Questioning  <input type="checkbox"/> Causal Relationships  <input type="checkbox"/> Modeling  <input checked="" type="checkbox"/> Argumentation</p>	<p><b>Materials:</b>  -Introduction Nervous System Packet  -Nervous System Case Study Packet  -Websites:  <a href="http://www.livescience.com/22665-nervous-system.html">http://www.livescience.com/22665-nervous-system.html</a>  <a href="http://www.innerbody.com/image/nervov.html">http://www.innerbody.com/image/nervov.html</a>  <a href="http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html">http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html</a>  <a href="http://symptoms.webmd.com/#introView">http://symptoms.webmd.com/#introView</a>  <a href="http://www.nhlbi.nih.gov/">http://www.nhlbi.nih.gov/</a>  <a href="http://www.strokeassociation.org/STROKEORG/AboutStroke/TypesofStroke/Types-of-Stroke_UCM_308531_SubHomePage.jsp">http://www.strokeassociation.org/STROKEORG/AboutStroke/TypesofStroke/Types-of-Stroke_UCM_308531_SubHomePage.jsp</a></p>

	<p>NOTE: Parts of test results were taken from real patients (family and friends) with consent</p>
<p><b>Learning Tasks:</b>          -Complete the Introduction Nervous System Packet using the websites provided          -Complete the Nervous System Case Study Packet in groups of three</p>	<p><b>Assessment Plan:</b>          SUMMATIVE          -Introduction Nervous System Packet          -Nervous System Case Study Packet</p> <p>FORMATIVE          -Periodically check to see if all members of group are contributing</p>

## Introduction: The Nervous System

**Directions:** Use the websites below to answer the following questions.

Website 1: <http://www.livescience.com/22665-nervous-system.html>

Website 2: <http://www.innerbody.com/image/nervov.html>

1. What is the main goal or function of the nervous system?
2. What are the two main components? \_\_\_\_\_ and \_\_\_\_\_
3. What are the two subdivisions of the nervous system? Provide an example of each.
  - a.
  - b.
4. Fill in the table below using **Website 1**:

	DESCRIPTION	FUNCTION
<b>Nerves</b>		
<b>Neurons</b>		
<b>Sensory Neurons</b>		
<b>Motor Neurons</b>		
<b>Glial Cells</b>		

5. According to **Website 2**, what makes up the nervous system?

6. Fill in the chart below using **Website 1**:

<b>SYSTEM</b>	<b>DESCRIPTION</b>	<b>CONNECTS TO</b>
<b>Cranial</b>		
<b>Peripheral</b>		
<b>Central</b>		
<b>Autonomic</b>		

7. Based on the neuron description on **Website 2**, draw and label a neuron using the following terms: *cell body*, *dendrites*, *axons*

8. Fill in the chart below using **Website 2**:

<b>TYPE OF NEURON</b>	<b>ALSO KNOWN AS</b>	<b>TRANSMITS TO THE</b>	<b>TRANSMITS FROM THE</b>
<b>Afferent</b>			
<b>Efferent</b>			
<b>Interneuron</b>			

9. What type of functions does the brain control?

Mental Functions

Lower Body Functions

10. What is the function of the spinal cord?

11. What is the difference between the white and grey matter within the spinal cord?

12. Using **Website 2**, fill in the chart below.

<u>NERVE TYPE</u>	<u>DESCRIPTION</u>	<u>FUNCTION</u>
<b>Afferent, Efferent, and Mixed</b>		
<b>Cranial</b>		
<b>Spinal</b>		

13. List the number of nerve pairs for each.

Cranial - \_\_\_\_\_

Spinal - \_\_\_\_\_

Cervical: \_\_\_\_\_

Thoracic: \_\_\_\_\_

Lumbar: \_\_\_\_\_

Sacral: \_\_\_\_\_

Coccygeal: \_\_\_\_\_

14. What are the meninges?



15. What do the layers of the meninges consist of? Provide a description of each.

-

-

-

16. What is the significance of cerebral spinal fluid (CSF)?

17. How is CSF formed?

18. Where does CSF flow through?

19. What are the three functions CSF provides?

20. What are the three main functions of the nervous system? Describe each one.

21. What makes up the CNS?

22. What makes up the PNS?

23. What is the difference between the sympathetic and parasympathetic autonomic nervous systems? Provide examples of each.

24. What is a synapse?

25. What is the function of myelin?

26. How is myelin formed?

27. What are reflexes?

28. According to **Website 1**, what type of tests can be used to diagnose nervous system disorders?

29. Fill in the chart below using **Website 1**:

<b>TEST</b>	<b>DESCRIPTION</b>	<b>CHECKS FOR</b>
Fluoroscopy X-ray		
MRI		
EEG		

PET		
Spinal Tap		

30. What is a common symptom of a nervous system disease?

31. Provide a brief description of each nerve disorder below:

Epilepsy-

Parkinson's-

Multiple Sclerosis (MS)-

Amyotrophic Lateral Sclerosis (ALS)-

Huntington's Disease-

Alzheimer's-

32. The nervous system can also be affected by vascular disorders. Provide a brief description of each vascular disorder below that is directly associated with the nervous system.

Stroke-

Transient Ischemic Attack (TIA)-

Subarachnoid Hemorrhage-

33. Label the diagram using the following terms: *Spinal Cord, Brain, Sciatic Nerve, Cranial Nerves, Lumbar Nerves, Cervical Nerves, Thoracic Nerves, Sacral Nerves*

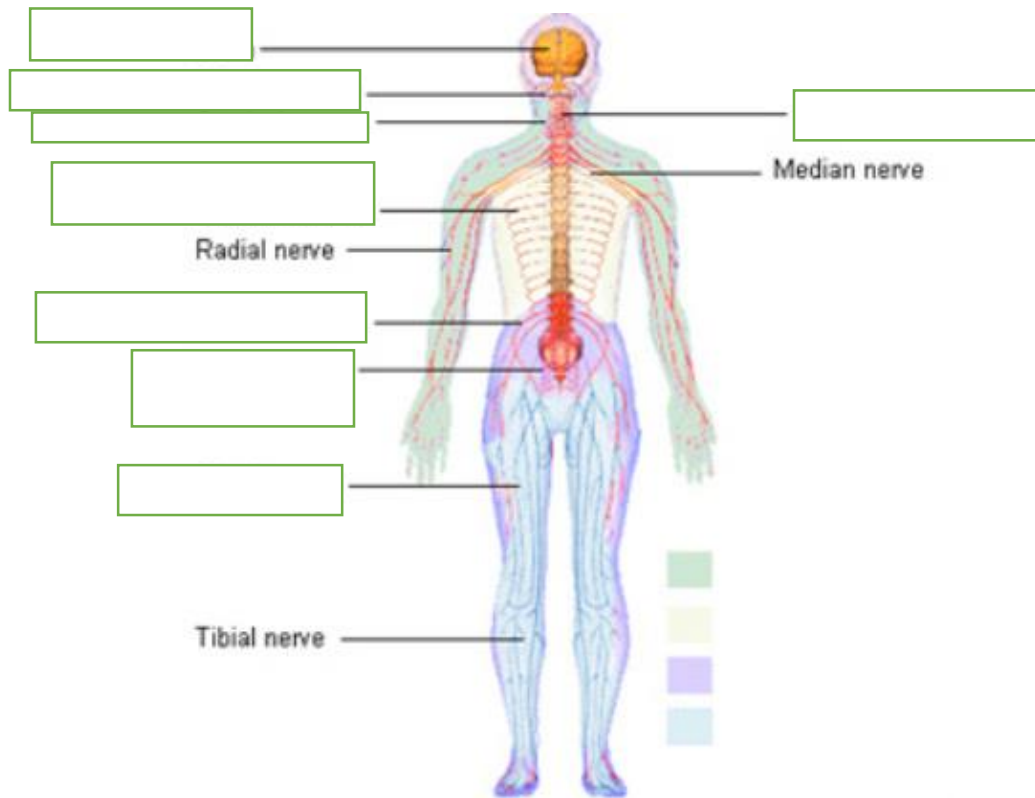


Image retrieved and altered from [allaboutthenervoussystem.weebly.com](http://allaboutthenervoussystem.weebly.com).

# Nervous System Case Study

## PART ONE

Name \_\_\_\_\_

### Emergency Room Patient Information:

**Patient name:** Jessica

**Age:** 52

**Current symptoms:** Severe headache, confusion, trouble speaking

**Blood pressure:** 160/95 (Normal: 120/80)

**Pulse:** 79 (Normal: 60-100)

**Weight:** 160 lbs.

**Height:** 5'3"

**BMI:** \_\_\_\_\_

**BMI Classification:** \_\_\_\_\_

(Use the following website:

[http://www.cdc.gov/healthyweight/assessing/bmi/adult\\_bmi/english\\_bmi\\_calculator/bmi\\_calculator.html](http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html) to help you)

### **Patient Summary of Events:**

I was working from home using the computer to complete some financial transactions. All of a sudden I had a severe headache. After the headache, I started to feel confused and became unable to speak. My body also was uncontrollably shaking. I began to notice that my vision was extremely blurry. I could not make out lettering or even my mother's face. My mother called 911.

### **Analysis Questions:**

1. Using the patient information and summary of events, what are some key pieces of information that you should consider if you are the doctor? (HINT: What is abnormal?)
2. Based on the information provided above create a list of nervous system disorders that could be causing Jessica's symptoms using the symptom checker website: <http://symptoms.webmd.com/#introView> Place a **star** next to the one you hypothesize Claire has.  
A.                                      B.                                      C.
3. What further questions would you want to ask Jessica to achieve an accurate diagnosis?  
-  
-  
-

4. Which type of tests should you order to help develop a diagnosis? (*Use this website to help you <http://www.nhlbi.nih.gov/> - type in the disease in the search bar on the page.*)

-

-

-

5. What organs are most likely involved with Jessica's symptoms?

6. Most people have experienced headaches at some point in their life. How do you know that Jessica's headache is more serious than the typical headache?

## **PART TWO**

### Jessica's Responses and Patient History:

#### Family History

Mom – High Blood Pressure, TIA

Dad – Heart Disease

#### Medications

None

#### Patient Responses (compare to question 10 answer)

Do you have any other symptoms? **Yes, blurred vision.**

Are you sensitive to light? **A little.**

Does your speech seem slurred? **No.**

Do you have any stiffness? **No.**

Do you feel fatigued? **No.**

Have you ever been on high blood pressure medication? **No.**

Do you have any double vision? **No.**

#### Physician Orders the Following Tests (compare to question 3 answer)

CT Scan of Head

CBC Blood Test

EKG

Angiography

**Analysis Questions:** (NOTE: You may use the symptom checker website or <http://www.nhlbi.nih.gov/> to look up key terms or tests. Use the search bar at the top.)

7. Is there anything within the patient information, family history, or medication list that you should be concerned with?
  
  
  
  
  
  
  
  
  
  
8. Why do you think the doctor asked if the patient has any stiffness? What disease was the doctor looking to eliminate?
  
  
  
  
  
  
  
  
  
  
9. Why did the doctor ask if the patient had slurred speech? What disease is associated with this?
  
  
  
  
  
  
  
  
  
  
10. Why did the doctor ask if the patient has ever been on high blood pressure medication?

11. Why do you think the physician ordered a CT Scan of the head? What is the doctor looking for?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
12. Why do you think the physician ordered a CBC blood test? What is the doctor looking for?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
13. Why do you think the physician ordered an EKG? What does this test show?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
14. Why do you think the physician ordered an angiography? What does this test look for?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
15. What is an angiography and an EKG?



**PART THREE**  
Jessica's Test Results:

**CBC**

<u>TEST</u>	<u>RESULT</u>	<u>HIGH/LOW</u>
WBC	6.0	
RBC	5.0	
HGB	13.6	
HCT	39.1	
MCV	89.0	
MCH	30.8	
MCHC	34.7	
PLATELET COUNT	142	
RDW	12.4	

**CT SCAN**

Protocol: Transaxial images obtained from foramen magnum thru vertex

IV Contrast: Yes

Findings:

Vascular system: Arterial acute blockage noted

Intracranial hemorrhage: None

Ventricular System: Normal

Cerebral parenchyma: Normal; No hemorrhage or mass.

Cerebellum: Normal

Brainstem: Normal

Hemiparesis: Middle cerebral artery occlusion (Damaged brain cells present)

**EKG**

Findings:

Normal except for absence of discrete P waves and an irregular ventricular rate noted

**ANGIOGRAPHY**

Findings:

No arteriovenous [AV] malformation present

No abnormal vessel formation noted

No bulging blood vessels present

Blockage in blood vessel noted consistent with CT Scan results

**Analysis Questions:**

16. Using the test results above, circle all abnormal test results.

17. What does the CBC results show?

18. What does the CT Scan report show?
  19. What do these CT Scan findings mean? HINT: Use the websites we have used previously to help you.
  20. What did the EKG show?
  21. What are these findings indicative of? HINT: Use the websites we have used previously to help you.
  22. What does the angiography show? Compare this finding to the CT Scan report.
  23. Based on these findings, what diseases can you rule out?
  24. Based on the patient's medical history, symptoms, and test results what do you think is the correct diagnosis? Why?
  25. The patient's information and blood test results showed a variety of concerns. What other conditions may this patient be diagnosed with in the future that are related to the diagnosed disease?
-

26. Fill in the stroke chart below using the website:

[http://www.strokeassociation.org/STROKEORG/AboutStroke/TypesofStroke/Types-of-Stroke\\_UCM\\_308531\\_SubHomePage.jsp](http://www.strokeassociation.org/STROKEORG/AboutStroke/TypesofStroke/Types-of-Stroke_UCM_308531_SubHomePage.jsp)

TYPE OF STROKE	ALSO KNOWN AS	PROBABLE CAUSE	DISEASE ASSOCIATION
Ischemic			
Hemorrhagic			
TIA			

27. According to the website, what are the four main warning signs of having a stroke?

28. Pick a disease from question 1 on the first page and compare its symptoms and test findings to the actual diagnosed disease in the study.

**Similarities**

**Differences**

29. What was the most beneficial information used in this case study: medical history, patient symptoms, or test results? Why?

\_\_\_\_\_ because \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

30. Besides the patient's medical history, symptoms, and test results, what other information or knowledge was useful in determining a possible diagnosis?
  
  
  
  
  
  
  
  
  
  
31. Doctors misdiagnose patients every day, how will the doctor be able to know for sure if the patient was diagnosed correctly?
  
  
  
  
  
  
  
  
  
  
32. According to the same website used in question 26, stroke is the number \_\_\_\_ cause of death in the United States.
  
  
  
  
  
  
  
  
  
  
33. What do you think caused Jessica's stroke?
  
  
  
  
  
  
  
  
  
  
34. Could Jessica's stroke have been prevented?

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