Spring 5-2012

Semipermeable Membranes, Diffusion, and Osmosis Inquiry: Effective Modeling in a High School Classroom

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SEMIPERMEABLE MEMBRANES, DIFFUSION, AND OSMOSIS INQUIRY: EFFECTIVE MODELING IN A HIGH SCHOOL CLASSROOM

A Capstone Experience/Thesis Project

Presented in Partial Fulfillment of the Requirements for

the Degree Bachelor of Sciences with

Honors College Graduate Distinction at Western Kentucky University

By

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Western Kentucky University

2012

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ABSTRACT

A novel approach is taken in teaching the core chemical and biological concepts of mass transport properties, specifically diffusion and osmosis, in an investigation-rich unit of instruction spanning fifteen days. The unit is based on the highly successful 5-E, inquiry based approach known as project-based instruction which emphasizes the use of laboratories and interactive discussions. The entire unit will center on a grand challenge which the students will provide a media-based solution for by encompassing the concepts taught in the unit. When introducing these topics in the high school classroom, the instructor must be able to help students understand the basic similarities and differences between diffusion and osmosis as well as provide real world applications for these phenomena. The current unit of instruction employs hands-on activities and physical models allowing students to visualize the processes and effects of diffusion and osmosis. Utilizing inquiry-based guided questions and strategies embedded within the lesson plans, the instructor can probe students for their understanding of mass transport properties. By employing the developed hands-on activities and guided-questioning discussions, students are actively engaged and better equipped to master fundamental concepts which can become a foundation for more advanced topics.

Keywords: mass transport properties, osmosis, diffusion, semipermeability, hands-on activities, inquiry-based

Dedicated to my friends, family, advisors, and mentors.

ACKNOWLEDGEMENTS

This completion of this project is due to the knowledge, support, and creativity of many people. My partner, Nicholas Neiman, and my advisor, Dr. Les Pesterfield, have provided hours of service to this project by critiquing my work and offering areas of improvement. My advisor's encouragement, push (against my procrastination), and willingness to engage in my research interest have played a significant role in my growth as a chemist and piqued my interest in chemical education. I would also like to thank the Melissa Rudloff, Stephanie Burba, and the members of my committee, Dr. Martha Day and Dr. Leslie Baylis, for providing me with their time and insight on the improvement of this project.

Dr. Martha Day was also able to provide financial support for the development of this project (SKyTeach funding) and the opportunity to present my project at the American Chemical Society National Conference in San Diego, CA (GSKyTeach funding) and the Uteach National Conference in Austin, TX (SKyTeach funding). Without this support, my project would have been a mere imagination rather than a physical finished project. Thank you to the countless others who were able to provide me with some sort of support during this process.

VITA

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CHAPTER 1

INTRODUCTION

The concepts of diffusion, semipermeability, and osmosis are fundamental to mastering many topics in chemistry and biology. The students will have an easier time understanding more advanced topics if they can understand the forces that lead to these phenomena and the resulting consequences. Unfortunately, many high school teachers do not spend much instructional time on these concepts, thus students leave their classes with only a rudimental understanding of these fundamental forces. Because they play a critical role in the fields of chemistry, biochemistry, and biology, it is important that students have a clear understanding of the concepts and how they relate to real world applications. This unit offers an effective method for teaching diffusion and osmosis using hands-on activities combined with guided-questioning discussions.

This unit is designed to move away from the direct instructional approach and incorporate a more inquiry-based approach. This thesis explores the concepts of osmosis and diffusion in terms of a project-based instruction approach. A very secific form of project-based instruction is employed; this method is derived from the Legacy Cycle. Within this cycle, students begin a unit with a grand challenge. This is often in terms of a

fictional scenario. This unit uses a media-based video as the grand challenge. This challenge is an umbrella for the unit; students begin the unit by trying to solve the grand challenge with what they already know. As the unit progresses, students learn new concepts through interactive discussion and engaging laboratory activities. Students will then synthesize all the information they have gathered and put it into perspective in terms of solving the grand challenge. Again, the students will use a technology based approach to present their findings. This helps add meaning and relevance to why students are studying these topics. Fundamentally, students are more intrigued in their studies hopefully leading to a greater retention of the course mateial.

The unit consists of two major projects: the grand challenge and the go public challenge. Both of these challenges are summative assessments of the students ability to utilize the information they have learned to solve real world problems. There is also a series of laboratories that allow students to visualize the effects of diffusion, semipermeability, and osmosis so that they can construct knoweldge based upon their predictions, observations, and findings. The use of expert opinion videos also helps students find relevance in the topics and introduces a sense of future career options. The experts in these videos include a college professor who explains the usefulness of these concepts nd how they pertain to specific career fields. Finally, a journal of events and ideas is kept by the students. The journal is known as a Noodle Novel. Each entry requires the students to take notes on their observations and ideas. These are discussed with the class as a whole are provide an outlet for the students to ponder any insights they might have. All documents and files are provided in Part 2 of the thesis.

CHAPTER 2

SCIENCE EDUCATION

Historically, science curriculum has been relayed to students via teachers through the most common instructional method: direct instruction. This type of teaching involves little work on the students' behalf and a large amount of load on the teacher (*1*). The instructor often teaches through lecture or assigns readings to the students. This method has been the gold standard for years with much research into the field on how to make direct instruction more effective (*1*). Direct instruction is pervasive in secondary and postsecondary education. Recent research has found that direct instruction has proven to be ineffective because of a fundamental flaw. This flaw is that students are not involved in the learning process, rather they are recipients of an influx of information which they typically reject (*2*). The key to direct instruction is that the student must be willing to learn and, if they choose this path, they are motivated to take notes and learn on their own. However, is it possible to teach a student science if they are generally unmotivated from a young age? Do instructors need to give up on these students?

That thought prevailed for centuries. Recently, psychological basis of learning has played a large role in aiding curriculum design. One of the fathers of the psychology of

learning was Piaget who advocated a constructivist approach to learning. This learning theory asserts that knowledge cannot be transmitted; it is constructed by the learner from interactions with people and materials (*3*). Further, learning builds upon prior knowledge and schemas. This completely debunks an instructional strategy that solely encompasses direct instruction. Years of research into this theory has shown over and over again that students engaged in the learning process are more likely to genuinely learn and retain the material. Recent policy changes in national standards advocate for the use of more hands-on activities in learning science. The goal is to get students to think and behave like scientist. The current educational system lacks in allowing students to test their abilities as scientists (*4*).

The idea of inquiry based lessons has been the forerunner in the evolution of science curriculum. Inquiry based instruction means that students are able to actively participate in the learning process. The role of the instructor is to guide and scaffold students to help them achieve the learning goals. Inquiry involves presenting a particular problem and allowing students to physically solve the problem using observations from experimentation (*1*). For example, instead of reciting Newton's second law of motion to the students, students actively perform laboratory activities. They are then assisted in understanding their results. Students are then led to find patterns in the data and come to the conclusion that force is equal to the product of mass and acceleration. Thus the students acted as scientists and "discovered" the law on their own. This helps students solidify concepts in their mind. Students are more likely to retain information that is meaningful to them. Thus inquiry enables students to not only appreciate science but also

participate in the scientific method and view science as a special way of knowing about the natural world (*5*). A very specific and novel method of inquiry is known as the 5-E model. This model, advocated by teacher preparation programs such as UTeach (University of Texas-Austin) and SKyTeach (Western Kentucky University), offers a template for how effective, inquiry-based lessons should be designed. The 5-E model has the following five sections engagement, exploration, explanation, elaboration, and evaluation. Utilizing this model effectively allows for students to be involved in the learning process by constructing new knowledge from their prior experiences and observations.

There are two major current approaches to changing science curriculum instructional methods to become more inquiry based. These two methods are guided inquiry (including open inquiry) and project based instruction. Each method will receive special focus in the following two sections to see how each method uses the idea of inquiry within the classroom to meet national students and promote better student learning. The guided inquiry focuses specifically on the design of laboratory experiments while project based instruction is a method for creating a longer unit building upon a central theme.

CHAPTER 3

GUIDED AND OPEN INQUIRY METHODS

The first major step in introducing inquiry into the classroom realm came with the introduction of guided inquiry based lessons from which another method grew: open inquiry based lessons. Both methods still allow for the use of the student to participate in the learning process by becoming involved and engaged in the material. Therefore, this has become an accepted way to modify curriculum so that it meets national standards and provides an overall "better" learning experience for the students (*4*). These methods specifically focus on laboratory experiments as becoming inquiry driven. Inquiry, in this method, means that the students are allowed to discover and experiment freely in order to obtain an understanding of the topic. Inquiry based lessons have already been produced and implemented in many classrooms across of the nation. A few sources used to describe this module of learning come from journal articles describing the implementation of this type of learning as well as student response (*4*). First, it is important to understand what is meant by guided and open inquiry. The guided inquiry focuses on the structure of laboratory experiments as a lesson within themselves. Each lab is a chance for the student to learn concepts but also for the instructor to implement various teaching strategies (*6*). The lab is designed so that the student does much of the

work while the teacher guides the students. Guidance occurs in the form of questioning strategies. The goal is for the students to use their observations and prior knowledge to build to the conclusion that the teacher wants the student to understand (*7*). However, the role of the teacher is instrumental in that they ask questions which allow students to make the desired connections. These questions typically fall in the format of "Why did this happen?" or "What do you think this means?"

The open inquiry process is fundamentally different because the role of the instructor is downplayed. Rather, the instructor is more of a facilitator who makes sure that progression is occurring. This method involves giving the students the purpose of a laboratory experiment and giving them materials available (*4*). It is now the student's job to effectively design a procedure and test it. From the data they obtain, conclusions are to be drawn. The instructor then brings the class together and formally discusses what was supposed to happen and the explanation of the results. This process requires students to think more deeply and become creative. In essence, they take on the role of a real scientist. While this may seem the best method, the major disadvantage is that the students will need ample amounts of time in order to correctly design a procedure and come to the right conclusions (*4*). Time is a precious resource that many secondary and postsecondary teachers do not have to spare.

When comparing these two methods, it was found that students prefer the guided inquiry overwhelmingly to the open inquiry (*4*). Further, it was found that after while students enjoy inquiry based laboratory experiments, the open inquiry method leads to a high level of frustration for learners. This data was taken from a study of 703 students general

chemistry course students comparing the two methods of instruction. Over 81% said that guided inquiries are easier to do and learn from (*4*). Many other questions were asked to these students and in every instance the majority of students preferred the guided inquiry to the open inquiry method. This was the only source used in this article that had such large favoring towards guided inquiry probably due to the large sample sizes. Many of the other sources focused specifically on a specific method and how the method had greater learning retention than direct instruction (*6*). As teachers attempt to adapt to the national standard progression towards inquiry style instruction, guided and open inquiry methods offer the advantage of fairly easy implementation and students find the lessons over all to be more engaging than direct instructional methods.

CHAPTER 4

PROJECT BASED INSTRUCTION

A second major way of modifying science curriculum is through the use of project based instruction (teacher's point of view) or project based learning (student's point of view). This method is yet another method for teachers to adopt changing national standard by creating a better learning environment for the students; allowing students to become engaged in their learning. Many sources used in this review provide a description of project based instruction and also different tactics to effectively use it. While many similarities exist between the application of project based instruction, this growing method still has many differing views on how it should take place (*8*). This review will focus on the method out lined by Marshall, Petrosino, & Martin (2010). This study was chosen because it allowed for a widespread survey involving a large participant pool including preservice, new, and experienced educators. Project based instruction places heavy emphasis on inquiry as well as student engagement like the previously mentioned methods; however, this method involves an entire lesson/unit instead of only laboratory components (*9*). In a typical unit, there is a grand challenge with an anchor scenario. This is provided so that students become invested in their education and they have a goal towards which they are working. The instructor creates this scenario and becomes

genuinely involved in the learning process with the students. Once this grand challenge has been established, students conduct multiple days of classroom experiments utilizing guided questioning strategies (*8*). The role of the instructor is to guide students to discovery and understanding. This method also involves direct instruction when the labs are finished. However, the direct instruction is modified by becoming a two way channel between the students and the teacher. Discussion about the lab results ad additional guidance from the teacher allows students to come to conclusion on their own which are reaffirmed by the instructor in a group setting. Each of these labs (and related instruction) corresponds to a different topic within the unit, all of which relate back to the grand challenge. The next step of the project based model is for students to conduct background research on the topic using outside resources. The students then come to present the topics within the unit to class to help solidify understanding of the concepts. Finally, the unit ends with students solving the grand challenge using the knowledge they have learned and presenting different solutions to their peers. The most important aspect of this model is that inquiry and investigation is used to help students become scientist (*5*). They use what they know to solve a problem.

The previous description is a summary of views of project based instruction from different sources. While the description of the unit is fairly similar among sources, differences exist in the specific methods. A few sources believe that preservice teachers are the best vehicle for delivery of this model because they can begin their career using it (*8*). Others believe that preservice teachers do not have the experience and older teachers are the best vehicle (*9*). Much of this debate lies with the role of the instructor because

project based instruction is heavily dependent on the instructor's creativity, flexibility, and mastery of content area to effectively model this method. However, all sources are in agreement that this model provides one of the greatest modes of teaching because students are engaged and involved in the learning process from beginning to end. The idea of a new grand challenge with each unit keeps instruction interesting and allows students to see how what they are learning can readily be applied to the real world. Project based instruction also relies heavily on collaboration between students in order to facilitate learning as described by the constructivist perspective. Students working together with a common goal leads to greater discussion. Students must look at science, then, from multiple views (their team members) and come to conclusions on what works and what does not (*8*). This has far reaching implications as students get a real perspective on science outside the classroom. Students are shown that scientist do not simply open a manual, find a lab and make discoveries. Scientists must look through resources, previous studies, and use their knowledge to come to an understanding on how something works. These conclusions are powerful because they provide long term retention for students (*8*). Thus, project based instruction is a complex but very useful strategy when attempting to modify instruction to become more inquiry based and engaging students.

CHAPTER 5

RATIONALE

This unit allows students to explore the central biological concepts of cellular transport in a novel way utilizing inquiry based investigations to draw conclusions from their observation. The National Science Education Standards asks that students "develop sophistication in their abilities and understanding of scientific inquiry." This unit is centered on the concept of inquiry guided instruction. Each laboratory activity builds upon the background knowledge of the students. The design and procedures of the experiments involve embedded questions which ask the students to analyze and make predictions based upon what they have done. These hypotheses are then tested and compared with actual results.

The concepts of diffusion and osmosis are central themes in biology. Many introductory biology (and chemistry) courses often gloss over this section. This leads to a rudimentary understanding for the students. The extent of required knowledge for most classrooms is for students to simply memorize the definition of these terms. As memorization ranks low on Bloom's Taxonomy, there is not a high level of understanding by the students. These concepts are often forgotten quickly. The major consequence of this type of action is that

students learn not to value the importance of cellular transport. As a student pursues further education in college, these ideas become central to the understanding of every biological concept. The idea that particles will preferentially move from an area of high concentration to an area of low concentration (diffusion) is essential to understanding muscle contraction, drug targeting, dehydration, temperature regulation, cellular respiration, and many other biological concepts. Because students do not receive a thorough education in these areas, it is often hard for students to truly grasp the reasoning behind the phenomena learned in later courses. Thus, they are forced to memorize concepts rather than grasp an understanding. This unit not only focuses on cellular transport in depth but it also helps students gain an understanding of cellular transport and resulting applications. Thus, this unit is crucial to developing the students' ability to learn concepts for understanding rather than memorizing.

This is the rationale for designing this unit. The pedagogy and classroom experiences provided to me over the past four years have led me to create a unit that can be utilized in the classroom. This unit contains laboratories that were designed specifically for the unit with specific questions that the instructor can ask. All equipment and resources are cost efficient and time efficient so that implementing this unit in a classroom is not a burden upon the teacher. The rewards reaped from spending time to prepare the laboratories will be worth any additional time spent in obtaining resources. The lesson plans also include adaptations available for students with exceptionalities and the wide use of instructional strategies is sure to meet most learning styles. The unit was designed with three goals in mind. The package must be easily implementable by the instructor, engaging to the

students, and provide formative and summative assessment data to the instructor. A combination of these three goals hopefully led to a product that will be effective and lead to increased retention of concepts.

CHAPTER 6

UNIT DESCRIPTION AND GOALS

Target Audience:

This inquiry based unit is designed for use in Biology I, Biology II, Chemistry I, or Chemistry II secondary classrooms. The unit pertains to biology in the area of cellular transport while describing mass transport in the chemistry field.

Unit Description:

This unit on cellular transport is designed to span 15 classroom periods of 45 minutes. However, more or less time can be devoted to the unit based upon the amount of research that can be done outside of class. The unit consists of four major content topics: diffusion, semipermeability, osmosis, and cellular applications. Six days of the unit will be dedicated to instructional time and laboratory work. Four days will be devoted to action research and student presentations of advanced topics related to the key concepts of the lesson (osmosis and diffusion, reverse osmosis, effect of drinking salt water, desalinization process). Three days will be devoted to the "Go Public" Challenge. Students will have time to conduct research in order to come to a conclusion as to why

fish can survive in salt water but humans can not drink salt water (Grand Challenge). Students are required to use the topics discussed in the unit as well as incorporate additional, outside information and give a presentation in the form of a press conference, news report, or closing argument. Formative and informative assessments will be interspersed throughout the unit.

The unit centers on the concept of cellular/mass transport, specifically the passive transport mechanisms of diffusion and osmosis. The key link between these concepts is another concept: semipermeability of membranes. The diffusion lesson consists of 1 lab containing 1 experiment, semipermeability lesson consists of 1 lab with 3 experiments, and the osmosis lesson contains 1 lab with 3 experiments. The experiments are different trials within a lab. All experiments are original and have been created solely for the purposes of this unit. Each lab is easy to prepare utilizing cost-effective materials. The central theme arching over the unit is the Grand Challenge. Students are given a scenario of a man who dies due to drinking salt water. The students are to determine why the salt water may have led to death. However, the students are also informed that there are many marine species that survive in salt water and drink it regularly; why does the salinity not lead to death for them? This is the challenge that students are asked to investigate. The answer to this question will involve a strong understanding of the fundamental principles of mass transport. Students are also asked to create an action research presentation where they delve independently (as groups) into a specific area within this scenario. The final product will be for the students to present why and how salt water was the cause of death of the man but did not affect the fish. All students will make a video recording of their

presentation and upload them to YouTube. The best presentation will be shown to the class. The project will culminate with a final formal assessment.

Unit Goals:

The underlying science behind this unit of study is cellular transport. Cellular transport can occur in many ways but this unit specifically focuses on passive transport or the movement of particles in a mode that does not require the expenditure of energy. This type of motion is governed by a differential in energy states. A particle will try to achieve and overall lower state of energy. In this topic of study, the energy differential correlates with a difference in concentration. Each lesson in this unit helps student build up a foundational knowledge in order to understand the topic as a whole rather than as parts. The first lesson in the sequence is over diffusion. This is one of the simplest and easiest to understand methods of cellular transport. As students are attempting to grasp the concepts, laboratory experiments and expert opinions will help facilitate the understanding. The next lesson builds upon diffusion by having the students assume that there is a barrier between the regions of high and low concentration. In this case, the solute particles are no longer able to travel. Students will learn about what it means for a barrier to be completely permeable, impermeable, and semipermeable. The focus of this lesson lies on the understanding of semipermeability. This will later be used to connect to another lesson: osmosis. If the solute cannot move through the barrier, the solvent will move in order to equalize the gradient thus bringing the system to a lower energy state. This will help students build upon the previously learned ideas and connect them to

newer concepts such as osmosis. Once again, labs and expert opinions will be used to supplement the learning. The unit also contains two large projects: the action research and the go public challenge. The action research will allow students to conduct research that allows them to dig deeper into the topics discussed in the unit. They will also be able to see how these topics are utilized in the commercial industries and how they affect normal human life. The go public challenge allows the students to connect back to the Grand Challenge which was stated at the beginning of the unit. The students must use the knowledge gained from this unit of students along with more outside resources to solve the original problem. This ties the entire unit together.

The objectives chosen for this unit are specific to each lesson. The objectives include the ability to understand, define, use, and apply content knowledge. Other objectives chosen specifically apply to important skills students will need to learn in order to be successful in the future such as collaborating with others, problem solving, teamwork, using technology to researching, communicating orally and through writing, and presentation skills. Thus this unit is not only solely used to teach the students about cellular transport; students will be able to make sense of the knowledge and gain a thorough understanding while utilizing a variety of learning techniques.

CHAPTER 7

CHALLENGES AND SOLUTIONS

When this project was being developed on paper, challenges were expected and accounted for. However, it soon became clear that challenges were impossible to predict. It seems that everything that should work in theory, somehow, did not seem to work in practice. Furthermore, the need for being cost effective and time efficient led to even more challenges. These challenges were resolved after much collaboration, trial and error scenarios, and pure frustration.

The content to be covered in this unit was a fairly simple process to incorporate. The goal of this unit was not to teach some bizarre, obscure concept; the concepts were well known, easy to account for (curriculum wise), and fairly straight forward. It was decided very early on in the process that diffusion would be taught first and then osmosis. As research into these topics progressed, it was evident that these stand alone topics needed to be related to one another. This relationship was simple: semipermebability. Using this concept as a bridge would seemingly make it easier to form connections between diffusion and osmosis. Thus, semipermeability because the integrating concept of the entire unit. Once all the information and research was completed on these three

topics, designing the interactive discussion was straight forward following the 5-E format. The lessons were then easily adapted into the Legacy Cycle to develop an effective unit of instruction.

The major challenges were approaching quickly: designing the laboratories. Each laboratory activity needs to incorporate hands-on student involvement with results that accurately show the concepts being investigated. The activities must allow students to make predictions, test their predictions, and make observations that can be used to come to a conclusion. Further, the students must be able to extend their results to real world applications.

The first major challenge was creating an effective semipermeability model to show the students. The original prototype, after weeks of hard work, was a demonstration tank. The left and right portion was separated by a foam board with multiple holes of a specific size. Items smaller than the holes filled one side of the tank while items larger than the holes filled the other side. The model was shaken to show the semipermeable nature of the membrane: only certain particles could move through while others could not. This model worked very well and showed the concepts very accurately. After much thought, it was determined that, while this model works, it is not in the true spirit of the unit. A model that the students are shown is not appropriate for an inquiry-based lesson. Thus, the tank was rejected and a brainstorming and collaborative session ensued. An activity was needed so that the students were participating rather than watching, however, the models must be easy to make and cheap to construct. A very effective solution was

reached. Two baby food jars were glued together at the lids. A drill bored holes into the double lids of specific sizes. Each group would get a lid setup with differing holes. Items were selected and filled the two baby food jars so that when shaken the desired effect occurred. This is the Shakers equipment. Each group will have differing results based on the hole size and the materials filling the jars. Students are to make prediction before the activity and monitor the effects during and after shaking. This allows students to use key vocabulary words to describe their observations and come to conclusions about their setup. This activity is followed by a class presentation in which the groups discuss their findings. Overall, the simple tank model was redesigned to become an inquiry-based activity performed by the students.

The biggest challenge in this unit was finding the most appropriate material to demonstrate osmosis. The original idea was to connect two soda bottles by the spouts with a membrane in between. A concentrated solution would fill one side while a dilute solution would be on the other side. Students would visualize the movement of water by a color change. This idea did not work very well because a suitable membrane could not be found. The membranes employed were completely permeable to the contents on both sides so osmosis was not actually occurring. This was a big letdown because the model had taken weeks of planning and brainstorming. After weeks more of planning and research, a reverse osmosis membrane was specially ordered from a company. This was a fail-proof method to show osmosis with the dual bottle setup. After tweaking the designs, this setup turned to work out. Osmosis was accurately demonstrated and a color change was apparent. However, there were severe issues. First, this method required the teacher

to special order a membrane for each model. This is not every economical or convenient for a high school teacher. Second, the osmotic pressure was not great enough to lead to a quick osmosis effect. The model took about five days to result in a noticeable difference. This is not very exciting for the students nor is it an inquiry-rich investigation. Thus, this model was rejected. Months of planning ensued when a decision was finally reached. The entire model design was scrapped and a new idea was in the works. This idea required sausage casing as the carrier. The casing would be easy to obtain and very cheap to purchase. The use of a sugar solution would eliminate the need for coloring dyes. This design was tested and worked amazingly well. There was a noticeable difference in pressure and volume. Now, the students had an object they could manipulate with their hands and see an accurate representation of osmosis. This was the most challenging problem; however the solution proved to be better than anything thought possible.

While these challenges may have greatly prolonged the completion of this project, the rewards of the solution process were invaluable. The failures of the original models led to an increase in the creativity and perspective approach to accomplishing the goals. To find solution, collaboration with advisors and peers was required along with contacting people in industrial and educational fields for their opinions. The amount of problem solving skills required have stretched my abilities to levels they have not been before. I have become a much better scientist and critical thinking due to the challenges posed by my thesis project.

CHAPTER 8

REFLECTION

In an effort to move away from traditional direct instruction and align with more modern curriculum standards, I have taken an inquiry-based approach in teaching an essential set of topics in biology and chemistry. It is important that students master these fundamental skills so that they will have a foundation to construct new knowledge upon as they progress through subsequent topics in their current and future courses. This unit is designed to hopefully improve the retention and comprehension of diffusion, semipermeability, and osmosis. By embedding these concepts in the project based instruction (Legacy Cycle) format, students are able to utilize the topics they learn and synthesize an argument for a grand challenge. This argument will require student to find the importance of the topics they are learning and relate them to real world scenarios. This project has taken me close to four semesters to complete from envisioning the project in my mind to producing a final product along with a thesis. I had to utilize all the concepts and experiences that I have had the opportunity to learn in the past four years of my undergraduate career at Western Kentucky University. This seemed to be the most appropriate topic for me because it combined two of my passions: chemistry and education.

There were many lessons that I learned throughout the process of completing the project. First, I learned what it means to be a scientist. Results do not occur overnight; a project can take on weeks to months of planning, preparing, trials, and modifications. It is so important to keep an open mind about the project. My lessons and laboratories required constant readjustments. I was even forced to completely throw out an original prototype and start over. This process can be very frustrating and often times seem impossible. Though, perseverance and the will to have a finished product led to a final completion that I am proud of. The end project makes all the effort and time spent on the thesis worth it because I feel that I have culminated my undergraduate experience with a significant work. I have also learned from this project the importance of collaboration with advisors, peers, and other who are experts in the field. I would be nowhere near a completed unit if not for the support and advice of these people. Often when I am stuck with an idea that is not working, it is another perspective that enters the scene that helps me move past the mind block. Collaborating with others is an essential part of any scientific research process; the skills and knowledge of others can be a useful aspect to help further my own ability.

Although I am finished with this project, I have aspirations to move forward with this work. I would like to see the unit implemented in a classroom setting. Assessments would help me see if there is a significant gain in knowledge when using this unit of instruction as opposed to a control setting which receives the typical direct instructional approach. This data would truly help me determine the effectiveness of the unit so that I know if all my objectives were accomplished. Along with this unit, I hope to continue

work in the field of chemical education in the future. I enjoy creating laboratory activities as well as class presentations to promote an inquiry-based approach to learning. My goal is to create a book or manual of activities that high school teachers can quickly and easily employ in their classrooms. Once again, cost and time efficiency are the most important guidelines for any project that I accomplish. Overall, my goal is to move away from students being passive in the learning process. Instructors must take the time to develop lessons that require students to take an active role in their learning and make the concepts more meaningful. Students are to use their observations and critical thinking skills to come to conclusions that help generalize their results. Thus students must not simply memorize learn the results of scientists, students must be the scientist who use investigation and inquiries in order learn concepts and provide a real world basis for their learning. This should be the goal of an effective instructor: create an effective lesson/unit that fosters the growth of students' interest in the science fields.

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PART 2:

The Unit of Instruction

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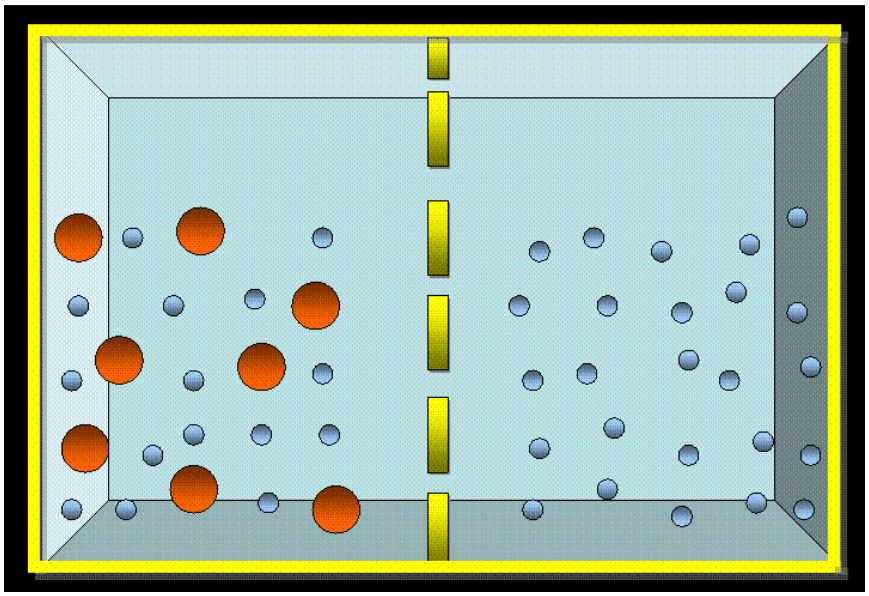
Cellular Transport

Diffusion, Semipermeability, and Osmosis



Amar Patel

SKyTeach Program

Department of Chemistry

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Acknowledgements

The author would like to thank the following individuals for assistance in the development of this unit:

1) Dr. Les Pesterfield – Department of Chemistry – Professor
2) Dr. Martha Day – SKyTeach Program – Co-director
3) Lee Ann Smith – SKyTeach Program – Master Teacher
4) Melissa Rudloff – SKyTeach Program – Master Teacher
5) Alicia McDaniel – Chemistry Department – Chemical Supplies Manager
6) Dr. Darwin Dahl – Chemistry Department – Expert Opinion on Osmosis
7) Noah Rudloff – Anchor Video Actor
8) Halle Rudloff – Anchor Video Actress

SMED 470: Project Based Instruction (PBI)

This course description is adopted completely from the syllabus provided at the beginning of the course by the instructors.

Course Description:

PBI has three essential components:

- Theory-driven perspective: Students learn about how people learn and how project-based instruction may be among our most informed classroom learning environments for bridging the gap between theory and practice.
- Instructional Development: Technological and pedagogical content knowledge are developed as UTeach students work toward the design of project-based units. Competency is continually built as students read about and discuss the principles of PBI; reflect on observations of project-based learning environments in high school settings; and incorporate what they are learning into the design of problem-based lessons and ultimately, an entire project-based unit.
- Field Experience: An intensive field component includes observation of well-implemented project-based instruction in local schools as well as implementation of problem-based lessons with area high school students on a study field trip.

Rationale:

PBI is designed to provide the teacher candidate with knowledge, skills, and attitudes which enable them to transmit knowledge required for STEM (Science, Technology, Engineering & Mathematics) literacy to their students and to assist each teacher with his/her own achievement of the Kentucky Teacher Standards for Preparation and Certification**.** Project-based instruction engages learners in exploring authentic, important, and meaningful questions of real concern to students. Through a dynamic process of investigation and collaboration and using the same processes and technologies that real scientists, applied mathematicians and engineers use, students work in teams to formulate questions, make predictions, design investigations, collect and analyze data, make products and share ideas. Students learn fundamental science and mathematical concepts and principles that they apply to their daily lives. Project-based instruction helps all students regardless of culture, race, or gender engage in learning.

Project Description

Target Audience:

This inquiry based unit is designed for use in Biology I, Biology II, Chemistry I, or Chemistry II secondary classrooms. The unit pertains to biology in the area of cellular transport while describing mass transport in the chemistry field.

Project:

This unit on cellular transport is designed to span 15 classroom periods of 45 minutes. However, more or less time can be devoted to the unit based upon the amount of research that can be done outside of class. The unit consists of four major content topics: diffusion, semipermeability, osmosis, and cellular applications. Six days of the unit will be dedicated to instructional time and laboratory work. Four days will be devoted to action research and student presentations of advanced topics related to the key concepts of the lesson (osmosis and diffusion, reverse osmosis, effect of drinking salt water, desalinization process). Three days will be devoted to the "Go Public" Challenge. Students will have time to conduct research in order to come to a conclusion as to why fish can survive in salt water but humans can not drink salt water (Grand Challenge). Students are required to use the topics discussed in the unit as well as incorporate additional, outside information and give a presentation in the form of a press conference, news report, or closing argument. Formative and informative assessments will be interspersed throughout the unit.

The unit centers on the concept of cellular/mass transport, specifically the passive transport mechanisms of diffusion and osmosis. The key link between these concepts is another concept: semipermeability of membranes. The diffusion lesson consists of 1 lab

containing 1 experiment, semipermeability lesson consists of 1 lab with 3 experiments, and the osmosis lesson contains 1 lab with 3 experiments. The experiments are different trials within a lab. All experiments are original and have been created solely for the purposes of this unit. Each lab is easy to prepare utilizing cost-effective materials. The central theme arching over the unit is the Grand Challenge. Students are given a scenario of a man who dies due to drinking salt water. The students are to determine why the salt water may have led to death. However, the students are also informed that there are many marine species that survive in salt water and drink it regularly; why does the salinity not lead to death for them? This is the challenge that students are asked to investigate. The answer to this question will involve a strong understanding of the fundamental principles of mass transport. Students are also asked to create an action research presentation where they delve independently (as groups) into a specific area within this scenario. The final product will be for the students to present why and how salt water was the cause of death of the man but did not affect the fish. All students will make a video recording of their presentation and upload them to YouTube. The best presentation will be shown to the class. The project will culminate with a final formal assessment.

Driving Question/Grand Challenge

Cells in the human body and in the bodies of all living things behave like microscopic bags of solution housed in a semipermeable membrane. The health and indeed the very survival of a person, animal, or plant depend on the ability of the cells to maintain their concentration of solutes.

One illustration involving salt water demonstrating how osmosis can produce disastrous effects in living things is the process that occurs when a person drinks salt water. The body can handle a little bit, but if you were to consume nothing but salt water for a period of a few days, as in the case of being stranded on the proverbial desert island, the osmotic pressure would begin drawing water from other parts of your body. Since a human body ranges from 60% water (in an adult male) to 85% in a baby, there would be a great deal of water available—but just as clearly, water is the essential ingredient in the human body. If you continued to ingest salt water, you would eventually experience dehydration and die.

On a beautiful, sunny Friday in late June, your neighbor decides to take your sailboat on a weekend get-a-way to a desert island you had found the summer before. In preparation, he decides not to pack a whole lot because he was only going to be staying one night. On Saturday morning he loads his boat and sets sail! It takes him just about the entire day to get to the island, and as he is about to anchor his boat a freak tidal wave engulfs him and the boat and everything in it. The boat is destroyed! All he is left with is the clothes on his body; everything else gets swept out to sea. The only thing he can do is sit and hope someone comes looking for him.

The first thing he thinks about is what he is going to eat and drink to survive. There are plenty of fish swimming around to catch and eat, but what is he going to drink? After thinking about it for a while, he decides that the only thing he can do is drink the water in the ocean. He sees all the animals in the water and how they are surviving so he comes to the conclusion that the water would be safe to drink.

After a few days he starts to become weak, and his body starts to shrivel. He eventually dies, even though he had plenty to eat and drink, or did he have enough to drink? Why are the animals in the ocean able to live off the same water that your neighbor could not?

Project Goals

The underlying science behind this unit of study is cellular transport. Cellular transport can occur in many ways but this unit specifically focuses on passive transport or the movement of particles in a mode that does not require the expenditure of energy. This type of motion is governed by a differential in energy states. A particle will try to achieve and overall lower state of energy. In this topic of study, the energy differential correlates with a difference in concentration. Each lesson in this unit helps student build up a foundational knowledge in order to understand the topic as a whole rather than as parts. The first lesson in the sequence is over diffusion. This is one of the simplest and easiest to understand methods of cellular transport. As students are attempting to grasp the concepts, laboratory experiments and expert opinions will help facilitate the understanding. The next lesson builds upon diffusion by having the students assume that there is a barrier between the regions of high and low concentration. In this case, the solute particles are no longer able to travel. Students will learn about what it means for a barrier to be completely permeable, impermeable, and semipermeable. The focus of this lesson lies on the understanding of semipermeability. This will later be used to connect to another lesson: osmosis. If the solute cannot move through the barrier, the solvent will move in order to equalize the gradient thus bringing the system to a lower energy state. This will help students build upon the previously learned ideas and connect them to newer concepts such as osmosis. Once again, labs and expert opinions will be used to supplement the learning. The unit also contains two large projects: the action research and the go public challenge. The action research will allow students to conduct research that allows them to dig deeper into the topics discussed in the unit. They will also be able to see how these topic are utilized in the commercial industries and how they affect normal human life. The go public challenge allows the students to connect back to the Grand Challenge which was stated at the beginning of the unit. The

students must use the knowledge gained from this unit of students along with more outside resources to solve the original problem. This ties the entire unit together. The objectives chosen for this unit are specific to each lesson. The objectives include the ability to understand, define, use, and apply content knowledge. Other objectives chosen specifically apply to important skills students will need to learn in order to be successful in the future such as collaborating with others, problem solving, teamwork, using technology to researching, communicating orally and through writing, and presentation skills. Thus this unit is not only solely used to teach the students about cellular transport; students will be able to make sense of the knowledge and gain a thorough understanding while utilizing a variety of learning techniques.

Project Objectives

Students will be able to…

- Communicate the grand challenge problem, process, and solution.
- Evaluate the grand challenge solution and its consequences.
- Conduct scientific investigations with minimal assistance from instructors.
- Use technology to improve investigations and communications.
- Conduct independent research on specific topics in relation to the unit as a whole.
- Recognize and analyze alternative explanations and models.
- Scientifically formulate possibilities describing any unforeseen errors with laboratory procedures/data.
- Describe similarities and differences between diffusion and osmosis.
- Explain how concentration differences affect the overall flow of molecules.
- Discover that molecules will diffuse through membranes.
- Discover that the size of molecules will affect their ability to cross membranes.
- Examine how concentration gradients determine the direction of diffusion.
- Create their own example of diffusion.
- Predict the motion of water based on the definition of osmosis.
- Differentiate between a hypotonic, hypertonic, and isotonic solution.
- Predict the effect of differing solutions on cellular structure.
- Predict the movement of particles based on membrane pore size.
- Synthesize real world metaphors in which there is a barrier that is completely permeable, semi permeable, and impermeable.
- Construct their own laboratory procedure to test diffusion, osmosis, and permeability.
- Connect laboratory observations to definitions and concepts.
- Describe reverse osmosis and methods utilized for making salt water potable.
- Effectively present their findings utilizing oral communication skills.
- Collaborate with group members to arrive at common solutions.
- Practice effective teamwork strategies to reach a common goal.

Rationale

This unit allows students to explore the central biological concepts of cellular transport in a novel way utilizing inquiry based investigations to draw conclusions from their observation. The National Science Education Standards asks that students "develop sophistication in their abilities and understanding of scientific inquiry." This unit is centered on the concept of inquiry guided instruction. Each laboratory activity builds upon the background knowledge of the students. The design and procedures of the experiments involve embedded questions which ask the students to analyze and make predictions based upon what they have done. These hypotheses are then tested and compared with actual results.

The concepts of diffusion and osmosis are central themes in biology. Many introductory biology (and chemistry) courses often gloss over this section. This leads to a rudimentary understanding for the students. The extent of required knowledge for most classrooms is for students to simply memorize the definition of these terms. As memorization ranks low on Bloom's Taxonomy, there is not a high level of understanding by the students. These concepts are often forgotten quickly. The major consequence of this type of action is that students learn not to value the importance of cellular transport. As a student pursues further education in college, these ideas become central to the understanding of every biological concept. The idea that particles will preferentially move from an area of high concentration to an area of low concentration (diffusion) is essential to understanding muscle contraction, drug targeting, dehydration, temperature regulation, cellular respiration, and many other biological concepts. Because students do not receive a thorough education in these areas, it is often hard for students to truly grasp the reasoning behind the phenomena learned in later courses. Thus, they are forced to memorize concepts rather than grasp an understanding. This unit not only focuses

on cellular transport in depth but it also helps students gain an understanding of cellular transport and resulting applications. Thus this unit is crucial to developing the students' ability to learn concepts for understanding rather than memorizing.

Background

As this is one of the first topics discussed in introductory biology, students do need to have a strong background in biology nor are they required to have a strong amount of background knowledge about cellular transport. However, students will probably recall hearing the terms diffusion, semipermeability, and osmosis from middle school science courses. By the end of the unit, students should understand the basics of cellular transport and the factor governing the direction of movement. Some fundamental skills will be necessary for this unit. The unit consists of conducting independent research so students will need to be literate in internet-based research. Students should also have the ability to communicate well, orally and on paper, in order to meet the presentation demands of the unit. Students must also have practice in performing laboratory and the related behaviors which are expected. Finally, students must understand the scientific process and be able to make hypotheses and determine whether laboratory results warrant the acceptance or rejection of that hypothesis.

Teachers need to have a strong grasp on the fundamental ideas of diffusion, semipermeability, and osmosis. Diffusion is the movement of particles from areas of high particle concentration to areas of low particle concentration. It is important to note that diffusion is concerned with the movement of particles. An example used within the unit is dropping a sugar cube into a container of water. Initially, there is high concentration of sugar in the cube form and low concentration of sugar particles in the open water. Thus, the sugar will spread out from the cube center as governed by diffusion. The teacher will need to explain that the reason for diffusion is to equilibrate concentration gradient. In other words, diffusion will continue to occur until there is no difference in concentration in the system. The next topic to consider is the role of a barrier placed in between a region of high concentration and low concentration. The barrier prevents particles from traveling from high to low if the pores in the barrier are smaller than the particle size. This introduces the idea of permeability. A membrane can be completely permeable, semipermeable, or impermeable to the particles in a system. Cell membranes are semipermeable in that most objects are too large to pass through the membrane to the internal environment of the cell. Often water will be the only particle that can travel. In the special case where the pores in a membrane/barrier do not allow solute particles to pass through but do allow water (solvent) molecules to pass, osmosis will occur to equilibrate the concentration gradient. Osmosis is the

movement of water from areas of low particle concentration to areas of high particle concentration. This term is focused on the movement of water. The reason for this motion is that water will move through the barrier to the high concentration side. This will dilute that side and bring the concentration closer to that of the more dilute side. Eventually, there will be no difference in concentration assuming that there is enough water. It is important to note that the movement of water will cause a physical change in volume that can be measured or observed as will be done in the osmosis lab.

The application of osmosis is discussed through the use of cells. Cell membranes are permeable to water so water can easily travel back and forth. If a cell is placed into pure water, the direction of water movement due to osmosis can be predicted. The inside of the cell is more concentrated than the pure solution so water will move, as described by osmosis, move into the cell causing the cell to bloat. Thus, the cell is placed in a hypotonic solution. The opposite of this situation is a hypertonic solution in which the cell will shrivel due to water moving out of the cell into a more concentrated solution. Finally, if the solution that the cell is placed in is the same concentration as the cell then the solution is called isotonic and there will be no change in cell size.

Go Public Presentation

At the conclusion of the mass transport unit over diffusion, osmosis, and semi permeability, students will be required to present findings for their explanation to the grand challenge question. The students will be split into groups of three to four students to conduct research about the similarities and differences of human cells and fish cells. During the research, students will need to analyze the characteristics of a fish cell in salt water and determine how the cell is able to survive in salt water. The students will need to do the same research for the human cell. After the research, the student groups must reach conclusions and report their findings to their peers in one of three different ways. The students will have a choice of developing a press conference, breaking news report, or skit/video. The presentations will incorporate the topics that were studied in a way in which they must use the evidence found and reasoning in order to argue their conclusions. With their evidence and conclusions, the presentations must be organized and original as explained in the rubric. The instructor will also review presentation skills in class during the period before the presentation. Presentations will occur in the evening with parents, school and city officials, and peers invited to attend.

Go Public Challenge

Name:_____

TASK: Create an informational…

a. Press Conference
b. Breaking News Report
c. Skit/Video

…that brings the Grand Challenge to a conclusion.

Let's revisit the Grand Challenge: Your neighbor is stranded on a desert island and has nothing to drink but the salt water around him. He eventually dies because he drank too much salt water. Why are the fish able to *live* in the same water that a human cannot drink?

TARGET AUDIENCE: The general public

REQUIRED CONTENT:

1. How salt effects a red blood cell
2. How the process of osmosis effects the red blood cell in salt
3. How the cell of a fish differs from that of a human
4. The differences in cell make-up between fish and humans

FINAL PRODUCT: Either…

a) Conduct a press conference that explains how the victim died and the causes of the death
b) Conduct a breaking news report that unveils where the victim was found and under what circumstances he was living and how those circumstances caused his death
c) Conduct a video viewing session explaining the death of the victim followed by a Q&A seminar

EVALUATION:

RUBRIC

	Beginning (0-6)	**Developing (7)**	**Proficient (8)**	**Advanced (9-10)**
Presentation	Delivery not smooth and audience attention often lost.	Delivery not smooth, but able to maintain interest of the audience most of the time.	Rehearsed with fairly smooth delivery that holds audience attention most of the time.	Well-rehearsed with smooth delivery that holds audience attention.
Requirements	Inadequate representation of the Go Public Challenge	Fair representation of the Go Public Challenge	Good representation of the Go Public Challenge	Excellent representation of the Go Public Challenge
Attractiveness	Use of font, color, graphics, effects etc. but these often distract from the presentation content.	Make use of font, color, graphics, effects etc. but occasionally these detract from the presentation content	Makes good use of font, color, graphics, effects etc. to enhance the presentation	Makes excellent use font, color, graphics, effects etc. to enhance the presentation
Time Allotment	Presentation exceeds 6 minutes or is less than 4 minutes and 15 seconds	Presentation is 5 minutes and 31 seconds to 6 minutes	Presentation is 5 minutes and 1 second to 5 minutes and 30 seconds	Presentation is within the 4 minutes and 15 seconds to 5 minute range
Originality	No evidence of original thinking	Little evidence of original thinking	Product shows some original thought; work shows new ideas and insight	Product shows a large amount of original thought; ideas are creative and inventive
TOTAL SCORE (50)x4				

Core Standards

I. National Science Education Standards

Content Standard A

As a result of activities in grades 9–12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard C

As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Cells have particular structures that underlie their functions. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and the storage of genetic material.

Content Standard E

As a result of activities in grades 9-12, all students should develop

- Abilities of technological design
- Understandings about science and technology

II. Kentucky Core Content

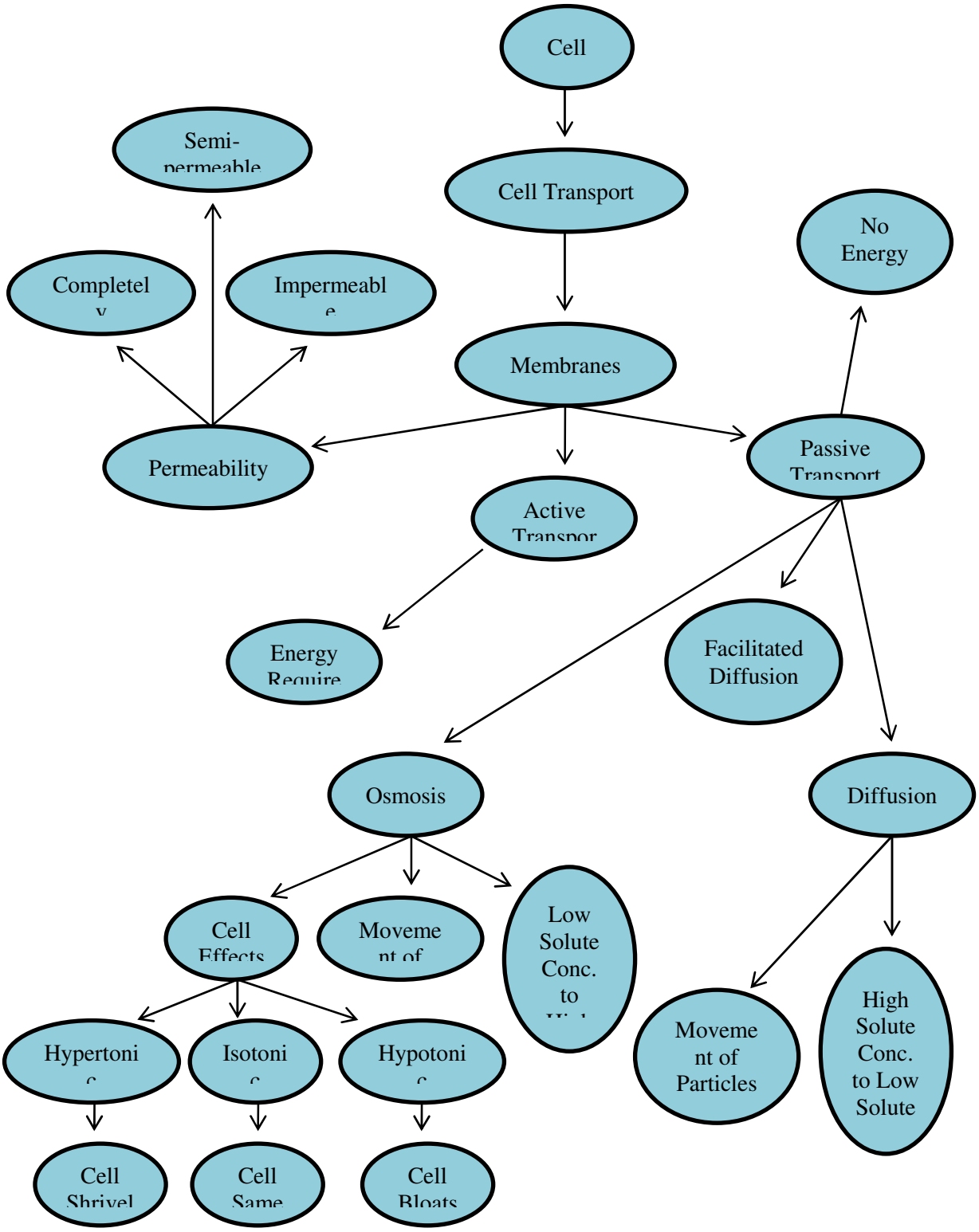
1. SC-H-UD-S-8
   Students will describe the processes by which cells maintain their internal environments within acceptable limits

2. SC-HS-3.4.3
   Students will:
   - describe cell regulation (enzyme function, diffusion, osmosis, homeostasis);
   - predict consequences of internal/external environmental change on cell function/regulation.

   Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through selective expression of individual genes. This regulation allows cells to respond to their internal and external environments and to control and coordinate cell growth and division.

3. SC-H-UD-U-2
   Students will understand that within every cell are specialized parts for the transport of materials, energy transfer, protein building, waste disposal, information feedback and even movement. In addition, most cells in multi-cellular organisms perform specialized functions that others do not.

Cell Transport Unit Concept Map



Unit Timeline

Day	Lesson Title	In-Class Activity
1	Pre-Assessment and Unit Introduction	Students will complete a pre-assessment. Teacher will show anchor video. Grand Challenge will be introduced. Students will have a generate ideas Noodle Novel homework assignment.
2	Diffusion I	Student will discuss their generate ideas assignment in groups. The teacher will lead a class discussion over the generate ideas assignment. Students will complete part 1 of the Noodle Novel diffusion lab. Students will work individually. Teacher will lead a discussion over diffusion using PowerPoint. Students will have guided notes along with the PowerPoint. Students will complete part 2 of the Noodle Novel diffusion lab. Students will work individually. Students will be given a diffusion concept homework assignment.
3	Diffusion II and Semipermeability I	Teacher will collect diffusion concept homework assignment. Students will complete part 3 of the Noodle Novel diffusion lab. Students will work individually. Teacher will review diffusion in

		class discussion. Teacher will lead a discussion over the role of barriers and membranes. Students will complete part 1 of the Noodle Novel semipermeability casing lab. Students will work in assigned groups. Student will complete the formal Shakers lab.
4	Semipermeability II	Teacher will lead a discussion on semipermeability using PowerPoint. Students will present their findings from the Shakers lab. Students will complete part 2 of the Noodle Novel semipermeability casing lab. Teacher will lead a class discussion on the results from the Shakers lab. Teacher will show an expert opinion video over diffusion. Students will complete Noodle Novel along with the video. For homework, students will read the osmosis and semipermeability section in their textbooks. Students will be required to write a one paragraph summary of the text.
5	Osmosis I	Teacher will take up homework from the previous night. Students will be engaged into the osmosis topic. An alternate

		scenario of the Shakers lab will be proposed. Students will complete part 1 of the Noodle Novel osmosis lab. Students will work in assigned groups. Teacher will show an expert opinion video over osmosis. Students will have a Noodle Novel to complete with the video. For homework, students will read the osmosis section in their textbooks. Students will be required to write a one paragraph summary of the text.
6	Osmosis II and Cellular Applications	Teacher will take up homework from the previous night. Students will complete part 2 of the Noodle Novel osmosis lab. Teacher will lead a discussion on osmosis with PowerPoint. Students will complete guided notes along with the PowerPoint. Teacher will extend discussion of osmosis to cellular applications. Students will have a worksheet that will be completed during the discussion. Students will complete the osmosis concept assignment for homework.
7	Action Research Introduction	Teacher will take up homework from the previous night. Teacher will introduce the Action Research project and explain the rubric.

		Students will have three Noodle Novel assignments to complete for homework.
8	Action Research Investigation	Students will meet in the computer lab. This day is devoted for research.
9	Action Research Presentation Preparation	Students will meet in the computer lab to finish researching and complete the presentation design.
10	Action Research Presentation	Students will present their Action Research and have time for questions and answers. Students not presenting will have a Noodle Novel to complete during presentations
11	Independent Review and Fish Physiology	Teacher will lead a discussion about the physiology of fish connecting to the concepts of osmosis and diffusion. Students will be given a study guide over the entire unit of instruction. Students may work individually or in small groups to complete study guide. Teacher will assist students as needed. Teacher will show an expert opinion video over the effects of salt on the human body. Students will have Noodle Novel to complete with the video. Students will need to complete study guide for homework.
12	Go Public Challenge Introduction	Teacher will answer any questions from the study guide. Teacher will take up homework from the previous night.

		Teacher will reintroduce Grand Challenge to the students. Teacher will go over the Go Public Challenge and rubric. Students will be put into assigned groups and will brainstorm any initial ideas. Students will have a Noodle Novel to complete in their groups.
13	Go Public Challenge Research	Students will meet in the computer lab. This day is devoted for research.
14	Go Public Challenge Presentation Preparation	Students will meet in the computer lab. This day is devoted for research.
15	Day: Go Public Challenge Presentation Practice Night: Go Public Challenge Presentations	Day: Students will create and practice their presentations. Teacher will lead a discussion on presentation skills. Teacher will approve all presentations. Night: Go Public Presentations!

Master Resource List

Day 1:

- 25 Pre-Assessment
- Anchor Video/Grand Challenge Video
- 25 Noodle Novel Entry 1: Video Analysis Sheet
- 25 Noodle Novel Entry 2: Generate Ideas

Day 2:

- 25 Noodle Novel Entry 3: Diffusion Lab
- 25 Diffusion Guided Notes Sheet
- PowerPoint Presentation Slide Number 1-7
- 25 plastic cups
- 5 grams Agrosoke
- Food coloring
- Water
- Paper towel rolls

Day 3:

- 25 Noodle Novel Entry 4: Semipermeable Casing Lab
- 25 Shakers Formal Lab
- PowerPoint Presentation Slide Number 8-10
- 8 sausage casing
- RIT Dye (clothing dye)
- 8 syringes
- 8 tubs
- food coloring
- water
- string roll
- 8 scissors
- 8 plastic cup

Day 4:

- 25 Noodle Novel Entry 5: Expert Opinion Diffusion
- PowerPoint Presentation Slide Number 11-13

Days 5-6:

- 1 timer
- 5 permanent markers
- 11 graduated cylinders
- 5 syringes
- 15 plastic tubs
- 3 scissors
- 3 rulers
- 3 rolls of string
- 15 sausage casings (cut 13 cm in lengths and soaked in water before use)
- 5.5 liters water
- 1.5 liters sugar water (~1.3 M, 0.750 kg table sugar in 1.125 liters water)
- PowerPoint Presentation Slide Number 14-18
- 25 Osmosis Guided Notes
- 25 Osmosis Lab Procedures
- 25 Noodle Novel Expert Opinion Entry 6
- 25 Cellular Application Guided Notes
- 25 Osmosis/Cell Concept Homework Assessment (evaluation sheets).

Days 7-10:

- Access to the internet (computer lab).
- Access to Microsoft Word (Word Processor).
- Access to Microsoft PowerPoint.
- Access to library references.
- 8 Post-It pads.
- 25 action research prompts.

Day 11:

- 25 Study Guide Worksheet (to be made during class)
- 25 Noodle Novel Entry 5: Expert Opinion Effect of Salt on the Body
- PowerPoint Presentation Slide Number 19-22
- Expert Opinion Effect of Salt on the Body Video

Day 12-15:

- 25 Go Public Challenge
- 25 Go Public Challenge Rubric
- 25 Noodle Novel Entry 11: Go Public Group Worksheet
- 25 Noodle Novel Entry 12: Go Public Group Presentation Evaluation

Expert Opinion Videos and Anchor Video

Anchor Video –

Media based format.

Expert Opinion: Diffusion-

http://www.youtube.com/watch?v=H7QsDs8ZRMI

Expert Opinion: Osmosis –

Media based format.

Expert Opinion: Effects of salt on the body-

http://www.youtube.com/watch?v=vibYqujUj1c

LESSON PLAN

Name: Amar Patel Date: Day 1 Age/Grade Level: 9^{th}/10^{th} Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Grand Challenge – Unit Introduction

Resources, media and technology

- 25 Pre-Assessment
- Anchor Video/Grand Challenge Video
- 25 Noodle Novel Entry 1: Video Analysis Sheet
- 25 Noodle Novel Entry 2: Generate Ideas

Procedures

Day 1 (Day 1 of Unit):

- Teacher will pass out the pre-assessment and allow students 30 minutes to complete assessment.
- Teacher will pass out Video Analysis Sheet and show the Grand Challenge Video. Students will watch the video and work on the sheet. The sheet asks students to discuss the video.
- Teacher hands out and goes over Generate Ideas sheet. Students are required to complete this sheet for homework.

Diffusion/Osmosis PRE-test

Name_____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

a) The movement of particles from high particle concentration to low particle concentration.
b) The movement of water from high particle concentration to low particle concentration.
c) The fusion of two separate particles into a larger particle.
d) The movement of particles from low particle concentration to high particle concentration.

2. Osmosis can be described as _____

a) The splitting of a larger particle into two separate smaller particles.
b) The movement of water from high particle concentration to low particle concentration.
c) The movement of water from low particle concentration to high particle concentration.
d) The movement of particles from low particle to high particle concentration.

3. A semi-permeable membrane can be best described as _____

a) Allowing all materials to pass through in either direction.
b) Allowing certain materials to pass through in either direction.
c) Allowing all materials to pass through in only one direction.
d) Allowing only certain materials through in only one direction.

4. An example of diffusion would be _____

a) A snail shriveling up after salt is poured on it.
b) Water
c) Water being sprayed on vegetables to make them crunchier.
d) The smell of cookies baking in the oven spreading through the house.

5. If a cell (whose membrane is only permeable to water) is placed in pure water, what will happen to the cell?

a) The cell will shrivel because water is moving from inside the cell to the outside pure water.
b) The salts and other solutes inside the cell will move from the inside of the cell to the outside pure water.
c) The cell will bloat and get larger because water is moving from the pure water outside the cell into the cell.
d) There will be no change in the cell because there will be no movement of water or solutes.

6. How well do you understand the concepts of diffusion and osmosis?

a) I do not understand the concepts at all.
b) I somewhat understand the topics.
c) I mostly understand the concepts.
d) I completely understand the concepts.

7. How comfortable do you feel explaining the concepts of diffusion and osmosis to another student?

a) Not comfortable
b) Somewhat comfortable
c) Mostly comfortable
d) Very comfortable

Diffusion/Osmosis PRE-test KEY

Name_____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

a) The movement of particles from high particle concentration to low particle concentration.
b) The movement of water from high particle concentration to low particle concentration.
c) The fusion of two separate particles into a larger particle.
d) The movement of particles from low particle concentration to high particle concentration.

2. Osmosis can be described as _____

a) The splitting of a larger particle into two separate smaller particles.
b) The movement of water from high particle concentration to low particle concentration.
c) The movement of water from low particle concentration to high particle concentration.
d) The movement of particles from low particle to high particle concentration.

3. A semi-permeable membrane can be best described as _____

a) Allowing all materials to pass through in either direction.
b) Allowing certain materials to pass through in either direction.
c) Allowing all materials to pass through in only one direction.
d) Allowing only certain materials through in only one direction.

4. An example of diffusion would be _____

a) A snail shriveling up after salt is poured on it.
b) Water
c) Water being sprayed on vegetables to make them crunchier.
d) The smell of cookies baking in the oven spreading through the house.

5. If a cell (whose membrane is only permeable to water) is placed in pure water, what will happen to the cell?

a) The cell will shrivel because water is moving from inside the cell to the outside pure water.
b) The salts and other solutes inside the cell will move from the inside of the cell to the outside pure water.
c) The cell will bloat and get larger because water is moving from the pure water outside the cell into the cell.
d) There will be no change in the cell because there will be no movement of water or solutes.

6. How well do you understand the concepts of diffusion and osmosis?

a) I do not understand the concepts at all.
b) I somewhat understand the topics.
c) I mostly understand the concepts.
d) I completely understand the concepts.

7. How comfortable do you feel explaining the concepts of diffusion and osmosis to another student?

a) Not comfortable
b) Somewhat comfortable
c) Mostly comfortable
d) Very comfortable

NOODLE NOVEL

Number: 1

Name_____

1. Briefly explain what happened during the video and describe the key points of the video.

2. What is the video asking you to do? What is the Grand Challenge?

NOODLE NOVEL

Number: 2

Name_____

1. What do you think are the differences between a fish and a human body in terms of the cell make-up?

2. Why do you think the fish are able to survive to salt water but humans cannot survive off drinking it?

LESSON PLAN

Name: Amar Patel Date: Day 2 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Diffusion

Resources, media and technology

- 25 Noodle Novel Entry 3: Diffusion Lab
- 25 Diffusion Guided Notes Sheet
- PowerPoint Presentation Slide Number 1-7
- 25 plastic cups
- 5 grams Agrosoke
- Food coloring
- Water
- Paper towel rolls

Procedures

Day 1 (Day 2 of Unit):

- Students will get into groups of five students and discuss the homework from the previous night as groups. The teacher will call the students together and discuss the ideas as a class.
- Teacher will pass out the Diffusion Lab Sheet. Teacher will give instructions before dismissing students to conduct the lab. Students will only do Part 1 of the lab at this time.
- Teacher will call class back together and pass out the Diffusion Guided Notes. Teacher will lead a discussion using the PowerPoint about diffusion.
- After the discussion, students will return to their lab stations and continue with Part 2 of the diffusion lab.

NOODLE NOVEL

Diffusion Lab Worksheet

Number: 3

Name_____

Part 1:

When instructed, you need to obtain…

10 Agrosoke crystals

1. Write down any observations about the color, size, and texture of the Agrosoke crystals.

When instructed, you need to obtain…

1 clear cup with 100 mL of water with food coloring

You will then add the 10 crystals to the water.

2. Make predictions about what you think is going to happen when the crystals are added to the water and food coloring.

Part 2:

Drain the water from the cup and pat the crystals dry.

3. Write down any observations about the color, size, and texture of the Agrosoke crystals.

4. What do you think will happen if the crystals are placed back into water?

Obtain 100 mL of water from the teacher and place the dried crystals into the water.

5. Make observations about what is happening to the crystals.

Part 3:

Drain the water from the cup and pat the crystals dry.

6. Write down any observations about the color, size, and texture of the Agrosoke crystals.

Diffusion Inquiry Guided Notes **Name**_____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. What is ***your*** definition of diffusion?

2. What is the ***formal*** definition of diffusion?

3. Why do you think the sugar particles move instead of staying clumped together?

4. What is the purpose or reason behind diffusion?

5. What is so special about equilibrium?

6. Describe an example of diffusion.

LESSON PLAN

Name: Amar Patel Date: Day 3 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Semipermeability

Resources, media and technology

- 25 Noodle Novel Entry 4: Semipermeable Casing Lab
- 25 Shakers Formal Lab
- PowerPoint Presentation Slide Number 8-10
- 8 sausage casing
- RIT Dye (clothing dye)
- 8 syringes
- 8 tubs
- food coloring
- water
- string roll
- 8 scissors
- 8 plastic cup

Procedures

Day 1 (Day 3 of Unit):

- Students will do part 3 of the diffusion lab activity. There will be a class discussion about the observations and results following the completion of the lab.
- Teacher will lead a discussion on the effects of a present barrier using the PowerPoint. Students will be expected to take notes.
- Teacher will review the concepts of diffusion and informally assess the students' understanding.
- Teacher will hand out the Semipermeability Casing Lab and discuss with the students what they are supposed to do. Students will go to lab stations in groups (assigned by instructor – 8 total groups). Students will do Part 1.
- After this lab is completed, teacher will pass out Shakers Formal Lab sheet. The instructor will go over the directions and be the timekeeper for the class. Students are to complete the entire activity.

NOODLE NOVEL

Semi Permeability Lab Worksheet

Number: 4

Name_____

Part 1:

After being put into your groups, you need to obtain…

- **1 sausage casing**
- **1 syringe**
- **1 tub**
- **String**
- **1 pair of scissors**
- **1 plastic cup**
- **RIT Clothing Dye**
- **Food Coloring**

Steps:

1. Obtain 30 mL of water with your syringe from the teacher.
2. Tie the bottom of the casing.
3. Put the water from the syringe in the casing.
4. Tie the other end of the casing.
5. Obtain 500 mL of water, dye, and food coloring mixture with your tub.
6. Place the casing inside the tub.

After completing the steps…

1. What do you think will happen to the mixture outside the casing or the water inside the casing? What are your general predictions?

Part 2:

1. Make observations about the dye on the outside of the casing.

Cut open the casing and pour into a plastic cup.

2. Make observations about the liquid on the inside of the casing. Were your predictions correct?

Shakers Lab

Team Members: _____
_____
_____
_____
_____
_____

Purpose: To investigate the movement of ***<u>particles</u>*** *across membranes.*

SHAKER: _____

1. Make initial observations (0 sec) about your shaker. Sketch a diagram of the particles and the model.

2. Make observations after 15 seconds. Note the motion of the particles in relationship to the pores in the bottle caps.

3. Make observations after 30 seconds.

4. Make observations after 45 seconds. Draw, <u>to scale</u>, a diagram of the model, particles, and the cap in between the bottles.

5. As a group come to an overall conclusion about your model. Think about what materials were able to pass from one bottle to the next. Which part of the model determined the motion of particles? Write your answer below. Be prepared to share your results.

6. Summarize the conclusions about the shakers from each of the other groups. Remember to discuss about the role of the pores in the cap.

A. SHAKER _____

B. SHAKER _____

C. SHAKER _____

D. SHAKER _____

E. SHAKER _____

LESSON PLAN

Name: Amar Patel Date: Day 4 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Semipermeability Conclusion

Resources, media and technology

- 25 Noodle Novel Entry 5: Expert Opinion Diffusion
- PowerPoint Presentation Slide Number 11-13

Procedures

Day 1 (Day 4 of Unit):

- The teacher will lead a detailed discussion on semipermeability. The students are expected to take notes on the same sheet as the notes from the previous day. This is a continuation of the same topic. The discussion will utilize the PowerPoint.
- Students will get back into the groups they had from the Skakers Lab. The groups will have five minutes to assign speaking roles and come to a conclusion on their observations. The groups will then present their finding and discuss the role of the pores in their specific Shaker membrane. The students must use the keywords of semipermeability: impermeable, semipermeable, or completely permeable.
- After the presentations, the students will go to their lab stations with the groups from the semipermebaility casing lab. Students will finish the lab sheet.
- The teacher will then lead a class discussion about the results and how semipermeability involves motion or "nonmovement" of particles in both directions.
- The teacher will pass out the Expert Opinion Sheet and play the video about diffusion.
- The students will have to read the sections in the book concerning diffusion and semipermeabilty and turn in a one paragraph summary the next class period.

NOODLE NOVEL

Expert Opinion Video: Diffusion

Number: 5

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

SMED 470 Lesson Plan

Unit Title: Cellular Transport Lesson Title: Osmosis

Name: Amar Patel Date: Days 5-6 Grade Level: 9-10th

Subject: Biology/Integrated Science Major Content: Cellular Transport - Osmosis

Lesson Length: 45 minutes/day # of Students: 25

Content Overview

- Students will be expected to recall the meaning of specific terms discussed previously in the unit.
- Diffusion: the movement of particles from high particle concentration to areas of low particle concentration.
- Semipermeability: the ability of a barrier to allow certain materials to pass through in either direction; dependent on barrier pore size.
- Semipermeability of a barrier will determine if diffusion of particles is possible.
- When an area of high concentration is separated from an area of low concentration, the system will change in order to favor the production of equal concentrations on both sides: relieve the concentration gradient.
- If the pores in the barrier do not allow solute particles to move through, the system will not stay in the high concentration gradient state. Water will move across the barrier (if it is small enough).
- Osmosis: the movement of water from areas of low solute concentration to areas of high solute concentration.
- Water moves into areas of high solute concentration so that the solution will become more dilute thus reducing the gradient.
- This is seen in osmotic effects on biological cells. Water can easily move back and forth between a membrane but solute particles typically cannot. This leads to changes in cell volume.

Objectives

Students will be able to-

1. Conduct scientific investigations with minimal assistance from instructors.
2. Recognize and analyze alternative explanations and models.
3. Scientifically formulate possibilities describing any unforeseen errors with laboratory procedures/data.

4. Describe similarities and differences between diffusion and osmosis.
5. Explain how concentration differences affect the overall flow of molecules.
6. Discover that only certain molecules will diffuse through membranes.
7. Discover that the size of molecules will affect their ability to cross membranes.
8. Examine how concentration gradients determine the direction of diffusion.
9. Predict the motion of water based on the definition of osmosis.
10. Differentiate between a hypotonic, hypertonic, and isotonic solution.
11. Predict the effect of differing solutions on cellular structure.
12. Synthesize real world metaphors in which there is a barrier that is completely permeable, semipermeable, and impermeable.
13. Connect laboratory observations to definitions and concepts.
14. Practice effective teamwork strategies to reach a common goal.
15. Collaborate with group members to arrive at common solutions.

Connections

National Science Education Standards

Content Standard A

As a result of activities in grades 9–12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard C

As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems

- Behavior of organisms

Cells have particular structures that underlie their functions. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and the storage of genetic material.

Kentucky Core Content

4. **SC-H-UD-S-8**
   Students will describe the processes by which cells maintain their internal environments within acceptable limits

5. **SC-HS-3.4.3**
   Students will describe cell regulation (enzyme function, diffusion, osmosis, homeostasis);

   predict consequences of internal/external environmental change on cell function/regulation.

   Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through selective expression of individual genes. This regulation allows cells to respond to their internal and external environments and to control and coordinate cell growth and division.

6. **SC-H-UD-U-2**
   Students will understand that within every cell are specialized parts for the transport of materials, energy transfer, protein building, waste disposal, information feedback and even movement. In addition, most cells in multi-cellular organisms perform specialized functions that others do not.

Resources, media, technology and safety

- RESOURCES:

  1 timer, 5 permanent markers, 11 graduated cylinders, 5 syringes, 15 plastic tubs, 3 scissors, 3 rulers, 3 rolls of string, 15 sausage casings (cut 13 cm in lengths and soaked in water before use), 5.5 liters water, 1.5 liters sugar water (~1.3 M, 0.750 kg table sugar in 1.125 liters water). PowerPoint Presentation Slide Number 14-18.

- SAFETY:

  Caution students to be careful with any chemicals or sharp objects they may encounter. Students should not try to ingest the sugar solution or water. Care must be taken when using scissors to cut string. The sausage casing are not edible thus should not be consumed.

- HANDOUTS:

  25 Osmosis Guided Notes, 25 Osmosis Lab Procedures, 25 Noodle Novel Expert Opinion Entry 6, 25 Cellular Application Guided Notes, 25 Osmosis/Cell Concept Homework Assessment (evaluation sheets).

Procedures

ENGAGEMENT **TIME: <u>10 minutes</u>**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Teacher will welcome the class and take up homework from the previous day. The teacher will pass out the Osmosis Guided Notes Sheet.		
The Teacher will ask the students to recall the Shakers lab activity performed earlier in the unit.	Think about the shaker where the pore size was smaller than both particles. Which species moved through? Why?	Neither one of the species moved through because the pores were too small. Both particles were too big.
Teachers asks students to imagine if the two species were replaced with blue water on one side and red water on the other side.	In the hypothetical situation, what will happen?	Water will mix and create a purple solution
	How will the water mix if they are separated?	Water will move through the pores in the membrane.
	Why can water move but not the previous species?	Water is much smaller than the pores.
Teacher will go into a discussion about the importance of water being a small molecule. It can pass through just about any membrane.		
This lesson is to further explore the role of the movement of water.		

EXPLORATION **TIME: <u>50 minutes</u>**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
Teacher will have states set up before lab begins. The first station will have the pre-cut and pre-soaked casing. Station 2 = rolls of string, rulers, and scissors. Station 3 = Lab Worksheets, Station 4 = Sugar solution and 3 graduated cylinders. Station 5 = supplies that students need to take back to their group.		
The teacher will go over the laboratory procedures with the slide show. It is imperative that the instructor keep track of time and make sure students follow the schedule.		
Groups will be assigned. Let students read over procedure.	Does anybody have any questions regarding the procedures?	Teacher will address any misconceptions at this stage.
Have students go to lab stations and get the required materials. The main role of the teacher now is to ask questions and assist with questions from the students. Again, the instructor must be a strict time keeper. The students must be filling out the lab questions as stated in the procedures.	What materials were placed into the casing? What materials were placed on the surroundings? Describe the differences between the solutions. What are your predictions as to any changes after one	Answers will vary based on each trial and any misconceptions.

	day? Why do you think these changes will happen? What science helps you come to that conclusion?	
Once all the trials have been completed, the instructor will make sure that each group has labeled each of their tubs. Students will then be instructed to place their buckets in a designated location. Students will return back to their seats and finish the necessary questions.		
Teacher will tell students that the activity will be finished the following day. The experiment requires an overnight soak in the solutions. Teach will ask students to share their predictions.	What do you think will happen in each trial? Why?	Answers will vary based on each trial and any misconceptions.
Teacher will pass out Noodle Novel Expert Opinion Journal Entry 6. The teacher will show the Expert Opinion video from a chemistry professor regarding osmosis. Students are required to finish the entry before class ends.		

Teacher will assign homework due the next day. Students must read the sections on osmosis and water transport in the text. Students are required to turn in a one paragraph summary of their reading along with two questions that they may have.		
END OF DAY 1 OF THIS LESSON.		
At the beginning of class, teacher will collect homework.		
Teacher will instruct students to go back with their groups to their station. Two members from the group will obtain their buckets from the designated storage location.		
Teacher will instruct students to follow make observations about any changes. They are to finish the lab questions related to each trial. Teach will circulate among the groups and ask questions.	What happened in the trials? Is this what you expected? How can you reason out why the changes occurred? Did the sugar particles move? What must have moved to cause these changes?	Answers will vary based on each trial and any misconceptions.

EXPLANATION **TIME: <u>15 minutes</u>**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will gather the students back to their normal seats and lead a class discussion about osmosis. NOTE: This is not the time to discuss the lab results.		
The teacher will use the powerpoint presentation and follow the guide described in the next block. [CLICK] refers to advancing on the slide. This begins at **slide 14.**	What can happen in order to reduce the concentration on the left side? - Water will move from the right to the left. - [CLICK] Show definition of osmosis. - Have students write down definition. - What is accomplished by osmosis? THE LEFT WILL BECOME LESS CONCENTRATED. - What will happen to the right side? THE VOLUME WILL DECREASE - [CLICK] Exactly. If water will move out of the right side, the volume has to decrease and there will be a greater volume on the left. The total water in the system will not change	See answers in all capital letters in the previous block.

	though. - Will the concentration of the left side change? YES - Will the concentration on the right side change? NO - When will water ever stop flowing from one side to the other? NEVER…constantly moving - When will there be no NET movement of water? Both sides have the same concentration. - This means that if the right side concentration is not changing, water will have a net flow into the left side until the concentration is equal to that of the right. - Diffusion and Osmosis: Similar-relieve conc. gradient; Different-solute mvmt/water mvmt	

ELABORATION **TIME: <u>15 minutes</u>**		
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
The teacher will pass out the Cellular Applications Guided Notes Sheet. This part of the lesson discusses the role of osmosis and cellular effects. . This is the continuation of the slide show presentation.	[CLICK] Biological systems such as cells make use of osmosis. For simplistic purposes, we are going to say that a cell membrane is semi-permeable by allowing only water to move freely between the inside and outside of the cell.	
This is where the results from the lab will be discussed. Make sure students are filling out the notes sheet.	[CLICK] Which trial had a similar concentration inside and outside the cell? Is there a concentration gradient? Based on the definition of osmosis, which way will water move? [CLICK] This is called an isotonic solution. What happened to the pressure and size of the casing before and	Trial 1 No, water on inside and outside. No net movement of water because no concentration gradient.

	after? [CLICK] Similarly in a biological cell, there will be no effect in the cell volume.	The casing remained the same as before.
	[CLICK] Which trial had a higher concentration inside than outside the cell? Is there a concentration gradient? Based on the definition of osmosis, which way will water move? [CLICK] This is called an hypotonic solution. What happened to the pressure and size of the casing before and after? [CLICK] Similarly in a biological cell, the cell will take in water and bloat. This could even cause a cell to burst.	Trial 3 Yes, there is sugar on the inside. Water will move into the cell in order to relieve the gradient. The casing filled with water and increased in pressure.
	[CLICK] Which trial had a lower concentration inside than outside the cell?	Trial 2

	Is there a concentration gradient? Based on the definition of osmosis, which way will water move? [CLICK] This is called an hypertonic solution. What happened to the pressure and size of the casing before and after? [CLICK] Similarly in a biological cell, the cell will lose water and shrivel. This could even cause a cell to dehydrate.	Yes, there is sugar on the outside. Water will move out of the cell in order to relieve the gradient. The casing lost water and decreased in pressure.
Have student fill in the diagrams on the guided notes.	[CLICK] This is a summary of the cellular effects on the cell. Plants have a cell wall so if they take in too much water, they will build pressure and become turgid. They will typically not burst. This is why vegetables are crisp and make a snapping sound when they are snapped. Water is absorbed and the pressure inside increases. This is not the case for animal cells. There is no cell wall so the animal cells tend to burst or lyse.	

FORMATIVE EVALUATION **TIME: <u>TAKE HOME</u>**		
Objective	**Assessment**	**Student Responses and Misconceptions**
The Teacher will pass out the Osmosis/Cell Concept Homework Assessment sheets.		
Know terminology associated with lesson.	Worksheet will have a question asking the students to define diffusion and osmosis.	
Make connections about how the barrier pore size determines the passage of molecules.	Worksheet will have a question asking the students to relate osmosis to semipermeability.	
Describe an hypertonic, isotonic, and hypotonic solution.	Worksheet will have a question asking the students to describe the differences between hypertonic, hypotonic, and isotonic.	
Predict the motion of water in cells.	Worksheet will have a question asking the students to determine the cellular effect of a hypertonic solution.	

Osmosis Inquiry Guided Notes **Name** _____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. What is the formal definition of osmosis?

2. How are diffusion and osmosis similar?

3. How are diffusion and osmosis different?

4. Describe any volume changes that may occur during osmosis and explain why.

5. Why is it that while most particles cannot move through a cell membrane, water molecules are able to move freely into and out of a cell?

Osmosis Lab

Team Members: _____
_____
_____
_____
_____
_____

Purpose: To investigate the movement of ***water*** *across membranes.*

Check for the following items at your station: 3 plastic tubs, 1 syringe, 1 graduated cylinder, and 1 sharpie.

Trial 1

Gather the following materials. You will have **7** minutes to complete this trial.

- 1 sausage casing
- 2 pieces of 20 cm string
- 280 mL of water in graduated cylinder

1. Label one of the tubs as "Trial 1: water in water."
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Pour the water into the Trial 1 tub.
4. Using the syringe, extract 30 mL of water from the tub.
5. Having one person hold the casing open (open end), inject the 30 mL of water into the casing.
6. Squeeze the open end of the casing so water does not leak.
7. Raise your hand for an instructor to come and check the casing.
8. Place the tied casing into the tub.
9. Complete Post Lab questions 1-2.
10. STOP! Wait for approval to move on.

Trial 2

Gather the following materials. You will have **7** minutes to complete this trial.

- 1 sausage casing

- 2 pieces of 20 cm string
- 280 mL of water in graduated cylinder
- 250 mL sugar solution (when told to do so below)

1. Label one of the tubs as “Trial 2: water in sugar.”
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Collect the sugar solution in this tub.
4. Using the syringe, extract 30 mL of water from the graduated cylinder.
5. Pour the remaining water into the tub containing the sugar water
6. Having one person hold the casing open (open end), inject the 30 mL of water into the casing.
7. Squeeze the open end of the casing so water does not leak.
8. Raise your hand for an instructor to come and check the casing.
9. Place the tied casing into the bucket.
10. Complete Post Lab questions 3-4.
11. STOP! Wait for approval to move on.

Trial 3

Gather the following materials. You will have **7** minutes to complete this trial.

- 1 sausage casing
- 2 pieces of 20 cm string
- 500 mL of water in graduated cylinder
- 30 mL sugar solution in the syringe

1. Label the last tub as “Trial 3: sugar in water.”
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Pour the water into this tub.
4. Having one person hold the casing open (open end), inject the 30 mL of sugar solution into the casing.
5. Squeeze the open end of the casing so water does not leak.
6. Raise your hand for an instructor to come and check the casing.
7. Place the tied casing into the bucket.
8. Complete Post Lab questions 5-6.

9. STOP! Wait for approval to move on.

Lab Questions

1. Make initial observations of the setup of **Trial 1**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

2. Predict what will happen after two days for **Trial 1**.

3. Make initial observations of the setup of **Trial 2**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

4. Predict what will happen after two days for **Trial 2**.

5. Make initial observations of the setup of **Trial 3**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

6. Predict what will happen after two days for **Trial 3**.

7. Describe any changes in the casing of **Trial 1** including descriptions of the shape of the casing and the pressure within.

8. Why did the changes in **Trial 1** occur? Was your hypothesis correct?

9. Describe any changes in the casing of **Trial 2** including descriptions of the shape of the casing and the pressure within.

10. Why did the changes in **Trial 2** occur? Was your hypothesis correct?

11. Describe any changes in the casing of **Trial 3** including descriptions of the shape of the casing and the pressure within.

12. Why did the changes in **Trial 3** occur? Was your hypothesis correct?

NOODLE NOVEL

Expert Opinion Video: Osmosis

Number: 6

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

Cellular Applications Guided Notes **Name** _____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. Define:
   a. Isotonic-

   b. Hypotonic-

   c. Hypertonic-

2. Sketch a diagram of a before and after of a cell in an isotonic solution. Use some method to chow concentration differences and any changes to size/pressure.

3. Sketch a diagram of a before and after of a cell in a hypotonic solution. Use some method to chow concentration differences and any changes to size/pressure.

4. Sketch a diagram of a before and after of a cell in a hypertonic solution. Use some method to chow concentration differences and any changes to size/pressure.

5. Why does a plant cell typically not burst when it has too much water but an animal cell will? Be explicit and thorough with your response.

Diffusion/Osmosis/Cell Concept Homework **Name** _____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

a) The movement of particles from high particle concentration to low particle concentration.
b) The movement of water from high particle concentration to low particle concentration.
c) The fusion of two separate particles into a larger particle.
d) The movement of particles from low particle concentration to high particle concentration.

2. Osmosis can be described as _____

a) The splitting of a larger particle into two separate smaller particles.
b) The movement of water from high particle concentration to low particle concentration.
c) The movement of water from low particle concentration to high particle concentration.
d) The movement of particles from low particle to high particle concentration.

3. A semi-permeable membrane can be best described as _____

a) Allowing all materials to pass through in either direction.
b) Allowing certain materials to pass through in either direction.
c) Allowing all materials to pass through in only one direction.
d) Allowing only certain materials through in only one direction.

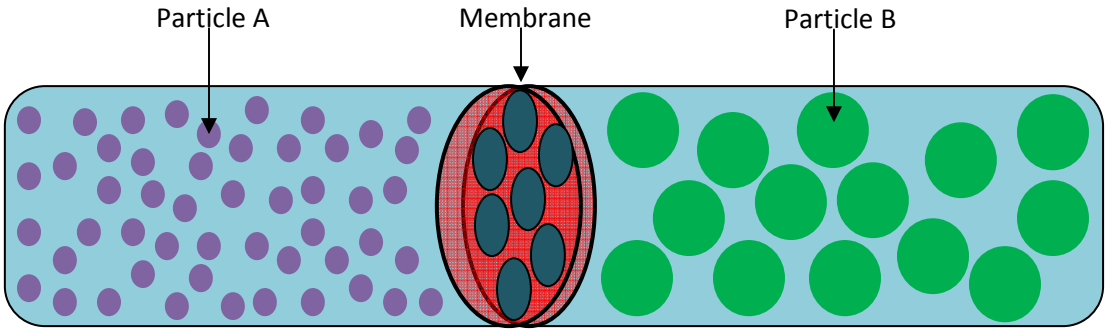
4. An example of diffusion would be _____

a) A snail shriveling up after salt is poured on it.
b) Water
c) Water being sprayed on vegetables to make them crunchier.
d) The smell of cookies baking in the oven spreading through the house.

5. If a cell (whose membrane is only permeable to water) is placed in pure water, what will happen to the cell?

a) The cell will shrivel because water is moving from inside the cell to the outside pure water.
b) The salts and other solutes inside the cell will move from the inside of the cell to the outside pure water.
c) The cell will bloat and get larger because water is moving from the pure water outside the cell into the cell.
d) There will be no change in the cell because there will be no movement of water or solutes.

6. Refer to the diagram. Explain the permeability of particle A and particle B (using key vocabulary) across the membrane. Describe the properties of the membrane in relationship to the particles. Justify your responses using size relationships.



7. Draw a hypertonic solution with a cell. Be sure to include before and after pictures. Describe why the changes occurred.

8. What happens (use key terms) in blood dialysis?

LESSON PLAN

Name: Amar Patel Date: Days 7-10 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 4 Days

Lesson Title: Action Research- Special Topics in Mass Transport

Context

- This lesson will provide further information that can help students come to a solution to the grand challenge.
- There are five available topics: osmosis, diffusion, reverse osmosis, desalinization, and effect of salt on the human body. An action research project and presentation by each group will elaborate on these special topics.
- All five topics relate to the concept of mass transport with review emphasis on the material discussed in earlier days in the lesson.
- The students will be required to understand to correctly utilize the internet as a reference source and learn to summarize their findings.

Objectives

Students will be able to…

1. Communicate with group members about the special topics problem, process, and solution.
2. Evaluate the special topics problem solution and its consequences.
3. Conduct scientific investigations with minimal assistance from instructors.
4. Use technology to improve investigations and communications.
5. Conduct independent research on specific topics in relation to the unit as a whole.
6. Describe similarities and differences between diffusion and osmosis.
7. Predict the effect of differing solutions on cellular structure.
8. Describe reverse osmosis.

9. Discuss methods utilized for making salt water potable.
10. Effectively present their findings utilizing oral communication skills as well as a slideshow.

Connections

I. National Science Education Standards

Content Standard A

As a result of activities in grades 9–12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard C

As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Cells have particular structures that underlie their functions. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules which form a variety of specialized structures that carry out such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and the storage of genetic material.

Content Standard E

As a result of activities in grades 9-12, all students should develop

- Abilities of technological design
- Understandings about science and technology

II. Kentucky Core Content

1. SC-H-UD-S-8

Students will describe the processes by which cells maintain their internal environments within acceptable limits

2. SC-HS-3.4.3

Students will:

- describe cell regulation (enzyme function, diffusion, osmosis, homeostasis);
- predict consequences of internal/external environmental change on cell function/regulation.

Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through selective expression of individual genes. This regulation allows cells to respond to their internal and external environments and to control and coordinate cell growth and division.

3. SC-H-UD-U-2
Students will understand that within every cell are specialized parts for the transport of materials, energy transfer, protein building, waste disposal, information feedback and even
movement. In addition, most cells in multi-cellular organisms perform specialized functions that others do not.

Assessment Plan

Objective/Assessment Plan Organizer (Sample)

Objective Number	Type of Assessment	Description of Assessment	Depth of Knowledge Level	Adaptations and/or Accommodations
Objectives 1, 10	Informal	Brainstorm	1	Record ideas visually using Post-It pads
Objectives 2, 3, 6-9	Formative	Verbal and visual presentation to classmates	3	Individual slide printouts will be provided for students with visual impairments
Objectives 4, 5	Formative	Creating a PowerPoint presentation	1	Supplement presentations such as a video or voice recording will be accepted

Resources, media and technology

- Access to the internet (computer lab).
- Access to Microsoft Word (Word Processor).
- Access to Microsoft PowerPoint.
- Access to library references.
- 8 Post-It pads.
- 25 action research prompts.
- Noodle Novels 7-9

Procedures

Day 1 (Day 7 of Unit):

- Review over previous material.
- Teacher will generate seven groups of three and one group of four students (assuming class of 25 students). Group members will be assigned randomly by second letter in the last name.
- Teach will pass out the prompt worksheet and discuss the expectations of the assignment. Teacher will also review the grading rubric.
- The project is to complete an action research with presentation. There are five available topics: osmosis, diffusion, reverse osmosis, desalinization, and effect of salt on the human body. Each group must choose one topic to research and present. Each topic must be covered by at least one group. This leaves three topics that are going to be covered by two groups.
- The teacher will explain that students will have three days to research and develop a four and a half minute presentation which will be presented on day four.
- After the teacher has allowed the students to read the prompt and has explained the procedures, the class will be taken to the computer lab to start research for the remainder of the period. Each group will be given Post-It note pads to write down relevant information. Students complete Noodle Novel 7.
- Students must pass teacher checkpoint: collecting good research.
-

Day 2 (Day 8 of Unit):

- For any students that were absent on **Day 1**, the teacher will pass out the prompt and inform them of the project and their group assignments.
- Student will continue research in the computer lab for the remainder of the period.
- Students should start developing their slideshow PowerPoint presentation.
- Students must pass teacher checkpoint: collecting research and starting presentation.

Day 3 (Day 9 of Unit):

- For any students that were absent on **Day 1 or Day 2**, the teacher will pass out the prompt and inform them of the project and their group assignments.
- Student will continue research in the computer lab for the first 25 minutes of the period.
- Students should finish developing their slideshow PowerPoint presentation, assign speaking roles, and practice to get an okay from the teacher. All students must have an equal role in the presentation.
- Students must pass teacher checkpoint: finish presentations.

Day 4 (Day 10 of Unit):

- Each group will be given four and a half minutes to give presentation and will have a one minute time period for questions from students and the teacher.

Students not presenting will complete Noodle Novel 9. Students will do Noodle Novel 8 for homework.

Name:_____

Action Research

TASK: Create an informational…

a. PowerPoint
b. Prezi

The project is to complete an action research with presentation. There are five available topics: osmosis, diffusion, reverse osmosis, desalinization, and effect of salt on the human body. Each group must choose one topic to research and present.

TARGET AUDIENCE: The general public

REQUIRED CONTENT:

1. Osmosis,
2. Diffusion,
3. Reverse osmosis,
4. Desalinization,
5. or Effect of salt on the human body

FINAL PRODUCT: Either…

a) Conduct a Prezi presentation over the topic that was chosen
b) Conduct a PowerPoint presentation over the topic that was chosen

FIND RUBRIC ON BACK

ACTION RESEARCH EVALUATION RUBRIC:

	EXEMPLARY (40-36 points)	**MEETS STANDARDS (35-30 points)**	**BELOW STANDARD (29 points or less)**
REQUIRED ELEMENTS	All required elements are presented effectively and completely	All required elements are present	Missing one or more required elements
PRESENTATION	Engaging, creative, and thoughtful presentation; coherent organized structure	Clear and thoughtful presentation; logical organization	Lacking development and detail in presentation; deficient in organization
COMMUNICATION	Free from surface feature errors	Minimal surface feature errors	Numerous surface feature errors
Total Score (out of 120)			

NOODLE NOVEL

Action Research Group Initial Direction

Number: 7

Name_____

1. List the names of your group members.

2. Thoroughly explain how you feel your group is working together. Are there any conflicts? Do you feel that each person is going to contribute to the research and presentation?

3. Give a brief summary of what your PowerPoint is going to include.

NOODLE NOVEL

Action Research Group Evaluation

Number: 8

Name_____

1. List your name and the names of your group members and give each person (including yourself) an overall grade out of 50 possible points.

2. Now that the research and presentation are over, what are some personal changes that you could have made to help in the research process, the presentation, and/or the group in general?

NOODLE NOVEL

Action Research Group Presentation Evaluation

Number: 9

Name_____

1. List the names of the group members and give a brief summary of each presentation. Include a final grade, out of 100 possible points

   Group 1-

   Group 2-

   Group 3-

   Group 4-

Group 5-

Group 6-

Group 7-

LESSON PLAN

Name: Amar Patel Date: Day 11 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Review and Fish Physiology

Resources, media and technology

- 25 Study Guide Worksheet (to be made during class)
- 25 Noodle Novel Entry 10: Expert Opinion Effect of Salt on the Body
- PowerPoint Presentation Slide Number 19-22
- Expert Opinion Effect of Salt on the Body Video

Procedures

Day 1 (Day 11 of Unit):

- Teacher will lead a discussion on fish physiology. There will be a comparison of saltwater and freshwater fish. This topic will relate back to the Grand Challenge. Students are expected to take notes.
- After the discussion, the teacher will show the expert opinion video and have students complete the Expert Opinion Video Sheet.
- Teacher will divide the class into four groups. Each group will be given a specific topic: diffusion, osmosis, semipermeability, or cellular applications. Each group will have to come up with 6 questions that concern their topic. The questions must include definitions, multiple choice, and short answer. Students will be required to provide answers as well.
- As groups finish, they will type the questions on the teacher's computer into a word processor. After all groups have compiled their questions (24 total questions), teacher will print out the file and give a copy to each student. This is their study guide.
- The study guide must be completed for homework.

NOODLE NOVEL

Expert Opinion Video: Effects of Salt on the Body

Number: 10

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

LESSON PLAN

Name: Amar Patel Date: Days 12-15 Age/Grade Level: 9th/10th Grade

Subject: Science Major Content: Biology/Integrated Science Lesson Length: 45 min

Lesson Title: Go Public Challenge and Unit Conclusion

Resources, media and technology

- 25 Go Public Challenge
- 25 Go Public Challenge Rubric
- 25 Noodle Novel Entry 11: Go Public Group Worksheet
- 25 Noodle Novel Entry 12: Go Public Group Presentation Evaluation

Procedures

Day 1 (Day 12 of Unit):

- Teacher will answer any questions over the homework from the night before and then collect the study guide.
- The Grand Challenge will be revisited via a discussion with the class.
- The Go Public Challenge and Rubric sheet will be given out and discussed with the students.
- Students will be grouped and allowed to work together. This class meeting will involve completing the Noodle Novel Entry 11. Teacher will check to see if completed.

Day 2 (Day 13 of Unit):

- Students will meet in the computer lab to conduct research. Each student will have a computer. This day is devoted to research only. Teacher Checkpoint.

Day 3 (Day 14 of Unit):

- Students will meet in the computer to finish conducting research and finish designing the presentation. Students may need to work outside of class. Teacher Checkpoint. Teacher will return graded study guide to students.

Day 4 (Day 15 of Unit):

- Students will meet in the computer lab to finish the presentation for the first 15 minutes. The next 15 minutes will be spent going over presentation skills. The remainder of the class period will be devoted to practicing presentations for the evening.
- Presentations will occur in the gymnasium at 5:00PM. Teacher will pass out the Noodle Novel Entry 12 to each student. This will be filled out while the group presents their Go Public Challenge. Each group will have a 4.5-5 minutes to present and answer questions. All presentation should take place this day. School and city officials along with parents and peers are invited to attend.

Go Public Challenge

Name:_____

TASK: Create an informational…

a. Press Conference
b. Breaking News Report
c. Skit/Video

…that brings the Grand Challenge to a conclusion.

Let's revisit the Grand Challenge: Your neighbor is stranded on a desert island and has nothing to drink but the salt water around him. He eventually dies because he drank too much salt water. Why are the fish able to *live* in the same water that a human cannot drink?

TARGET AUDIENCE: The general public

REQUIRED CONTENT:

1. How salt effects a red blood cell
2. How the process of osmosis effects the red blood cell in salt
3. How the cell of a fish differs from that of a human
4. The differences in cell make-up between fish and humans

FINAL PRODUCT: Either…

a) Conduct a press conference that explains how the victim died and the causes of the death
b) Conduct a breaking news report that unveils where the victim was found and under what circumstances he was living and how those circumstances caused his death
c) Conduct a video viewing session explaining the death of the victim followed by a Q&A seminar

EVALUATION:

RUBRIC

	Beginning (0-6)	**Developing (7)**	**Proficient (8)**	**Advanced (9-10)**
Presentation	Delivery not smooth and audience attention often lost.	Delivery not smooth, but able to maintain interest of the audience most of the time.	Rehearsed with fairly smooth delivery that holds audience attention most of the time.	Well-rehearsed with smooth delivery that holds audience attention.
Requirements	Inadequate representation of the Go Public Challenge	Fair representation of the Go Public Challenge	Good representation of the Go Public Challenge	Excellent representation of the Go Public Challenge
Attractiveness	Use of font, color, graphics, effects etc. but these often distract from the presentation content.	Make use of font, color, graphics, effects etc. but occasionally these detract from the presentation content	Makes good use of font, color, graphics, effects etc. to enhance the presentation	Makes excellent use font, color, graphics, effects etc. to enhance the presentation
Time Allotment	Presentation exceeds 6 minutes or is less than 4 minutes and 15 seconds	Presentation is 5 minutes and 31 seconds to 6 minutes	Presentation is 5 minutes and 1 second to 5 minutes and 30 seconds	Presentation is within the 4 minutes and 15 seconds to 5 minute range
Originality	No evidence of original thinking	Little evidence of original thinking	Product shows some original thought; work shows new ideas and insight	Product shows a large amount of original thought; ideas are creative and inventive
TOTAL SCORE (50)x4				

NOODLE NOVEL

Go Public Group Worksheet

Number: 11

Name_____

1. List the names of your group members.

2. Which form of presentation is your group going to use?

NOODLE NOVEL

Go Public Group Presentation Evaluation

Number: 12

Name_____

1. List the names of the group members and give a brief summary of each presentation. Include a final grade, out of 100 possible points

   Group 1-

   Group 2-

   Group 3-

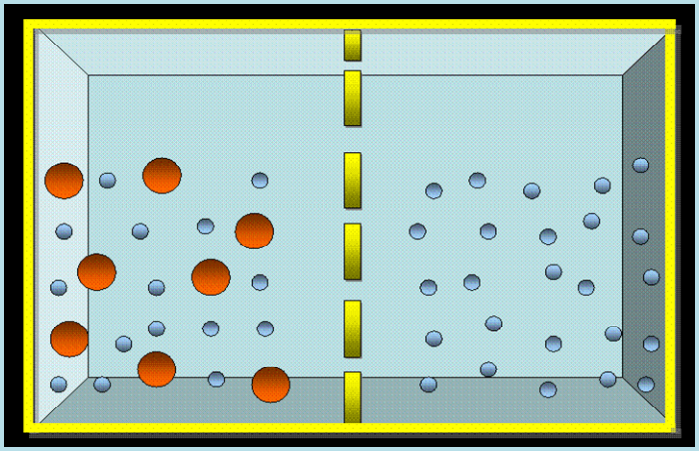
   Group 4-

Group 5-

Group 6-

Group 7-

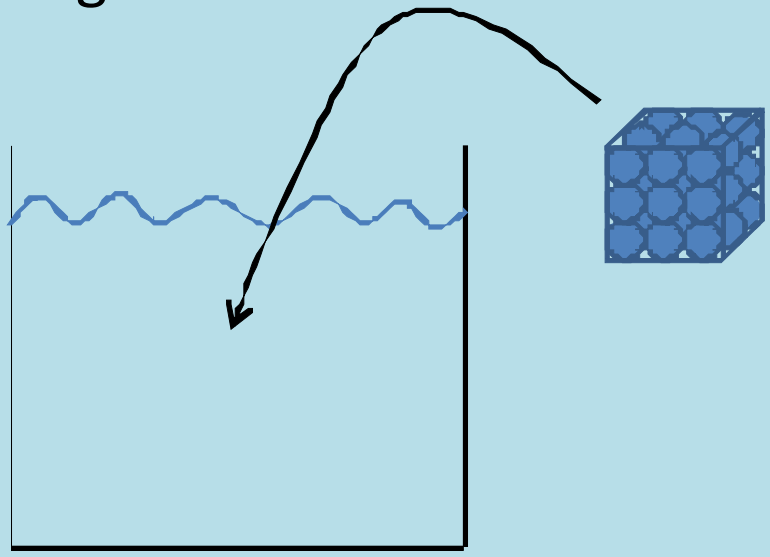
Cell Transport



Amar Patel Nick Neiman

Diffusion

- The movement of **particles** from high particle concentration to low particle concentration.
- Example: Sugar cube in water



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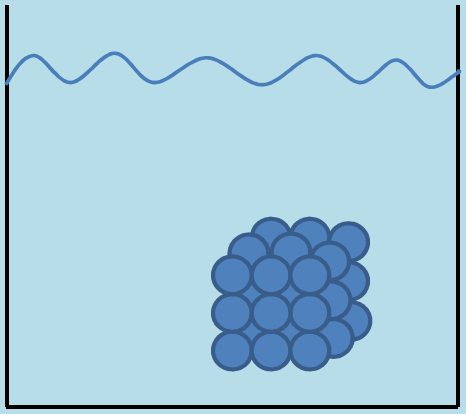

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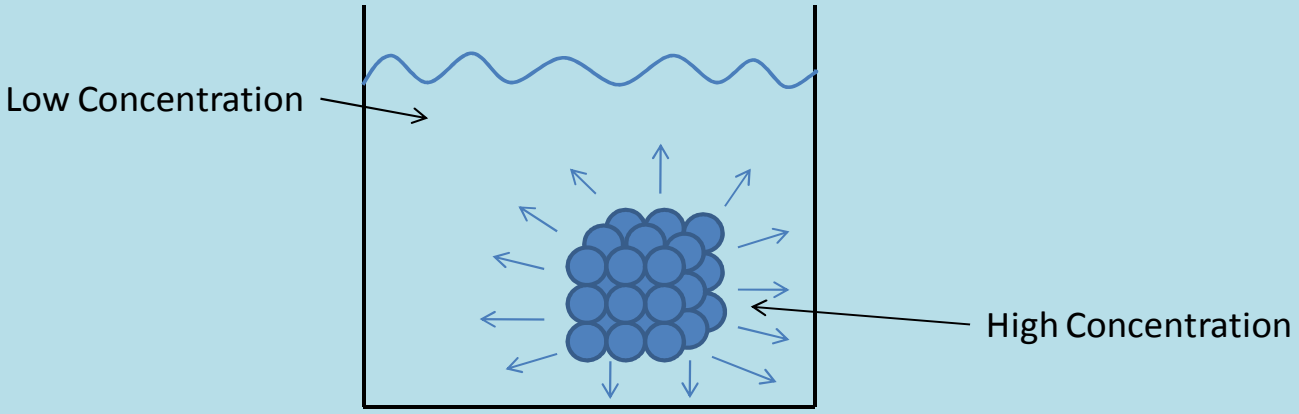
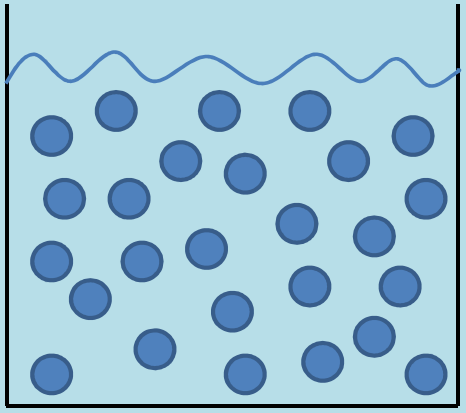


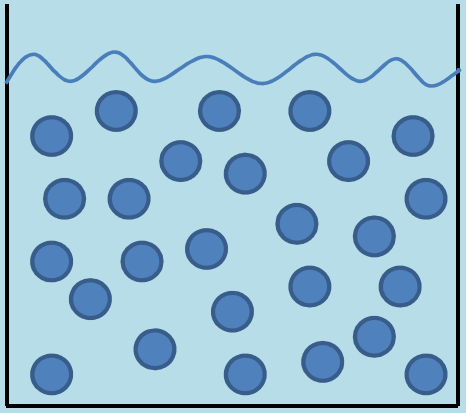
Diffusion

- The movement of particles from high particle concentration to low particle concentration.
- Example: Sugar cube in water



So, what's the point?

- The movement of particles from high particle concentration to low particle concentration
- **<u>to equilibrate the concentration.</u>**
- Example: Sugar cube in water



END PART 1

Types of Barriers

- Completely Permeable
- Semipermeable
- Impermeable
- Depends on particle and pore size

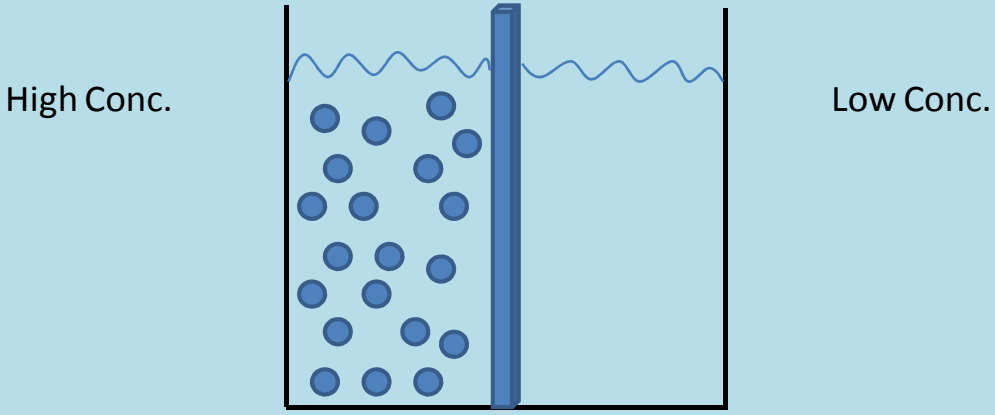
Shakers Lab

- Record your observations at the following times: 0 sec, 15 sec, 30 sec, and 45 seconds
- Note the motion of the particles in relationship to the pores in the bottle caps
- Write your overall conclusions about your shaker
- Be prepared to share your results with the class

END PART 2

What if there is a barrier?

- Semi-permeable barrier…is semi-permeable
- Solutes can not move
- Does it stay in high concentration?



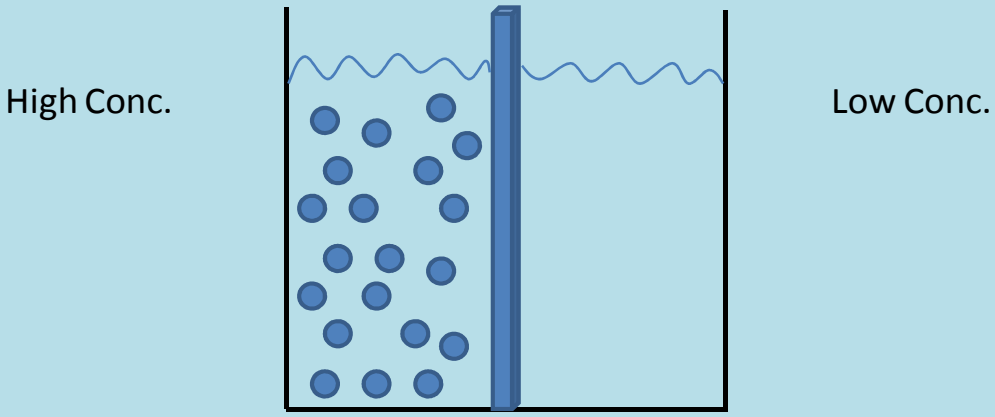
What if there is a barrier?

- NO!!!
- Water will move across the barrier
- Size differences
- Semi-permeable: allows certain materials to pass through in either direction

END PART 3

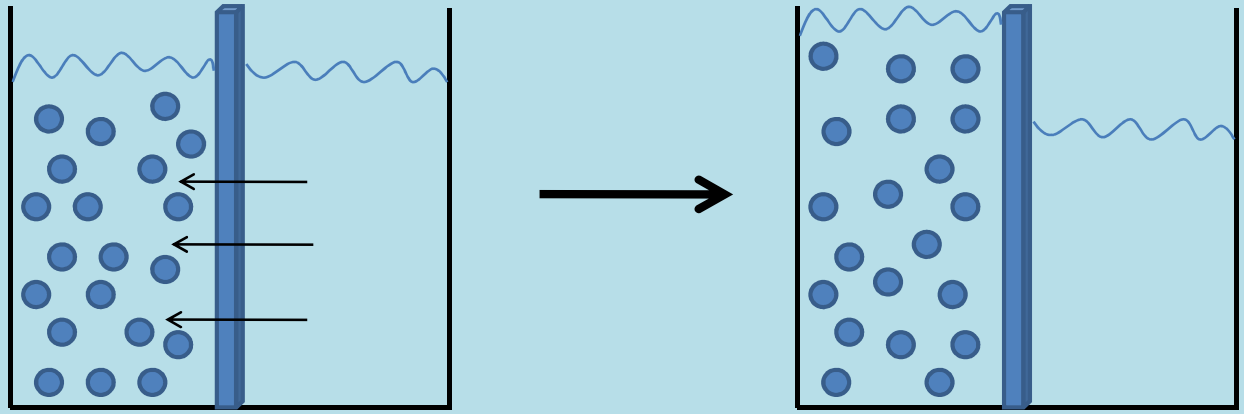
What if there is a barrier?

- Does water move from high solute to low solute concentration?



Osmosis!

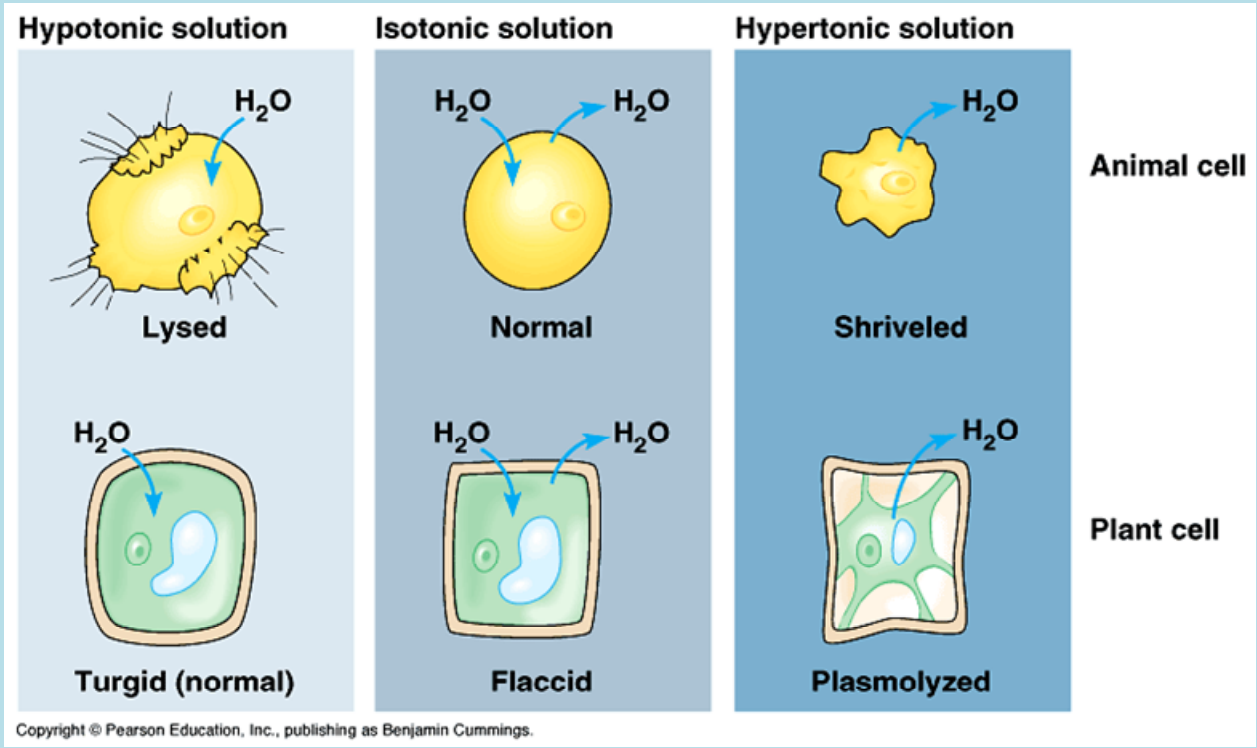
- The movement of **<u>water</u>** moves from low solute concentration to high solute concentration
- Why? To reduce the concentration gradient



Biological Systems

- Cell in water with similar concentration
  - No change
  - Isotonic
- Cell in pure water
  - Bloat
  - Hypotonic
- Cell in highly concentrated solution
  - Shrivel
  - Hypertonic

Biological Systems



END PART 4

Fish Physiology

- Physiology – the study of the normal functioning living organisms
- This topic describes why and how do organisms function the way they do.
- An important physiology to understand is the difference between freshwater fish and salt water fish.

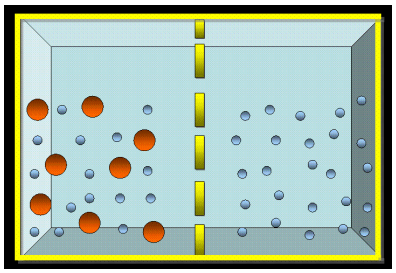
Saltwater fish

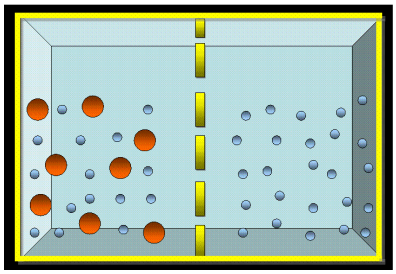
- Environment is **more** concentrated than fish
- What are the problems?
  - Water leaves body
  - Salt comes in (eating or drinking, diffusion)
- Solutions
  - Low filtering in kidney = retain water, lose salt
  - Produce a low volume, concentrated urine
- How do these solutions solve the problems?

Freshwater fish

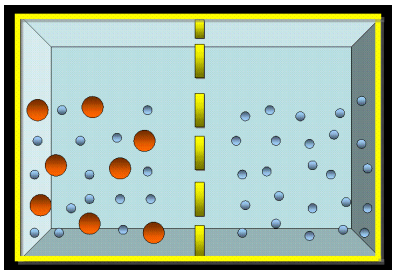
- Environment is **less** concentrated than fish
- What are the problems?
  - Water comes into body
  - Salt leaves body (urine, diffusion)
- Solutions?
  - High filtering in kidney = removal of water
  - Produce a high volume, dilute urine
- How do these solutions solve the problems?

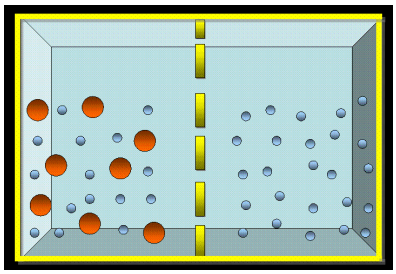
END PART 5





NOODLE NOVELS





Noodle Novels Rubric

	10	8	6	4	0
Completion	Completed all 12 Noodle Novels	Completed 11 Noodle Novels	Completed 10 Noodle Novels	Completed 9 Noodle Novels	Completed less than 9 Noodle Novels
Final Score (10)					

	40	30	20	10
Quality of Work	No spelling or grammar errors, uses all complete sentences, and ideas are very clear	1-3 spelling or grammar errors, mostly uses complete sentences, and ideas are clear	4-5 spelling or grammar errors, hardly uses complete sentences, and ideas are somewhat clear	More than 5 spelling or grammar errors, uses no complete sentences, and ideas are not clear.
Total Score (40)				

Completion + Quality of Work TOTAL SCORE=_____ out of 50

NOODLE NOVEL

Number: 1

Name_____

1. Briefly explain what happened during the video and describe the key points of the video.

2. What is the video asking you to do? What is the Grand Challenge?

NOODLE NOVEL

Number: 2

Name_____

1. What do you think are the differences between a fish and a human body in terms of the cell make-up?

2. Why do you think the fish are able to survive to salt water but humans cannot survive off drinking it?

NOODLE NOVEL

Diffusion Lab Worksheet

Number: 3

Name_____

Part 1:

When instructed, you need to obtain…

10 Agrosoke crystals

1. Write down any observations about the color, size, and texture of the Agrosoke crystals.

When instructed, you need to obtain…

1 clear cup with 100 mL of water with food coloring

You will then add the 10 crystals to the water.

2. Make predictions about what you think is going to happen when the crystals are added to the water and food coloring.

Part 2:

Drain the water from the cup and pat the crystals dry.

3. Write down any observations about the color, size, and texture of the Agrosoke crystals.

4. What do you think will happen if the crystals are placed back into water?

Obtain 100 mL of water from the teacher and place the dried crystals into the water.

5. Make observations about what is happening to the crystals.

Part 3:

Drain the water from the cup and pat the crystals dry.

6. Write down any observations about the color, size, and texture of the Agrosoke crystals.

NOODLE NOVEL

Semi Permeability Lab Worksheet

Number: 4

Name_____

Part 1:

After being put into your groups, you need to obtain…

- **1 sausage casing**
- **1 syringe**
- **1 tub**
- **String**
- **1 pair of scissors**
- **1 plastic cup**
- **RIT Clothing Dye**
- **Food Coloring**

Steps:

1. Obtain 30 mL of water with your syringe from the teacher.
2. Tie the bottom of the casing.
3. Put the water from the syringe in the casing.
4. Tie the other end of the casing.
5. Obtain 500 mL of water, dye, and food coloring mixture with your tub.
6. Place the casing inside the tub.

After completing the steps…

1. What do you think will happen to the mixture outside the casing or the water inside the casing? What are your general predictions?

Part 2:

1. Make observations about the dye on the outside of the casing.

Cut open the casing and pour into a plastic cup.

2. Make observations about the liquid on the inside of the casing. Were your predictions correct?

NOODLE NOVEL

Expert Opinion Video: Diffusion

Number: 5

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

NOODLE NOVEL

Expert Opinion Video: Osmosis

Number: 6

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

NOODLE NOVEL

Action Research Group Initial Direction

Number: 7

Name_____

1. List the names of your group members.

2. Thoroughly explain how you feel your group is working together. Are there any conflicts? Do you feel that each person is going to contribute to the research and presentation?

3. Give a brief summary of what your PowerPoint is going to include.

NOODLE NOVEL

Action Research Group Evaluation

Number: 8

Name_____

1. List your name and the names of your group members and give each person (including yourself) an overall grade out of 50 possible points.

2. Now that the research and presentation are over, what are some personal changes that you could have made to help in the research process, the presentation, and/or the group in general?

NOODLE NOVEL

Action Research Group Presentation Evaluation

Number: 9

Name_____

1. List the names of the group members and give a brief summary of each presentation. Include a final grade, out of 100 possible points

   Group 1-

   Group 2-

   Group 3-

   Group 4-

Group 5-

Group 6-

Group 7-

NOODLE NOVEL

Expert Opinion Video: Effects of Salt on the Body

Number: 10

Name_____

1. What are the credentials of the speaker? Can we trust what he/she is saying? Why?

2. In one paragraph, summarize the video.

NOODLE NOVEL

Go Public Group Worksheet

Number: 11

Name_____

1. List the names of your group members.

2. Which form of presentation is your group going to use?

NOODLE NOVEL

Go Public Group Presentation Evaluation

Number: 12

Name_____

1. List the names of the group members and give a brief summary of each presentation. Include a final grade, out of 100 possible points

   Group 1-

   Group 2-

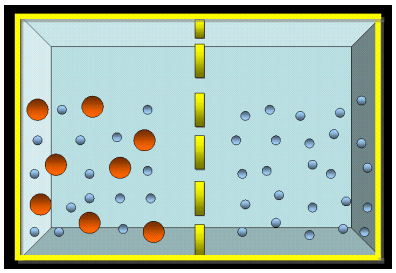
   Group 3-

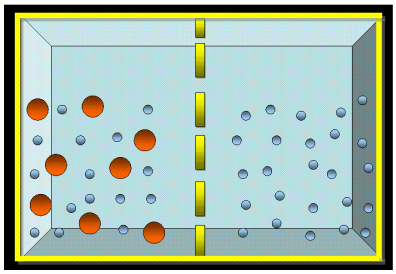
   Group 4-

Group 5-

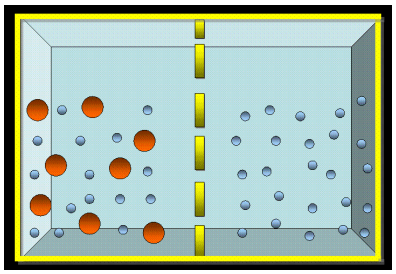
Group 6-

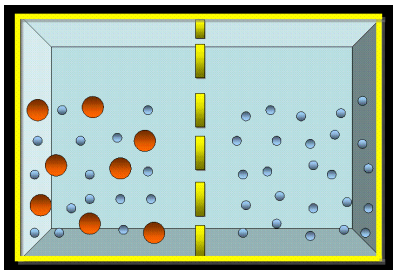
Group 7-





LETTER TO THE PARENTS





November 25, 2011

Amar Patel
WKU SkyTeach Program
1906 College Heights Blvd
Bowling Green, KY 42101

Regarding: Mass Transport within Cells Problem Based Lesson Sequence

Dear Parent(s) or Guardian(s),

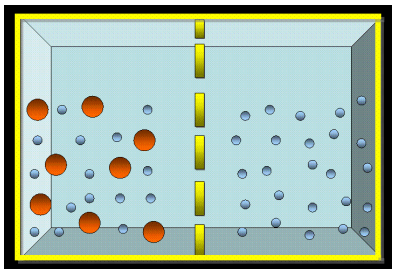
Your child will be working on a project based lesson sequence beginning November 30, 2011 and will tentatively end December 20, 2011. In the project based unit, your child will be learning key concepts pertaining to mass transport within cells. The unit will include laboratory experiments, notes, research projects, and inquiry-based discovery learning. While working through the unit, your child will learn about osmosis, diffusion, semi permeability, characteristics of a cell, and hypertonic, hypotonic, and isotonic cells. Within the unit, your child will be required to work in groups and research different factors that could influence different changes in cells. This research will allow your child to give his/her reasoning and evidence to suggest the conclusions that are found in the study. This research will be presented in a presentation of the students' choice that he/she will present to his/her peers at the conclusion of the unit. In this unit, your child will be introduced to teaching techniques that are not traditionally used in typical public school classrooms. Your child will be encouraged to actively participate in group discussion of content, collaboration of experimentation, interactive lecture, and guided discovery. As teachers, we will be working with your child to ensure that he/she will understand how the environment and cell type contribute to how cells in mass transportation.

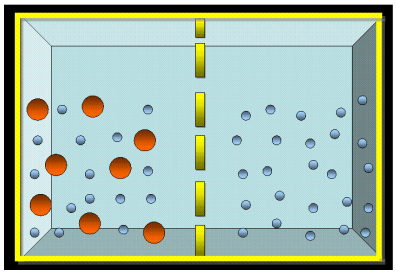
Finally, your child will be tentatively making his/her presentation on December 20, 2011, at 5 PM in the gymnasium. You, as a guardian, are welcome to view your child's and other students' presentations. Staff from the school district will also be present to view presentations. If you wish to discuss the project for any reason, feel free to contact me.

Amar Patel: Amar.Patel@wku.edu

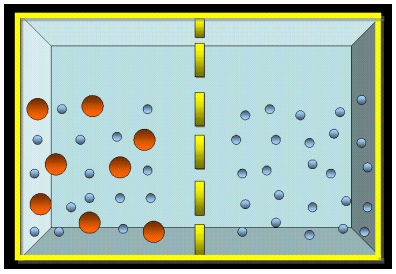
Sincerely,

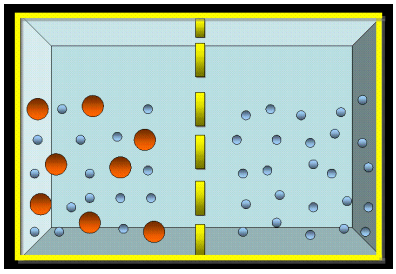
Amar Patel
SkyTeach Teacher





GUIDED NOTES





Diffusion Inquiry Guided Notes **Name**_____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. What is ***your*** definition of diffusion?

2. What is the ***formal*** definition of diffusion?

3. Why do you think the sugar particles move instead of staying clumped together?

4. What is the purpose or reason behind diffusion?

5. What is so special about equilibrium?

6. Describe an example of diffusion.

Osmosis Inquiry Guided Notes **Name** _____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. What is the formal definition of osmosis?

2. How are diffusion and osmosis similar?

3. How are diffusion and osmosis different?

4. Describe any volume changes that may occur during osmosis and explain why.

5. Why is it that while most particles cannot move through a cell membrane, water molecules are able to move freely into and out of a cell?

Cellular Applications Guided Notes **Name** _____

Please answer the appropriate questions as the class progresses with the information being presented by the instructors.

1. Define:
   d. Isotonic-

   e. Hypotonic-

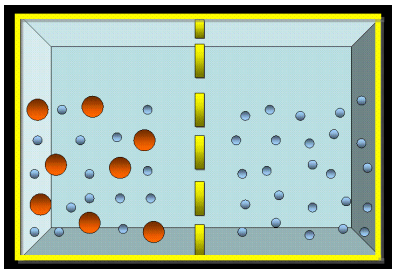
   f. Hypertonic-

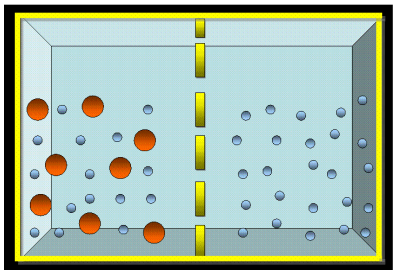
2. Sketch a diagram of a before and after of a cell in an isotonic solution. Use some method to chow concentration differences and any changes to size/pressure.

3. Sketch a diagram of a before and after of a cell in a hypotonic solution. Use some method to chow concentration differences and any changes to size/pressure.

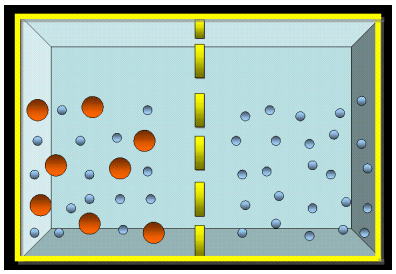
4. Sketch a diagram of a before and after of a cell in a hypertonic solution. Use some method to chow concentration differences and any changes to size/pressure.

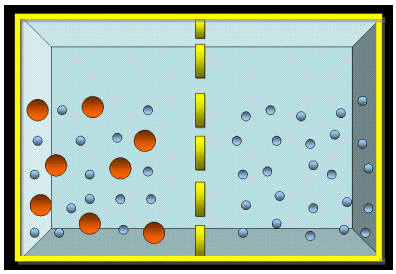
5. Why does a plant cell typically not burst when it has too much water but an animal cell will? Be explicit and thorough with your response.





PROJECTS ASSESSMENT HOMEWORK





Name:_____

Action Research

TASK: Create an informational…

a. PowerPoint
b. Prezi

The project is to complete an action research with presentation. There are five available topics: osmosis, diffusion, reverse osmosis, desalinization, and effect of salt on the human body. Each group must choose one topic to research and present.

TARGET AUDIENCE: The general public

REQUIRED CONTENT:

1. Osmosis,
2. Diffusion,
3. Reverse osmosis,
4. Desalinization,
5. or Effect of salt on the human body

FINAL PRODUCT: Either…

a) Conduct a Prezi presentation over the topic that was chosen
b) Conduct a PowerPoint presentation over the topic that was chosen

FIND RUBRIC ON BACK

ACTION RESEARCH EVALUATION RUBRIC:

	EXEMPLARY (40-36 points)	**MEETS STANDARDS (35-30 points)**	**BELOW STANDARD (29 points or less)**
REQUIRED ELEMENTS	All required elements are presented effectively and completely	All required elements are present	Missing one or more required elements
PRESENTATION	Engaging, creative, and thoughtful presentation; coherent organized structure	Clear and thoughtful presentation; logical organization	Lacking development and detail in presentation; deficient in organization
COMMUNICATION	Free from surface feature errors	Minimal surface feature errors	Numerous surface feature errors
Total Score (out of 120)			

Go Public Challenge

Name:_____

TASK: Create an informational…

a. Press Conference
b. Breaking News Report
c. Skit/Video

…that brings the Grand Challenge to a conclusion.

Let's revisit the Grand Challenge: Your neighbor is stranded on a desert island and has nothing to drink but the salt water around him. He eventually dies because he drank too much salt water. Why are the fish able to *live* in the same water that a human cannot drink?

TARGET AUDIENCE: The general public

REQUIRED CONTENT:

1. How salt effects a red blood cell
2. How the process of osmosis effects the red blood cell in salt
3. How the cell of a fish differs from that of a human
4. The differences in cell make-up between fish and humans

FINAL PRODUCT: Either…

a) Conduct a press conference that explains how the victim died and the causes of the death
b) Conduct a breaking news report that unveils where the victim was found and under what circumstances he was living and how those circumstances caused his death
c) Conduct a video viewing session explaining the death of the victim followed by a Q&A seminar

EVALUATION:

RUBRIC

	Beginning (0-6)	**Developing (7)**	**Proficient (8)**	**Advanced (9-10)**
Presentation	Delivery not smooth and audience attention often lost.	Delivery not smooth, but able to maintain interest of the audience most of the time.	Rehearsed with fairly smooth delivery that holds audience attention most of the time.	Well-rehearsed with smooth delivery that holds audience attention.
Requirements	Inadequate representation of the Go Public Challenge	Fair representation of the Go Public Challenge	Good representation of the Go Public Challenge	Excellent representation of the Go Public Challenge
Attractiveness	Use of font, color, graphics, effects etc. but these often distract from the presentation content.	Make use of font, color, graphics, effects etc. but occasionally these detract from the presentation content	Makes good use of font, color, graphics, effects etc. to enhance the presentation	Makes excellent use font, color, graphics, effects etc. to enhance the presentation
Time Allotment	Presentation exceeds 6 minutes or is less than 4 minutes and 15 seconds	Presentation is 5 minutes and 31 seconds to 6 minutes	Presentation is 5 minutes and 1 second to 5 minutes and 30 seconds	Presentation is within the 4 minutes and 15 seconds to 5 minute range
Originality	No evidence of original thinking	Little evidence of original thinking	Product shows some original thought; work shows new ideas and insight	Product shows a large amount of original thought; ideas are creative and inventive
TOTAL SCORE (50)x4				

Diffusion/Osmosis PRE-test

Name_____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

a) The movement of particles from high particle concentration to low particle concentration.
b) The movement of water from high particle concentration to low particle concentration.
c) The fusion of two separate particles into a larger particle.
d) The movement of particles from low particle concentration to high particle concentration.

2. Osmosis can be described as _____

a) The splitting of a larger particle into two separate smaller particles.
b) The movement of water from high particle concentration to low particle concentration.
c) The movement of water from low particle concentration to high particle concentration.
d) The movement of particles from low particle to high particle concentration.

3. A semi-permeable membrane can be best described as _____

a) Allowing all materials to pass through in either direction.
b) Allowing certain materials to pass through in either direction.
c) Allowing all materials to pass through in only one direction.
d) Allowing only certain materials through in only one direction.

4. An example of diffusion would be _____

a) A snail shriveling up after salt is poured on it.
b) Water
c) Water being sprayed on vegetables to make them crunchier.
d) The smell of cookies baking in the oven spreading through the house.

5. If a cell (whose membrane is only permeable to water) is placed in pure water, what will happen to the cell?

a) The cell will shrivel because water is moving from inside the cell to the outside pure water.
b) The salts and other solutes inside the cell will move from the inside of the cell to the outside pure water.
c) The cell will bloat and get larger because water is moving from the pure water outside the cell into the cell.
d) There will be no change in the cell because there will be no movement of water or solutes.

6. How well do you understand the concepts of diffusion and osmosis?

a) I do not understand the concepts at all.
b) I somewhat understand the topics.
c) I mostly understand the concepts.
d) I completely understand the concepts.

7. How comfortable do you feel explaining the concepts of diffusion and osmosis to another student?

a) Not comfortable
b) Somewhat comfortable
c) Mostly comfortable
d) Very comfortable

Diffusion/Osmosis PRE-test KEY

Name_____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

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b) Somewhat comfortable
c) Mostly comfortable
d) Very comfortable

Diffusion/Osmosis/Cell Concept Homework **Name** _____

Circle the correct choice which best answers each of the following questions or give the appropriate responses for the short answer questions. There are questions on the front and back.

1. Diffusion can be described as _____

a) The movement of particles from high particle concentration to low particle concentration.
b) The movement of water from high particle concentration to low particle concentration.
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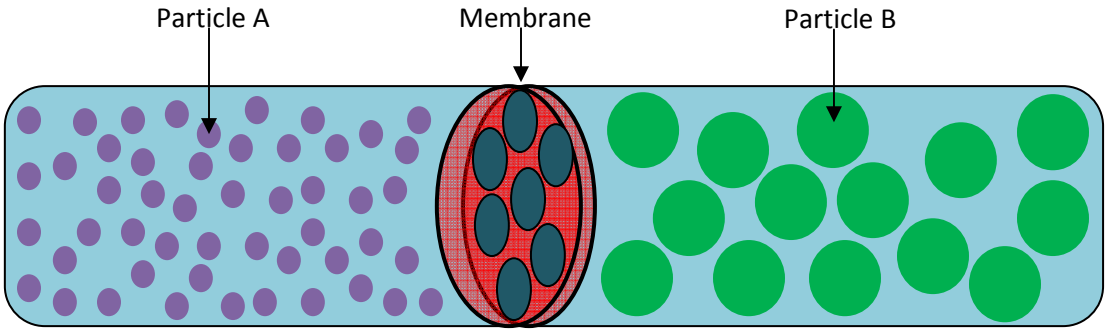
a) A snail shriveling up after salt is poured on it.
b) Water
c) Water being sprayed on vegetables to make them crunchier.
d) The smell of cookies baking in the oven spreading through the house.

5. If a cell (whose membrane is only permeable to water) is placed in pure water, what will happen to the cell?

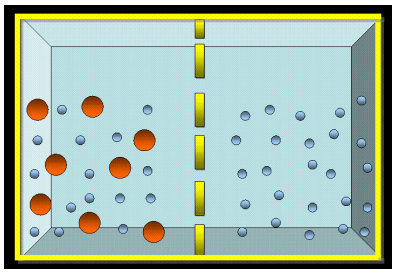
a) The cell will shrivel because water is moving from inside the cell to the outside pure water.
b) The salts and other solutes inside the cell will move from the inside of the cell to the outside pure water.
c) The cell will bloat and get larger because water is moving from the pure water outside the cell into the cell.
d) There will be no change in the cell because there will be no movement of water or solutes.

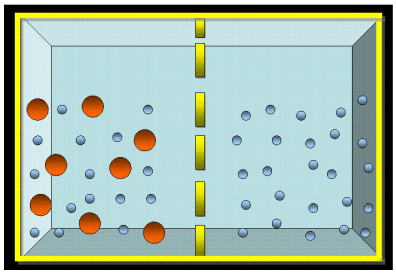
6. Refer to the diagram. Explain the permeability of particle A and particle B (using key vocabulary) across the membrane. Describe the properties of the membrane in relationship to the particles. Justify your responses using size relationships.



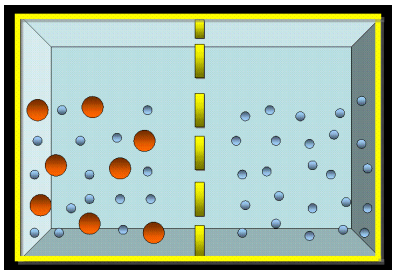
7. Draw a hypertonic solution with a cell. Be sure to include before and after pictures. Describe why the changes occurred.

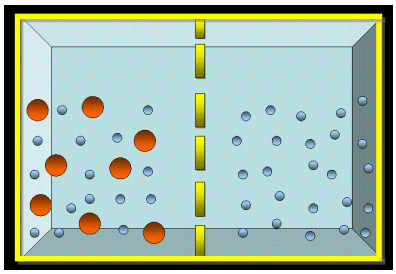
8. What happens (use key terms) in blood dialysis?





FORMAL SHAKERS LAB





Shakers Lab

Team Members: _____
_____
_____
_____
_____
_____

Purpose: To investigate the movement of ***particles*** *across membranes.*

SHAKER: _____

1. Make initial observations (0 sec) about your shaker. Sketch a diagram of the particles and the model.

2. Make observations after 15 seconds. Note the motion of the particles in relationship to the pores in the bottle caps.

3. Make observations after 30 seconds.

4. Make observations after 45 seconds. Draw, to scale, a diagram of the model, particles, and the cap in between the bottles.

5. As a group come to an overall conclusion about your model. Think about what materials were able to pass from one bottle to the next. Which part of the model determined the motion of particles? Write your answer below. Be prepared to share your results.

6. Summarize the conclusions about the shakers from each of the other groups. Remember to discuss about the role of the pores in the cap.

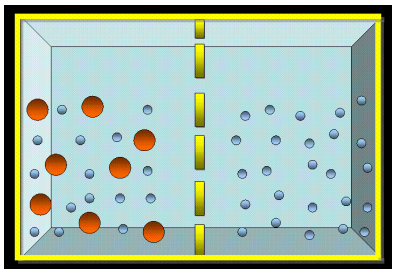
F. SHAKER _____

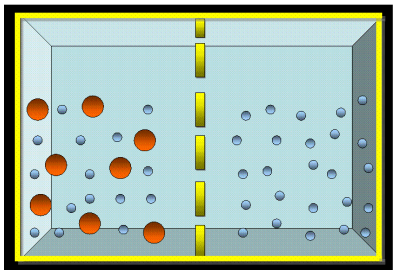
G. SHAKER _____

H. SHAKER _____

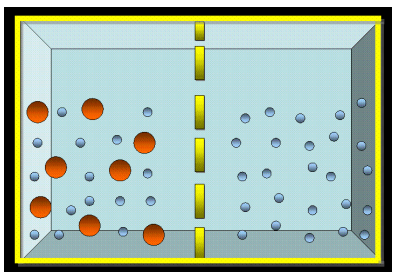
I. SHAKER _____

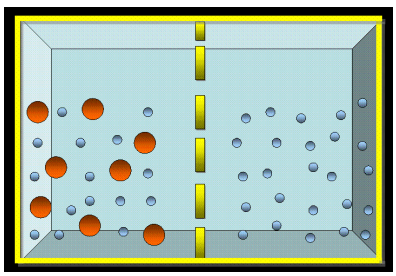
J. SHAKER _____





FORMAL OSMOSIS LAB





Osmosis Lab

Team Members: _____
_____
_____
_____
_____
_____

Purpose: To investigate the movement of ***<u>water</u>*** *across membranes.*

Check for the following items at your station: 3 plastic tubs, 1 syringe, 1 graduated cylinder, and 1 sharpie.

<u>Trial 1</u>

Gather the following materials. You will have **<u>7</u>** minutes to complete this trial.

- 1 sausage casing
- 2 pieces of 20 cm string
- 280 mL of water in graduated cylinder

1. Label one of the tubs as "Trial 1: water in water."
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Pour the water into the Trial 1 tub.
4. Using the syringe, extract 30 mL of water from the tub.
5. Having one person hold the casing open (open end), inject the 30 mL of water into the casing.
6. Squeeze the open end of the casing so water does not leak.
7. Raise your hand for an instructor to come and check the casing.
8. Place the tied casing into the tub.
9. Complete Post Lab questions 1-2.
10. STOP! Wait for approval to move on.

<u>Trial 2</u>

Gather the following materials. You will have **<u>7</u>** minutes to complete this trial.

- 1 sausage casing
- 2 pieces of 20 cm string

- 280 mL of water in graduated cylinder
- 250 mL sugar solution (when told to do so below)

1. Label one of the tubs as “Trial 2: water in sugar.”
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Collect the sugar solution in this tub.
4. Using the syringe, extract 30 mL of water from the graduated cylinder.
5. Pour the remaining water into the tub containing the sugar water
6. Having one person hold the casing open (open end), inject the 30 mL of water into the casing.
7. Squeeze the open end of the casing so water does not leak.
8. Raise your hand for an instructor to come and check the casing.
9. Place the tied casing into the bucket.
10. Complete Post Lab questions 3-4.
11. STOP! Wait for approval to move on.

Trial 3

Gather the following materials. You will have **7** minutes to complete this trial.

- 1 sausage casing
- 2 pieces of 20 cm string
- 500 mL of water in graduated cylinder
- 30 mL sugar solution in the syringe

1. Label the last tub as “Trial 3: sugar in water.”
2. Tie one end of the case shut using the string. Make sure the knot is very tight.
3. Pour the water into this tub.
4. Having one person hold the casing open (open end), inject the 30 mL of sugar solution into the casing.
5. Squeeze the open end of the casing so water does not leak.
6. Raise your hand for an instructor to come and check the casing.
7. Place the tied casing into the bucket.
8. Complete Post Lab questions 5-6.
9. STOP! Wait for approval to move on.

Lab Questions

1. Make initial observations of the setup of **Trial 1**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

2. Predict what will happen after two days for **Trial 1**.

3. Make initial observations of the setup of **Trial 2**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

4. Predict what will happen after two days for **Trial 2**.

5. Make initial observations of the setup of **Trial 3**. Include the contents within the casing and the contents outside the case. Also, describe the shape of the casing and the pressure within.

6. Predict what will happen after two days for **Trial 3**.

7. Describe any changes in the casing of **Trial 1** including descriptions of the shape of the casing and the pressure within.

8. Why did the changes in **Trial 1** occur? Was your hypothesis correct?

9. Describe any changes in the casing of **Trial 2** including descriptions of the shape of the casing and the pressure within.

10. Why did the changes in **Trial 2** occur? Was your hypothesis correct?

11. Describe any changes in the casing of **Trial 3** including descriptions of the shape of the casing and the pressure within.

12. Why did the changes in **Trial 3** occur? Was your hypothesis correct?