Embracing a Diverse Student Population within an Urban Science Classroom Through the Use of Inquiry-Based and Culturally Relevant Pedagogy: A Multipedagogical Approach in Narrowing the Science Achievement Gap

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Embracing a Diverse Student Population within an Urban Science Classroom Through the Use of Inquiry-Based and Culturally Relevant Pedagogy: A Multipedagogical Approach in Narrowing the Science Achievement Gap

By

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A Culminating project submitted to the Department of Education and Human Development of The College at Brockport, State University of New York in partial fulfilment of the Requirements for the degree of Master of Science in Education
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Abstract

Inequalities have always existed between individuals of varying race, ethnicity, gender, and socioeconomic status. How to overcome such injustices is always a highly debated topic. One way these inequalities between individuals of various demographic groups have shown themselves in a tangible way, is through the modern day recognizable achievement gaps that exist between urban and nonurban student populations in the realm of science education. Improving science learning outcomes for all students while attempting to narrow the science achievement gaps have become a theme in recent science education reforms brought about through the National Research Council (1996, 2000) and the release of the Next Generation Science Standards (NGSS, 2013).

The demographic student population within modern urban science classrooms have seen both rapid changes and an increase in diversity. Traditional ways of teaching science are no longer successful in reaching the current diverse student groups as can be seen in the noticeable science achievement gaps. Ineffective pedagogy and a lack of understanding for new diverse student populations have led to an increase in research and studies examining alternative methods for teaching science.

Keeping these realities at the forefront of intent, this project and unit plan were designed with an attempt at teaching science in a way that is both meaningful and relevant to diverse student populations found within current urban science classrooms. A multipedagogical approach through the use of Inquiry-Based and Culturally Relevant Pedagogy was chosen per recommendation of current literature and research on how to successfully teach science within an urban setting.
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Chapter I: Introduction

Achievement gaps in science have long existed between students of differing socioeconomic backgrounds, ethnicities, cultures, and genders. Improving science learning outcomes and closing any existing achievement gaps are a priority in modern educational reform. Numerous attempts at closing the gaps have been made in the past with various results. However, with the advent and implementation of No Child Left Behind (NCLB) Act of 2001, the achievement gaps between urban students and their nonurban counterparts have come to the forefront of the educational world. Changes within the student demographics within the United States have become increasingly diverse and the science achievement gaps among demographic subgroups continue to persist (NGSS, 2013). With this in mind, modern initiatives brought forth by the National Research Council (NRC, 1996, 2000) and Next Generation Science Standards (NGSS, 2013) have attempted to meet the needs of the ever changing demographics within modern science classrooms. As a result, teachers are currently compelled to make instructional shifts producing effective pedagogical practices that meet the needs of diverse students as the new standards are implemented.

Beginning urban science teachers face numerous challenges. One pressed in particular is the lack of preparation to effectively teach students of various cultural backgrounds different from their own (Brown-Jeffey and Cooper, 2011). Teachers desiring to work in an urban setting must acknowledge the reality they will inevitably have interactions with students who embody various cultures, ethnicities, social economic levels, religious beliefs, and languages other than English as their primary means of communication. Consequently, teachers must be able to meet the social and cultural realities of their students through the ability to construct pedagogical practices that can achieve this undertaking (Howard, 2003). Failure to do so can result in disconnects within the classroom and the establishment of pedagogical practices that fail in tapping into the strengths and relating to the specific needs found among urban students. Teacher-centered classrooms where teachers give information and students are responsible to receive and recall facts through memorization and rote activities fail to embrace the cultural strengths and individuality of urban learners. An example of the inability to establish this vital connection between teachers and students through teacher centered pedagogical practices
can be seen in what Haberman (1991) has termed the pedagogy of poverty. Haberman (1991) explains the pedagogy of poverty as “not being a professional methodology at all; and is not supported by research, by theory, or by the best practice of superior urban teachers” (p.292). Bransford, Brown, and Cocking (1999), indicate such pedagogy is not tailored to what is known about how children learn. The pedagogy of poverty also conflicts with what science education experts recommend as teaching and learning practices in science education (National Research Council, 2000). Ineffective pedagogy and the inability to understand and relate to diverse urban students have established the need for education reform and opened the eyes of educators to possible causes for the visible achievement gap seen between urban youth and their nonurban counterparts.

According to Brown-Jeffey and Cooper (2011), “one of the major concerns in the education of students has been how to address the race/ethnicity-based achievement gap between mainstream and minority children (p.66).” The need for reform that is able to address issues such as the pedagogy of poverty and the achievement gap must be taken into account. Modern educational reform has promoted a change within the urban science classroom from being one of a teacher-directed classroom to one in which students are actively engaged in their learning rather than just passive recipients (NRC, 2000; NGSS, 2013). The use of Inquiry-Based and Culturally Relevant Pedagogies can improve the success of ethnically diverse students found within an urban setting.

According to Songer et al. (2002), reforms that challenge the pedagogy of poverty through the use of inquiry-based instruction have promising results because they interrupt teacher-centered rote activities and demand active participation from students in the learning process (as cited in Thadani, et al., 2010, p.23). Improved academic success has also been demonstrated through the incorporation of native traditions, language, and culture into school science curriculum (Gilbert, 2011). The Australian Curriculum Studies Association (1996) recommends teachers use a repertoire of pedagogical and curriculum approaches to meet the various differences found among urban students (as cited in Black, 2007, p.13). Combining Inquiry-Based and Culturally Relevant Pedagogies increases the likelihood of overcoming the difficulties new urban teachers face of effectively teaching students of various cultural backgrounds different from their own. Allowing students to remain engaged through Inquiry-Based Learning while supporting and embracing their cultural identities through
Culturally Relevant Pedagogy will provide urban students with an increase possibility for success within the urban science classroom. Both urban science teachers and students of all diversity can benefit from the combination and implementation of this strategy thus supporting the notion of “All Standards, All Students” set forth by the Next Generation Science Standards (NGSS, 2013).

**Significance of Project**

The unit consisting of lesson plans, labs, and activities serves to provide an exemplary framework for pre-service and/or beginning science teachers who desire to work with diverse students within an urban setting. Since the lack of appropriate training and equipping of teachers for an urban setting has been well documented (Ladson-Billings, 2006; Haberman, 1995), teachers who desire to teach in an urban science setting are in need of resources to help them adjust. According to Gay (2002), “teachers need to develop rich repertoires of multicultural instructional examples to use in teaching ethnically diverse students” (p.113). This project will provide examples of how to turn a standards-based science curriculum into one in which diverse students will not be passive participants of a teacher-directed classroom, but will be engaged and actively participate in their attempt at fulfilling their learning targets thus meeting the mandate of their standards-based curriculum. The overall project will attempt to meet the inquiry science instruction conceptual framework set forth by Minner, Levy, Century (2010) characterizing inquiry science as consisting of

1. The presence of science content
2. Student engagement with science content
3. Student or communication responsibility for learning, student active thinking, or student motivation within one component of instruction-question, design, data, conclusion, (p.478)

Student cultural identities will also be supported, embraced, and strengthened through the insertion of Culturally Relevant Pedagogy in addition to the inquiry-based configuration thus promoting a student centered classroom. The final project will be an example of a transitional unit of study for an urban science teacher looking to overcome the pedagogy of poverty and change their classroom from one of a teacher-centered focus to that of student-centered while meeting the needs of their diverse student population.
Definition of Terms

Constructivist Theory of Learning: Theory in which learning is an active process and is a personal interpretation of the world by which knowledge is constructed from and shaped by experience.

Culturally Relevant Pedagogy: The teaching and learning that integrates and nurtures students’ unique background knowledge, culture, home, family and community experiences to promote student achievement and cultural consciousness.

Culturally Responsive Practices: Culturally responsive practices are specific educational practices, instructional strategies, team processes, and curricula content which have been established by research to increase the achievement of culturally diverse students.

Disadvantage: Encompasses a range of economic, social, cultural, and political exclusions that influence and are influenced by educational achievement.

Inquiry-Based Learning: a range of philosophical, curricular, and pedagogical approaches to teaching in which the core premises include the requirement that learning should be based upon student engagement, investigation, and questions. Students are active in their pursuit of knowledge rather than passive recipients. Teachers act as facilitators of learning rather than vessels of knowledge.

Pedagogy of Poverty: Concept devised by Martin Haberman to describe a form of instruction that has been accepted within the typical urban classroom illustrated by teacher centered classrooms with students who partake in rote activities.
Chapter II: An Outline of the Literature Review with References

Achievement Gap in Urban Science Classroom

With the advent and implementation of No Child Left Behind (NCLB) Act of 2001, the achievement gap between urban students and their nonurban counterparts has come to the forefront of the educational world. Though the achievement gap has existed for quite some time, NCLB has attempted to bring accountability within the realm of education and social justice. High-stakes test results, government-established standards, and the requirement of “qualified teachers” brought about through NCLB have created a demand for examination of current educational practices and their effectiveness (Minner, Levy, & Century, 2010). As inquiries take place, possible explanations for the lack of success within “low performing” schools have been brought to light. Since “low performing” schools tend to be located in urban areas, the need for reform within such schools has become paramount.

One significant area in which the achievement gap is quite visible is within science education between urban and nonurban students. The science achievement gap can first appear to be the result of socioeconomic diversity found among urban students and their nonurban counterparts. Students attending nonurban schools tend to be from affluent upbringings when compared to urban students who are more likely to be from poverty stricken backgrounds. Socioeconomic differences can in return influence the achievement patterns among students within the science classroom (Norman, Ault, Bentz, & Meskimen, 2001; Johnsons, 2009). However, upon further investigation, one will discover economic disadvantage is not the only factor contributing to the science achievement gap found within differing classrooms. Urban schools are also home to a larger population of ethnically diverse students. This ethnically diverse student population can consist of individuals from a variety of ethnic minority groups along with large numbers of immigrant families. Upon entering the urban science classroom, this ethnically diverse student population carries with them a vast array of cultures, beliefs, religions, and languages spoken. However, these experiential, societal, and cultural factors may prevent urban
students from experiencing success in the science classroom if such characteristics are seen as a barrier to overcome rather than as a means to connect with the diverse student population (Gibbons, 2003).

Areas in which urban students face inequalities in their science education experiences are seen in schooling practices, academic achievement, the culture of schooling, and resources (Barton, 2001). Social conditions such as poverty influence academic achievement and the quality and quantity of resources allocated to urban schools thus influencing urban students’ success. Schooling practices are influenced by a teacher’s beliefs about multicultural issues and as a result inadequately address the complexities of teaching and learning with a culturally diverse student population. The culture of schooling may appear contradictory or conflicting with home culture of urban students. A combination of any of these factors within the science classroom contribute to the overall science achievement gaps we see among urban and nonurban student populations (Lee, 2005).

Social conditions and hardships can influence the academic achievement of urban students. Students who attend urban schools face the multifaceted challenges found within an urban environment. According to McKinney, Flenner, Frazier, & Abrams, 2006, concentrated poverty, “collective socialization,” victimization, family instability, and early exposure to violence within an urban environment can become obstacles urban students must overcome in order to achieve personal, social and academic success. Poverty, for example, can impact the lives and cultural values of urban learners (Heard, 2011). As a result, a child’s perceptions, interactions, and relationships can be influenced by the effects of family poverty. In order to narrow the achievement gap between urban and nonurban students within science education, awareness of the urban culture and social conditions must be taken into account when developing pedagogical practices and methodologies for teaching science in order to properly reflect the cultural identities seen among urban students (McKinney, Flenner, Frazier, & Abrams, 2006)).

Resource allocation disparities also persist between urban and nonurban schools and may partially contribute to the continuing recognizable science achievement gap. Norman, Ault, Bentz, & Meskimen, (2001), views resource allocation between suburban schools attended by predominantly white students and urban
schools attended by minority students as a smaller gap that contributes to the overall visible achievement gap. Disparity in science achievement can be attributed to urban students disproportionately attend schools with fewer or inferior resources. These resources can consist of a lack of school-based materials such as updated science textbooks, scientific materials, lab equipment, and access to sufficient technology in order to teach science. Limited access to certified science teachers can also be found in urban schools with students having to take science courses with teachers who are unqualified and/or uncertified to teach science. High rates of urban teacher attrition combined with certified science teachers who lack adequate preparation to teach culturally diverse students can influence science teacher effectiveness (Johnson, 2009).

In terms of science in the urban classroom, the notion of how teachers and students view one another along with how they interact can determine how science is presented (Barton, 1998). These interactions can represent wide-ranging beliefs, styles of communication, and values. How a teacher chooses to represent science to students based upon their own beliefs about teaching-learning process can determine what types of activities, lesson plans, assessments, and classroom management strategies are developed and incorporated into the classroom. According to Bryan and Atwater (2002), culturally diverse students tend to be seen as and believed to be less capable than other students by both prospective and practicing teachers. Bryan and Atwater (2002), also claim teachers who have a low expectations regarding their students cause them to behave differently towards them and provide pedagogical practices that fail to enhance their learning. As a result, schooling practices such as the pedagogy of poverty are established in which urban students are expected to be passive learners within a teacher centered classroom performing tasks such as rote activities, reading textbooks, and completing worksheets (Haberman, 1991). However, such pedagogical practices are contrary to the “scientific inquiry” approach to teaching science recommended by the National Research Council (1996, 2000). The need for teachers to acquire effective pedagogical practices has become a necessity with regards to closing the achievement gap and improving science learning outcomes for students of all culture, ethnic, racial, socioeconomic, and gender backgrounds (Jackson & Ash 2012).
Classroom environments can be different from real-life environments of the students. As a result, conflict may exist between students’ home culture and school culture (Barton, 2001). Urban science classrooms become cultural interface zones where the culture of students mingle with culture of schooling (Norman, Ault, Bentz, & Meskimen, 2001). Norman, Ault, Bentz, & Meskimen, (2001), suggest the lack of both the students’ and teachers’ preparation and understanding of how to navigate these interface zones allows for cultural conflict to arise. Lee (2002), explains how miscommunications and misunderstandings can be developed as a result of differences between discourse patterns found in school and those of diverse languages and cultures. Consequently, student learning is hindered as well as the teacher’s effectiveness resulting in a negative effect on science achievement within the urban classroom. Without proper teacher preparation, training, and professional development to manage and navigate cultural interface zones, conflicts will continue to arise within urban classrooms resulting in a lack of student learning contributing to the science achievement gap.

As long as inequalities exist, science achievement gaps found between urban and their nonurban counterparts will persist. Although teachers and schools may function at their best and meet all requirements, most cannot eliminate inequalities that have an origin outside school doors (Berliner, 2009). Gorski (2013) states “the only surefire way to eliminate the achievement gap is to eradicate poverty” (p.48). Education practitioners can’t eliminate poverty on their own so current research suggest they find ways to overcome inequalities in the realm of schooling practices and the culture of schooling in order to meet the increasing demands of the diverse student populations found within the urban science classroom (Lee, 2005; Lee, Miller, & Januszyk. 2014; National Research Council, 1996, 2000; NGSS, 2013).

Reform: Confronting the Science Achievement Gap

In recent years, there has been an increase in the attention given by science educators to issues of student diversity and the closure of the science achievement gap. With the ever changing student demographics, science educators are in need of being able to adapt and adjust to their ever changing diverse student populations. In order to meet the needs of the changing landscape of the urban science classroom and the rise
for accountability in decreasing the science achievement gap, institutions such as the National Research Council (1996, 2000), National Science Teachers Association, and the American Association for the Advancement of Science created initiatives such as A Framework for K-12 Science Education and the Next Generation Science Standards (NGSS, 2013). With the advent of such initiatives, urban science teachers are now confronted with the necessity for change to occur with how they teach science and how they view their current diverse student populations. The research conducted and set forth by the National Research Council (NRC) in A Framework for K-12 Science Education and the new science standards expressed within the Next Generation Science Standards promote a need for change to take place within the areas of schooling practices and the culture of schooling itself.

The release of A Framework for K-12 Science Education by the NRC (1996, 2000) showed research no longer supports the traditional model for teaching science through a teacher-centered atmosphere and culture, but one of student-centered based upon constructivist theory of learning. Where a teacher-centered environment prevails, students are passive learners through teacher’s lectures, have no/few interactions between students, form no cooperative groups, and promote sporadic assessments of learning (Burrows, 2003).

Traditional science instruction presents scientific concepts as isolated facts without making connection to the real world and fails to make connections needed for students to find relevance of concepts in their own lives (Johnson, 2011). Conversely, Burrows (2003) describes a student-centered culture and environment as one in which students are active learners through constructivist activities, have constant interaction among one another, form cooperative groups, and partake in daily assessments of learning. Implementing science-inquiry into the classroom allows students to explore and investigate meaningful activities opening the door for connections to be made between scientific concepts/ideas and personal life experience/knowledge of students.

With an increase in the diversity of student populations within the urban science classroom, teachers must learn to embrace the culturally diverse urban student and learn how to properly alternate and combine a variety of pedagogical practices in order to meet their needs. Schooling practices must change in order to adapt to the ever changing urban science classroom and student demographics. Teachers are now faced with the
important task of modifying instruction to make science comprehensible for all learners (Gibbons, 2003). With this in mind, the Next Generation Science Standards have put forth science standards that attempt to provide a foundation for all students regardless of their socioeconomic status, racial/ethnic background, disability, English proficiency, gender, and gifted/talented to be proficient in scientific concepts/ideas making them college and career ready (NGSS, 2013). The NGSS (2013) recommends educators to use effective strategies based upon existing research such as:

1. Connecting science education to student’s sense of “place” as physical, historical, and sociocultural dimensions
2. Apply students’ funds of knowledge and cultural practices
3. Use project-based science learning as a form of connected science
4. Home Culture Connections
5. Culturally relevant pedagogy

as a means to connect with the diverse student populations found within the urban science classroom. The combination of effective teaching strategies provides a way to narrow the science achievement gap seen between urban and nonurban student groups (Johnson, 2009).

Inquiry-Based Pedagogy

As efforts are made to transition from teacher-centered classrooms to those of student-centered, one common goal is to encourage teachers to use scientific inquiry in their instruction as a means to advance students’ understanding of scientific concepts and procedures (Minner, Levy, Century, 2010). Scientific inquiry is rooted in a constructivist theory of learning in which students need to be actively engaged in the learning process. Learning theorists such as Jean Piaget, Lev Vygotsky, and John Dewey proposed that students who are actively participating in their education develop a conceptual understanding and express a greater comprehension of content. The use of relevant realia in the learning process provides opportunities for student engagement. As a result, students become active and motivated in their pursuit of knowledge and information and experience a genuine learning opportunity.
The National Research Council (NRC) presented inquiry-based instruction as the central strategy for teaching science in the release of A Framework for K-12 Science Education (NRC, 1996). The NRC (2000) suggests the essential features of classroom inquiry are:

1. Learners are engaged by scientifically oriented questions.
2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
3. Learners formulate explanations from evidence to address scientifically oriented questions.
4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
5. Learners communicate and justify their proposed explanations (pgs. 45-46).

According to the NRC (2000), if students are able to partake in the above essential features of classroom inquiry, then they will be given an authentic opportunity to learn science, learn to do science, and learn about science. With the acknowledgment of the science standards put forth by the NRC and their recommendation to use inquiry-based strategies to teach science, change needs to occur within the classroom. As a result of the NRC releasing such findings, both teachers and students need to experience change in how science is being taught and how science is learned.

Documentation through literature and research have shown varying results from the implementation of scientific inquiry within science education instruction. Minner, Levy, Century (2010), analyzed over 138 studies and claim instruction that emphasizes student active participation in the learning process exhibit a positive trend favoring inquiry-based instructional practices. Geier et al., (2008), provides evidence that curriculum-based science-inquiry interventions can improve student outcomes in traditionally underserved educational settings. This was shown by improved performance on standardized tests. The use of standards-based instruction in combination with inquiry, problem solving, and open-ended questioning improved student achievement and attitudes among urban African American students (Kahle, Meece, & Scantlebury, 2000).

However, even though some studies and research show a positive trend in the implementation of inquiry-based pedagogy there are also studies who have shown inquiry not having any effect on learning outcomes.

Inquiry-Based learning can overcome barriers for students with diverse languages and cultures (Cuevas, Lee, Hart, & Deaktor, 2005; Lee, 2002). Lee, Buxton, Lewis, & LeRoy (2006), showed students from all
demographic subgroups were benefited by an inquiry-based instructional intervention, having those students from non-mainstream and less privileged backgrounds in science showing greater gain than their more privileged counterparts. English Language Learners (ELL) benefited from inquiry-based instruction because of its ability to facilitate learning of science in an environment more supportive and effective to their needs of acquiring vocabulary, cooperative learning, time allotment, and comfort level (Amaral, Garrison, & Klentschy, 2002).

Through the process of inquiry, learners are taught to question, challenge, and critically analyze information rather than blindly accept what is taught. Teachers are no longer seen as the final authority, but students develop ability to see themselves as having the capacity of self-empowerment. Inquiry-based learning and instruction then becomes a tool for promoting equity in science education. According to Moje, (2007), such characteristics provides inquiry-based instruction as a means to represent both socially just pedagogy and social justice pedagogy. Inquiry-Based learning challenges instruction inequality (Thadani et al., 2010). This aspect is important when working with diverse student populations within an urban setting who tend to have experienced inequalities and injustices.

With increase research directed towards students from diverse languages and cultures as a result of changing student demographics and desire to close the achievement gaps, it appears an inquiry-based pedagogy has additional advantages for urbans students by providing opportunities for all students to engage in scientific investigation in a way meaningful to them individually (Johnson, 2011). Rather than receive scientific concepts through teacher centered lectures and being required to recall facts, students are provided with opportunity to learn new scientific concepts through personal investigation opening door to gain understanding of science in an active way which is unique to them. Each individual who is involved in the inquiry process take from what they already know and try to make sense out of what is being introduced. Teachers who provide learning environments where science is practiced through personal investigation allow for students to explore their ideas and investigate questions derived from personal experience increasing chance for conceptual understanding and retention of scientific concepts (Lee, 2005).
Ladson-Billings (1995), advocates Culturally Relevant Pedagogy (CRP) can be used as a means towards authentic student learning for students of diversity. Ethnically and culturally diverse student populations can benefit through the use of CPR within the classroom as supported by literature (Gay, 2000; Gay 2002; Ladson-Billings, 1994; Ladson-Billings 1995). CRP is researched-based pedagogical practice that can unite a student’s cultural knowledge and way of life with a teacher’s beliefs and understandings. According to Ladson-Billings (1994), CRP is a teaching method “that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes” (p. 18). Gay (2002), defines culturally relevant teaching “as using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively” (p. 106). It provides a way for diverse students to maintain their cultural integrity and succeed academically and socially within the classroom. CRP works as a necessary bridge between school and home culture and can bring about a smooth transition between cultural identity and science concepts.

Teachers play a vital role when implementing CRP. In order for teachers to put CRP into practice, they must be able to incorporate student culture into their lessons, curriculum and classroom environments. Therefore, teachers must find ways to build their cultural competence. Gay (2002), suggests five essential elements of CRP are:

1. Developing a knowledge base about cultural diversity
2. Including ethnic and cultural diversity content in the curriculum
3. Demonstrating caring and building learning communities
4. Communicating with ethnically diverse students
5. Responding to ethnic diversity in the delivery of instruction (p.106).

Creating a classroom where teachers use students’ lived experiences as part of science learning is at the core of implementing CRP in science education (Upadhyay, 2006). Examining everyday experiences and informal language practices students exhibit may become an entry point for effective teaching and learning of science to take place (Lee, 2002). It is through such observations, teachers gain a wealth of information needed to create
cultural congruent environments and instruction. Teachers need to understand the relationship between scientific practices and their students’ everyday knowledge. According to Lee (2005),

“Learning environments that articulate the relation of science disciplines with students’ cultural and linguistic practices enable students to capitalize on their experiences as intellectual resources for science learning and to explore and construct meanings in ways that relate science to their social, cultural, and linguistic identities” (p. 438).

At the intersection of what students know and where scientific concepts connect with what they know is the place new understandings are formed. Teachers must learn to identify and elevate the funds of knowledge (Moll, 1992) students poses and enter the science classroom with. It is through these funds of knowledge connections can be made with scientific ideas and concepts. Students are not the only individuals who can be sources of funds of knowledge, but parents, relatives, teachers, and community members may also be sources. Lipka et al. (2007), describes a study where a Yupiaq immersion teacher investigates and discovers funds of knowledge from students, relatives, elder members, and within her own knowledge among the Native Yupiaq Eskimo Communities. Based upon Yupiaq cultural activities such as pattern making, berry picking, and others, along with math topics, a mathematical curriculum was developed entitled Mathematics in a Cultural Context (MCC). Linking the concepts of geometry with patterns and parkas making, they were successfully able to create authentic learning situations in which the cultural identity of the native Yupiaq students were not abandoned but preserved. This case study exhibited how all individuals involved were able to connect the culture and language of the native Yupiaq communities with curricular concepts meeting the goal of improving Alaskan Native students’ math performance. Though this case study was subject specific to math, there has been similar success in science classrooms also implementing CRP.

With the failure of the educational systems ability to implement students’ native culture and languages into the learning approaches incorporated within classrooms, there has been a call for culturally based science curriculums. An example of a culturally based science curriculum lesson plan would be the *Loololma Model* created by the Native Science Connections Research Project (NSCRP) funded by the National Science
Foundation (Gilbert, 2011). This model was created to be implemented on the Navajo, Hopi, San Carlos Apache and Zuni reservations in the Native Science Connections Supplemental Curriculum. The foundational elements of this model are an action and inquiry oriented theme in combination with culturally based native, ideas, concepts, knowledge and language. According to Gilbert (2011), curriculum developers work with local community members such as tribal elders, medicine men and women, community leaders and educators, and local cultural experts in order obtain native science culture and create a culturally relevant curriculum also including national and state science standards. The idea is to provide native students an academically demanding and culturally relevant method of learning.

With a desire to create a lifelong learning and assessment model for science within Indigenous settings, Sutherland and Henning (2009) created Ininiwi-kiskānītamowin. Ininiwi-kiskānītamowin is a framework for long-term science education with a goal to see teachings of Indigenous cultures incorporated into school curricula in order that science education can become more relevant for Indigenous students. In connection with science teachers, consultants, administrators, and current research/literature Sutherland & Swayze (2012) determined four key components were necessary for the framework:

1. Learning science wholistically by “coming-to-know”: perspectives that identify how individually, Indigenous students uniquely engage with Western science and Indigenous knowledge;
2. Culturally relevant approaches to teaching science: suggested pedagogical approaches to teaching science in Indigenous settings;
3. Social and ecological justice: approaches to teaching for social and ecological justice in science; and
4. Ecological literacy: the inclusion of incorporating values into science instruction with the overall goal of ecological literacy. (pgs. 85-86)

Ininiwi-kiskānītamowin framework was eventually applied to the Bridging the Gap (BTG) in Winnipeg, Manitoba (Sutherland & Swayze, 2012). BTG is a year-long program providing inner-city students with free, science-based, culturally relevant environmental education programming. Ininiwi-kiskānītamowin framework was used to assess the BTG for its strengths and weaknesses. The framework exposed where BTG program needed improvement and what areas of the program should be preserved. The assessment of the BTG program provided opportunity to observe and determine how the Ininiwi-kiskānītamowin framework could be used as a
tool in future evaluations of urban and indigenous science education programs. Using the *Ininiwi-kiskānītamowin* framework also provided science educators with new ways of thinking and designing science education modules through incorporating CRP, indigenous language, and community members in a more effective learning experience for urban science students within Winnipeg. The use of the *Ininiwi-kiskānītamowin* framework exposed how creating learning environments corresponding to one’s home environment could be improved. CRP can be adapted in design and manipulated to meet the local needs of a community in any location serving diverse student populations.

Both literature and research have shown academic achievement of ethnically diverse students will improve when they are taught through their own cultural and experiential filters. Culturally based research studies have demonstrated students’ academic achievement has improved as a result of CRP along with preserving native language and culture.

**Conclusion**

As student demographics continue to change and diversify within the urban science classroom, so should the schooling practices and methods which teachers/educators use to make teaching science meaningful and applicable to the lives of the students. According to Lee (2002), “to enable these students to learn science, a pedagogy merging subject-specific and diversity-oriented approaches is needed, although these approaches have traditionally remained distinct and separate from each other” (p. 34). With the notion of using and applying a multipedagogical approach through the implementation of Inquiry-Based and Culturally Relevant Pedagogy the expectation is to bring together a fusion of pedagogical practices to meet the multifaceted characteristics of today’s diverse student populations within the urban science classroom. As the culture of schooling is transformed through Inquiry-Based Pedagogy from teacher-centered to student centered, and schooling practices are altered by the application of Culturally Relevant Pedagogy, classrooms will no longer be a place of cultural conflict but an environment that is culturally congruent and advantageous in narrowing the science achievement gap for diverse urban learners.
Chapter III: Curriculum Transitional Unit Project

Overview

The overall unit plan was developed from two core constructs. The first was incorporating the social-cultural norms of an average urban student in the Rochester City School District and make an authentic connection with the school based science standards. The second was to transition the classroom environment from one of teacher centered to that of student centered. By using methods such as inquiry-based and culturally relevant pedagogy, the goal was to create a “third space” in which students’ background, identity, and culture fuse with curricular concepts. Liptka et al. 2007, claims classrooms can become a “third space” by allowing the opportunity for local cultural knowledge to be combined with that of the educational school based realm. It is a place in which contemporary pedagogy could be used without the loss of the students’ culture, language, and values.

A major theme within the activities and lesson plans was to transition the classroom environment from one of teacher centered to that of student centered. In order for this to occur, there must be a change in the social relations and authority structures within the classroom. Students become an active member in their own learning process instead of a passive recipient. As the teacher releases more control and responsibility to the students, they become more accountable and responsible for their own work and progress. They begin to decide on their own when they need help and if they should ask the teacher or a classmate. Incorporating inquiry-based pedagogy provides opportunity for this transition to take place. Class time within each lesson plan was allocated specifically for working on assigned projects and activities. Before the beginning of each module, students are assigned a video to watch for homework or at a time convenient to them. These videos could also be referred back to during or after the activities. Freedom is provided for the teacher to create their own instructional video in which they provide necessary input students need for content purposes or they can choose from a variety of instructional videos available today. During class time, teacher spends little time lecturing (if any at all), but provides guidance by assisting and supporting students as facilitator in their assigned activities as well and mediating and facilitating whole class discussions and/or debates.
Another major theme was to create culturally conducive lesson plans. In order to create modules supportive of this concept, I decided to implement the Loololma Model set forth by the Native Science Connections Research Project (NSCRP) (Gilbert, 2011). As seen in the figure below, each phase was kept in the forefront of designing the modules and activities used in the overall unit plan. Each phase represented within the activities is in sequential order as requested per Loololma Model. In phase 1 students are introduced to a topic in order to gain interest and stir up motivation. This tends to be something they know or are interested in. Phase 2 provides information on topic in which students have some background knowledge and feel comfortable with. The individuals are introduced to information and topic of focus. This phase helps students cope with any indifference, fear, or insecurities they may have with the science concepts about to be introduced. Found between Phase 2 and Phase 3 is the transitional move from cultural understandings to scientific concepts to be learned. Students are eased into knew material through ideas and concepts they already know from a working knowledge of topic and experience. Phase 3 is all about introducing and communicating desired science concepts found within the standard based curriculum. As the cultural topic and interest of choice fuses with the new science concepts being introduced students are able to make needed connections between what they know and new information. In phase 4 the connections made in Phase 3 will be furthered developed and students begin
to relate new concepts with other ideas along the same notion as newly received science concepts. In this phase, the eventual assessment piece is found and students make necessary steps in meeting their stated learning targets.

**Project Design**

This project’s objective is to take a unit of study from the Rochester City School District Living Environment Curriculum and create lesson plans, labs, exercises, and activities while keeping student engagement, participation, and cultural identities at the forefront of the design. The intent is to take a standards-based curriculum and support it with Culturally Relevant Pedagogy and an Inquiry-Based Learning platform. The design will support the notion if reform is to take place within a classroom, there must be change with how concepts and standards are being currently taught. Culturally Relevant Pedagogy demands alterations and modifications to be made to teaching practices and materials in order to connect with students of a diverse population (Rychly & Graves, 2012). According to Black (2007):

Student-centered learning promotes:

1. Is based on a challenging curriculum connected to students’ lives
2. Caters for individual differences in interest, achievement and learning styles putting learners at the center
3. Develops students’ ability to take control over their own learning
4. Uses authentic tasks that require complex thought and allow time for exploration
5. Emphasizes building meaning and understanding rather than completing tasks
6. Involves cooperation, communication and negotiation
7. Connects learning to the community (p.13-14)

Such considerations will be taken into account within the overall design.

**Project Unit Plan**

The table below is an overview of the transitional unit project proposed to meet the particular needs of students within the Rochester City School District. No allotted time table was introduced within the unit plan below in order to allow for freedom to alter or change plans according to learning needs of students and provide opportunity for further investigation if so demanded by students’ learning process. The unit plan below provides an exemplary overview of how the educational unit topic provided by the Rochester City School
District Living Environment Curriculum (see appendix) could be organized into corresponding lessons and sequence of ideas and concepts. As one glances over the unit plan they will recognize not all human body systems and concepts are represented in detailed lessons as demanded by the curriculum. As is the case, I felt free to take the liberty to provide a few examples of how some of the ideas, concepts could be represented in an introductory way in order to remain consistent with the significance of the project. Educators who view this unit plan should take their own liberty to add complete modules representing all body systems in order to comprehensively satisfy all concepts and ideas demanded by the curriculum.

<table>
<thead>
<tr>
<th>Intro Human Machine</th>
<th>Intro Overview of different features of the Human Body</th>
<th>Biological Levels of Organization From Atoms to Complex Organisms</th>
<th>Body Systems Movement and Coordination</th>
<th>Body Systems Circulation and Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity 1:</strong> Our Love of Smartphones</td>
<td>Activity 2: Your Body on Cannabis</td>
<td>Activity 3: Organization of the Rochester City School District Student Population</td>
<td>Activity 4: Top 10 Most Popular Dance Moves</td>
<td>Activity 5: From One Place to Another</td>
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<tr>
<td><strong>Body Systems:</strong> Digestion and Excretion</td>
<td>Maintaining Homeostasis Endocrine System &amp; Negative and Positive Feedback Mechanisms</td>
<td>Disruption in Homeostasis Intro to Pathogens Immune System Lymphatic System</td>
<td>Human Body Systems Interactions Connections Between Body Systems</td>
<td>Movie Day Unit Overview and Review</td>
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<tr>
<td><strong>Activity 6:</strong> Pass the Pepto</td>
<td>Activity 7: I Need My Energy Drink</td>
<td>Activity 8: Tattoo Terror</td>
<td>Activity 9: Web of Connections</td>
<td>Students watch: Incredible Human Machine</td>
</tr>
</tbody>
</table>
Lesson 1: Lesson Plan

Brian Walker                          9th Grade Living Environment
Lesson Title: Our Love of Smartphones Topic II: Human Structure and Function
Time Estimation: 45+ minutes

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

Purpose:
Student prior knowledge of the Human Body will be collected through questionnaire on whether or not the Human Body could be considered a machine by comparing and contrasting it to Smartphones.

Student Objective:
- Students complete Our Love of Smartphones activity by working with a partner and answering questionnaire.
- Students participate in whole class discussion on similarities and differences between Smartphones and the Human Body.
- Students independently read article Smartphones: Smart Chemistry by Brian Rohrig and complete questions.

Essential Questions:
Can the Human Body be considered a Machine?

Learning Targets:
- Recall Prior Knowledge of the Human Body
- Compare similarities between Smartphones (non-living) and the Human Body (Living)
- Contrast differences between Smartphones (non-living) and the Human Body (living)

Materials:
- Our Love of Smartphone Activity Packet
- Smartphones: Smart Chemistry article by Brian Rohrig

Procedures:
Teacher’s Role: Teacher will introduce activity and direct students into working with partner on the Our Love of Smartphones Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Partner Work Activity - Students work with classmate on Our Love of Smartphones activity by completing module.
1. Introduction (Phase 1) – Our Love of Smartphones Brainstorm
2. Cultural Context (Phase 2) – Students investigate Smartphones in their own life situations by answering
3. Classroom Science (Phase 3) – What is a human machine? Students investigate what defines a machine?

4. Integration (Phase 4) – Students begin to compare and contrast Smartphones with the human body

Whole Class Activity - Class discussion facilitated by teacher and ongoing student participation as a result of completing partner work.

Independent Work Activity (if time permits): Students read article Smartphones: Smart Chemistry by Brian Rohrig and complete Homework

**Homework:**
Finish Reading Article and complete questions
Directions:
Choose a partner and make a list of as many types of Smartphones and their brand names as you can think of.

Why do you think there are so many different types of Smartphones available in today’s commercial market?

Why would an individual want to purchase a Smartphone when compared to a regular cell phone?
Even though there are a variety of Smartphones, what are some of the common functions most Smartphones can perform?

If you don’t own a Smartphone, how have you seen others use them? If you own a Smartphone, what are some specific ways you make use of it?

What do you think engineers and designers could improve upon with current Smartphone models?

Is a Smartphone considered a machine? What qualifications would a Smartphone need in order to be classified as a machine?
Dictionary.com defines a *machine* as:

“an apparatus consisting of interrelated parts with separate functions, used in the performance of some kind of work”

Wikipedia defines a *machine* as:

“A machine is a tool containing one or more parts that uses energy to perform an intended action.”

Merriam-Webster defines a *machine* as:

“a piece of equipment with moving parts that does work when it is given power from electricity, gasoline, etc.”

*Example*: a vehicle (such as a car or motorcycle)

Do the definitions of a machine listed above support your answer from the previous question? Why or why not?

As humans, we embrace machines such as Smartphones because they help us perform numerous tasks. Let us take it a step backwards and consider the Human Body that allows us to use these helpful tools. Could our Human Bodies be considered a machine as well? What characteristics of the Human Body could classify it as a machine?
Directions: Answer each question below to the best of your knowledge. Remember, there is no right or wrong answer. Make sure to write down whatever comes to your mind and leave nothing blank!

As a machine, Smartphones have numerous parts (varying in different shape, sizes, and structure) that work together to perform specific tasks allowing the phone to function and work properly. Each part has a specific structure and function allowing the phone to complete the work required of it. Are there any similarities between a Smartphone and the Human Body? What are they?

Are all the parts of the Human Body the same shape or size? Do their structures differ at all? Is there any variation in simplicity and complexity among the parts? Make sure to give detailed answers to support your claims!

Like a Smartphone, the Human Body has numerous parts functioning together in order to perform specific tasks. What are these parts and how do they work together in order to accomplish the intended actions? Give detailed examples:
Smartphones have GPS (Global Positioning System) which allow for individuals to figure out how to get from one location to another. How is the Human Body able to move from one place to another?

Smartphones have the ability to delete unwanted pictures, text messages, emails, files, etc. How do you think the human body purges itself of unwanted items?

Every now and then, an individual needs to plug their Smartphone into a charger. Why? What purpose or function does the Smartphone’s charger perform? Does the human body require anything in order to function properly? If so what (make a list below)? How does the body obtain these items and distribute their benefits?

Electrical messages are sent through different parts within a Smartphone in order to communicate desired tasks. Is the Human Body able to send electrical messages? If so how is it accomplished? Are electrical messages the only way different parts of the human body communicate? How else could different parts of the body communicate?
Smartphones are able to have Antivirus/AntiSpyware/AntiMalware programs installed on them. This type of software protects Smartphones from harmful entities. Is the human body susceptible to any type of harmful entities? If so what? Do our bodies come with any protective adaptations installed in them? If so, are these adaptations sufficient or do we also have to “install” certain protective safety measures?

**Smartphones: Smart Chemistry**

**Directions:** Read Article and answer questions that follow. This is an independent activity!

**Article Taken From:**

**April/May 2015**
*By Brian Rohrig*

**Download PDF**
As many as 84% of U.S. residents would not last a day without their cell phone.

Could you last a day without your cell phone? As many as 84% of U.S. residents could not, according to a recent poll conducted by *Time* magazine. It is hard to believe that 20 years ago, hardly anyone even owned a cell phone. And now the cell phone has morphed into something bigger and better—the smartphone. Worldwide, more than one billion smartphones were purchased last year. If you own a smartphone, you are probably aware that in a year or two, it will be practically obsolete, because the smartphone just keeps getting smarter.

In the 1950s, you would have needed a whole bank of computers on an entire floor of an office building to do what you are able to do with a single smartphone today. Even a low-end smartphone has more computing power than the computer system the National Aeronautics and Space Administration (NASA) used to put a man on the moon. Amazingly, you can surf the Internet, listen to music, and text your friends with something that fits in the palm of your hand. None of this would be possible without chemistry, and every time you use your smartphone, you are putting chemistry into action.

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**Smartphone chemistry**

If you are wondering what chemistry has to do with smartphones, just look at the periodic table. Of the 83 stable (nonradioactive) elements, at least 70 of them can be found in smartphones! That’s 84% of all of the stable elements.

Metals are what make smartphones so “smart.” An average smartphone may contain up to 62 different types of metals. One rather obscure group of metals—the rare-earth metals—plays a vital role. These rare-earth metals include scandium and yttrium, as well as elements 57–71. Elements 57–71 are known as the lanthanides, because they begin with the element lanthanum. The lanthanides often appear as the first of two free-floating rows located at the bottom of the periodic table. Scandium and yttrium are included in the rare-earth metals because their chemical properties are similar to those of the lanthanides.

A single iPhone contains eight different rare-earth metals. If you examine several varieties of smartphones, you can find 16 of the 17 rare earth metals. The only one you will not find is promethium, which is radioactive.

Many of the vivid red, blue, and green colors you see on your screen are due to rare-earth metals, which are also used in the phone circuitry and in the speakers. Also, your phone would not be able to vibrate without neodymium and dysprosium.
Rare-earth metals are not only used in smartphones but in many other high-tech devices, too. They are found in televisions, computers, lasers, missiles, camera lenses, fluorescent light bulbs, and catalytic convertors. Rare-earth elements are so important in the electronics, communications, and defense industries that the U.S. Department of Energy dubbed them the “technology metals.”

Rare-earth metals are not necessarily rare, but they tend to be scattered within the Earth. You typically do not find high concentrations of them in any one place. Extracting them from the earth can be costly and difficult. Rare-earth metals are a finite resource, and there is no known substitute for many of these elements. One of the biggest current challenges for the cell-phone industry is finding suitable replacements for many of these elements.

**Smartphone’s display**

When shopping for a smartphone, the single most important feature that people look for is the display. The screen allows you to see the phone’s display. If you have ever dropped your phone without damaging the screen, you were probably relieved. Smartphone screens are designed to be extremely tough.

This toughness is actually the result of a serendipitous accident. In 1952, a chemist at Corning Glass Works was trying to heat a sample of glass to 600 °C in a furnace when, unbeknownst to him, a faulty thermostat caused it to be heated to 900 °C. Upon opening the door, he was glad—and surprised—to find that his glass sample was not a melted pile of goo and that it had not ruined the furnace. When he took it out with tongs, he dropped it on the floor (another accident). But instead of breaking, it bounced!

Thus was born the world’s first synthetic glass-ceramic, a material that shares many properties with both glass and ceramic. Glass is an amorphous solid, because it lacks a crystalline structure (Fig. 1(a)). The molecules are not in any kind of order but are arranged more like a liquid, yet they are frozen in place. Because glass does not contain planes of atoms that can slip past each other, there is no way to relieve stress. Excessive stress forms a crack, and molecules on the surface of the crack become separated. As the crack grows, the intensity of the stress increases, more bonds break, and the crack widens until the glass breaks.

Ceramics, on the other hand, tend to be crystalline (Fig. 1(b)), and they are often characterized by ionic bonds between positive and negative ions—even though they can also contain covalent bonds. When they form crystals, the strong force of attraction between ions of opposite charges in the planes of ions makes it difficult
for one plane to slip past another. Ceramics are therefore brittle. They resist compression, but they can break when they are bent.

The combination of glass and ceramic forms a material that is tougher and stronger than each of the materials by themselves. A glass-ceramic is formed by overheating the glass, so a portion of its structure is transformed into a fine-grained crystalline material. Glass-ceramics are at least 50% crystalline, and in some cases, they are more than 95% crystalline.

This amazing glass-ceramic material is so resistant to heat that it has been used in the nose cones of supersonic-guided missiles used by the military. As a result of the success of glass-ceramic materials, the Corning Glass Works Company undertook a large research effort to find ways to make ordinary transparent glass as strong as glass-ceramic products. By 1962, Corning had developed a very strong type of chemically strengthened glass, unlike anything ever seen before. This super-strong glass would eventually make its way to nearly every smartphone screen. It is so strong it goes by the name, **Gorilla Glass. Laboratory tests have shown that Gorilla Glass can withstand 100,000 pounds of pressure per square inch!**

Gorilla Glass is composed of an oxide of silicon and aluminum—also called aluminosilicate glass—along with sodium ions (Fig. 2).

![Figure 2. Gorilla Glass, which is used in smartphone displays, is a type of glass that is strengthened by the addition of potassium ions, which replace smaller sodium ions. (Note: This drawing is for illustration purposes only.) Shelley Russell, adapted from a figure at: http://cgg-dev.angelvision.tv/gorilla-channel/ion-exchange-process](image)

But Gorilla Glass gains its tremendous strength through one final step, in which the glass is chemically strengthened. The glass is put into a molten bath of potassium salt, usually potassium nitrate, at 300 °C. Because the potassium ions are more reactive than sodium ions, they displace them. Potassium atoms are bigger than sodium atoms, and the same holds true for ions—potassium ions are much larger than sodium ions. Therefore, these potassium ions take up more space in the glass than do sodium ions.

Cramming larger ions into the spaces formerly occupied by smaller ions results in a compressing of the glass. Consider this analogy to visualize the process: The world record for the most people crammed into a Volkswagen Beetle, which is a very little car, is 25. These were most likely small people. Now imagine replacing these 25 small people with 25 National Football League linebackers, each weighing in at 350 pounds. To squeeze such large men into such a small space would require a fair amount of compression. Compression will always try to make things smaller.
In the same way, as the larger potassium ions push against each other, the glass is compressed. Compressed glass is very strong. As a result of this compression, a lot of elastic potential energy is stored in the glass, much like the elastic potential energy that you might find in a compressed spring.

**What’s behind a touchscreen?**

As every smartphone user knows, the screen on a smartphone is far more than just a tough piece of glass. It is a screen that responds to your touch—aptly named a touchscreen—giving you a personal connection to your phone.

There are two basic categories of touchscreens. The first category of touchscreens, called **resistive touchscreens**, can be touched with any type of material and they will still work. A pencil works just as well as a finger. You can activate the screen even if wearing gloves. Resistive touchscreens are found in an automated teller machine (ATM) and at checkout counters in stores, where you sign your name for a credit purchase on the display screen.

Resistive touchscreens are composed of two thin layers of conductive material under the surface (Fig. 3). When you press down a resistive touchscreen, it physically indents, causing the two layers to touch, completing the circuit and changing the electrical current at the point of contact. The software recognizes a change in the current at these coordinates and carries out the action that corresponds with that spot. Resistive touchscreens are also known as pressure-sensitive screens. Only one button at a time can be pressed. If two or more buttons are pressed at once, the screen does not respond.
Figure 3. When a finger presses down on a resistive touchscreen, the top and bottom resistive circuit layers are pressed against each other, causing the two transparent metal coatings (left and right) to touch. This leads to a change in the electrical current at the point of contact, which allows a controller within the smartphone to determine the position of the point of contact.
Rhonda Saunders

Smartphones use the second basic category of touchscreens, called capacitive touchscreens (Fig. 4), which are electrical in nature. A capacitor is any device that stores electricity.

![Diagram](image)

Figure 4. When a finger presses down on a capacitive touchscreen, a very small electrical charge is transferred to the finger, creating a voltage drop on that point of the screen. A controller within the smartphone processes the location of this voltage drop and orders the appropriate action.
Rhonda Saunders

Glass, being an insulator, does not conduct electricity. Even though glass contains ions, they are locked into place, stopping electricity from flowing through. So, the glass screen must be coated with a thin transparent layer of a conductive substance, usually indium tin oxide, which is laid out in crisscrossing thin strips to form a grid pattern.

This conductive grid acts as a capacitor, storing very small electrical charges. When you touch the screen, a tiny bit of this stored electrical charge enters your finger—not enough for you to feel but enough for the screen to detect. As this electrical charge leaves the screen and enters your finger, the screen registers a voltage drop, the location of which is processed by the software, which orders the resulting action.

This tiny bit of electrical current enters your finger because your skin is an electrical conductor—primarily due to the combination of salt and moisture on your fingertips, creating an ionic solution. Your body actually becomes part of the circuit, as a tiny bit of electricity flows through you every time you use the touchscreen on your phone.
Smartphone technology is evolving at a dizzying pace. You can now use your smartphone to check your blood sugar, adjust your home’s thermostat, and start your car. Twenty years ago, no one envisioned that people would someday take more pictures with their cell phones than with their stand-alone cameras. It is anyone’s guess what will come next. Thanks to the intersection of chemistry and innovation, the possibilities are limitless.

Selected references


Brian Rohrig is a science writer who lives in Columbus, Ohio. His most recent ChemMatters article, “Air Travel: Separating Fact from Fiction,” appeared in the February/March 2015 issue.

Even though smartphones are considered non-living things, they are made up of chemical elements which allow them to have the structures and functions needed to perform the task in which they were designed to do. As a living organism, are our bodies made up of chemical elements? If so which ones do you think are found within the Human Body?
A Smartphone’s display and touchscreen capabilities are two options that are important when determining which Smartphone to purchase. Having the proper chemical makeup allow these two options to function properly. How do you think the various chemical configurations within human body structures contribute to their proper function? Use example from article to explain your answer.

What do you think would happen to the different human body structures if the current chemical components were somehow altered or changed? Think about when you may have dropped your phone or it fell in water!
Lesson 2: Lesson Plan

Brian Walker                                                                                             9th Grade Living Environment
Lesson Title: Your Body on Cannabis                                                                                  Topic II: Human Structure and Function
Time Estimation: 90-120 minutes

State Standards:
Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
Key Idea: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.
Performance Indicator 1.2: Hone ideas through reasoning, library research, and discussion with others, including experts.
   1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
   1.2b Inquiry involves making judgments about the reliability of the source and relevance of information.

Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

Purpose:
Through investigating marijuana’s effects on the body, students will be introduced to different structures, functions, and levels of organizations found within the body.

Student Objective:
- Students watch National Geographic DVD: Marijuana, Cocaine, and Ecstasy: See what Happens Inside a Body on Drugs (A documentary on the effects of marijuana on the body) and answer corresponding questions.
- Students Read article The Science of the Endocannabinoid System: How THC Affects the Brain and the Body and answer corresponding questions.
- Students investigate/research articles and websites and create a poster to support whether or not they believe Marijuana use is safe or harmful to the body and whether it should be legalized or not.
- Students participate in Debate Day by presenting debate posters and verbally defending their choice in which they chose to defend and participate in whole class discussion

Essential Questions:
Does Marijuana have a positive or negative effect on the Human Body?

Learning Targets:
- Give examples of how marijuana effects different organizational levels of the body.
- Determine if marijuana is detrimental or beneficial towards one’s body
- Evaluate evidence and determine validity of claims
- Critique arguments for or against legalization of marijuana
**Materials:**
- National Geographic DVD: Drugged: Marijuana, Cocaine, and Ecstasy: See What Happens Inside a Body on Drugs (A documentary on the effects of marijuana on the body).
- Your Body on Cannabis Activity Packet
- Articles (not limited to but must include)
  - The Science of the Endocannabinoid System: How THC Affects the Brain and the Body (Found in activity packet)
- Websites (not limited to but must include):
- Butcher Paper or Poster Paper
- Drawing Supplies
- Internet access through Chromebooks/Laptops/Computers

**Procedures:**

**Bellwork** – Students fill out questionnaire from prior day’s activity

**Whole Class or Independent Work:**

1. **Introduction (Phase 1)** - Students watch National Geographic DVD: Marijuana, Cocaine, and Ecstasy: See what Happens Inside a Body on Drugs (A documentary on the effects of marijuana on the body)

Teacher’s Role: Teacher will introduce activity and direct students into working on the Your Body on Cannabis Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

**Independent Work – Begin working on Your Body on Cannabis Activity Packet**

2. **Cultural Context (Phase 2)** – Students reflect on influence of marijuana after watching documentary
3. **Classroom Science (Phase 3)** – How THC enters the Body and affects the brain and body?
4. **Integration (Phase 4)** - Students perform research for Marijuana Debate Poster

**Whole Class Exercise - Debate Day:** each student presents poster along with argument whether or not they believe Marijuana use is safe or harmful to the body and whether it should be legalized or not.

**Homework:**
Students watch video such as: Introduction to Anatomy & Physiology: Crash Course A&P #1 [https://www.youtube.com/watch?v=uBGl2BujkPQ](https://www.youtube.com/watch?v=uBGl2BujkPQ) in order to prep students for next activity on the following day. Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
YOUR BODY ON CANNABIS

Watch:
National Geographic DVD: Drugged: Marijuana, Cocaine, and Ecstasy: See What Happens Inside a Body on Drugs

- A documentary on the effects of marijuana on the body.
- National Geographic- Effects of Marijuana: [http://www.youtube.com/watch?v=P0lzYFHTGho](http://www.youtube.com/watch?v=P0lzYFHTGho)

Directions: Answer the following questions below

List the numerous parts of the body mentioned throughout the movie:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

After watching the documentary, do you think marijuana’s effect on the body plays a role in the hot topic of debate within the US right now on whether or not to legalize the use of marijuana? Explain your answer:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
How THC enters the Body

According to the documentary, what are some ways THC from Marijuana can enter the body?

1. Marijuana smoke is inhaled. It travels down the trachea and into the lungs.
2. The THC passes through the membrane of the lungs and enters the bloodstream. Excess blood may flow to the skin, giving the user a warm feeling. Tiny blood vessels can pop in the eyes and make them red.
3. The heart pumps the THC throughout the body. Within only seconds of inhalation of Marijuana, it has already reached the brain.
4. THC seizes control of receptors in the brain, affecting the flow of information. It also controls receptors in the hypothalamus, often making the user feel hungry. The hippocampus is very susceptible to THC as well. This part of the brain controls short term memory and coordination.

Once in the body, how does THC travel to the brain?
The Science of the Endocannabinoid System: How THC Affects the Brain and the Body

First published 2011: http://headsup.scholastic.com/students/endocannabinoid

After several decades of research, scientists studying the effects of marijuana made several important discoveries. Not only did they identify the active ingredient in marijuana, they also discovered where and how it works in the brain—via a new system they called the endocannabinoid (EC) system. The EC system—named after the marijuana plant Cannabis sativa and its active ingredient delta-9-tetrahydrocannabinol (THC)—is a unique communications system in the brain and body that affects many important functions, including how a person feels, moves, and reacts.

The natural chemicals produced by the body that interact within the EC system are called cannabinoids, and like THC, they interact with receptors to regulate these important body functions. So what makes the EC system unique and how does THC’s impact on this system affect a person’s memory, risk for accidents, and even addiction?

Review Figure 1 and the steps below to take a closer look at the components of the EC system, how it works, and the effects of THC.

Figure 1: The Endocannabinoid (EC) System and THC
How Cannabinoids Work Differently From Other Neurotransmitters

Brain cells (neurons) communicate with each other and with the rest of the body by sending chemical “messages.” These messages help coordinate and regulate everything we feel, think, and do. Typically, the chemicals (called neurotransmitters) are released from a neuron (a presynaptic cell), travel across a small gap (the synapse), and then attach to specific receptors located on a nearby neuron (postsynaptic cell). This spurs the receiving neuron into action, triggering a set of events that allows the message to be passed along.

But the EC system communicates its messages in a different way because it works “backward.” When the postsynaptic neuron is activated, cannabinoids (chemical messengers of the EC system) are made “on demand” from lipid precursors (fat cells) already present in the neuron. Then they are released from that cell and travel backward to the presynaptic neuron, where they attach to cannabinoid receptors.

So why is this important? Since cannabinoids act on presynaptic cells, they can control what happens next when these cells are activated. In general, cannabinoids function like a “dimmer switch” for presynaptic neurons, limiting the amount of neurotransmitter (e.g., dopamine) that gets released, which in turn affects how messages are sent, received, and processed by the cell.

How Does THC Affect the EC System and Behavior?

When a person smokes marijuana, THC overpowers the EC system, quickly attaching to cannabinoid receptors throughout the brain and body. This interferes with the ability of natural cannabinoids to do their job of fine-tuning communication between neurons, which can throw the entire system off balance.

Because cannabinoid receptors are in so many parts of the brain and body, the effects of THC are wide-ranging: It can slow down a person’s reaction time (which can impair driving or athletic skills), disrupt the ability to remember things that just happened, cause anxiety, and affect judgment. THC also affects parts of the brain that make a person feel good—this is what gives people the feeling of being “high.” But over time THC can change how the EC system works in these brain areas, which can lead to problems with memory, addiction, and mental health.

Refer to Figure 2 to see areas of the brain with cannabinoid receptors, then locate those areas on the chart to study some of the different effects of THC on the user.

**Figure 2:**

Locations of Cannabinoid Receptors in the Brain
Once in the brain, THC hijacks the nervous system and begins to alter how receptors usually work. The term “hijacks the nervous system” was used in the documentary. What did the researcher intend to portray about THC’s effects on the body through the use of this term?

Once THC began to influence the brain, how did it alter the choices of individuals in the documentary? (Be specific)

THC can disrupt information between brain and rest of body. The individual’s ability to make choices is altered. Remember the boys walking through the woods. How did using marijuana alter their judgment and choices?

After looking at the diagram above, what brain structures contain cannabinoid receptors? Why do you think each structure in the brain when influence by THC produces different types of effect?
Listed above are some documented health benefits of using marijuana?  Can you think of any other possible benefits besides the ones listed above?  Did the documentary mention anything different from those above?

Do you know anybody who has a prescription from their doctor to use medical marijuana?  Have you heard stories about individuals using marijuana for medical purposes?  If so, give examples below:
Make a list below of all the negative side effects mentioned within the documentary that marijuana has on the human body (be sure to include both short and long term effects)


Marijuana was described as “not good medicine” by a researcher in the documentary. What characteristic of marijuana caused it to be labeled as “not a good drug” as in terms of medical use?


Do you think some of the health benefits from the use of marijuana outweigh the negative side effects? Explain your answer:
Marijuana Debate Poster

Students will investigate/research articles and websites and create a poster to support whether or not they believe Marijuana use is safe or harmful to the body.

**Step 1:** Research

**Articles (not limited to but must include):**
- The Science of Marijuana
  http://headsup.scholastic.com/sites/default/files/NIDA10-INS2_Stu%20Mag_0.pdf
- Marijuana Facts-Breaking Down the Myths
- Mind over Matter

**Websites (not limited to but must include):**
http://teens.drugabuse.gov/drug-facts/marijuana

**Step 2:** Determine which side of debate you favor

1. I am in favor of the use of marijuana because of the positive benefits for the body
   or
2. I am not in favor of the use of marijuana because of the harmful side effects on the body

**Step 3:** Design a promoting or warning poster supporting your view

- Clear statement of viewpoint on whether or not you believe marijuana is or is not harmful to body
- Statements supported by research or article read to justify stance. Do not just give opinions
- Poster must include how Marijuana impacts specific structures within the human body in a positive or negative Leway.
- Visual cues: pictures, drawings, designs, etc.
Lesson 3: Lesson Plan

Brian Walker                                                                                             9th Grade Living Environment
Lesson Title: Organization of the Rochester City School District Student Population
Time Estimation: 120+ minutes

NY State Standards:
Standard 4:   Living Environment
Key Idea 1:   Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2  Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).
   1.2a  Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.
   1.2e  The organs and systems of the body help to provide all the cells with their basic needs. The Cells of the body are different kinds and are grouped in ways that enhance how they function together.
   1.2f  Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.

Purpose:
Students discover the importance of organizational levels and their functions through investigation of the Rochester City School District while making connections with the organizational levels of the Human Body.

Student Objective:
- Students investigate different levels of organization found within the student population with in the Rochester City School District by completing the Organization of the Rochester City School District Student Population Activity Packet.
- Students draw Bohr Diagrams of some basic elements.
- Students assemble molecules and compounds using molecular model sets.
- Students label organelles of a cell and match corresponding function of each organelle
- Students play Human Body Cells Memory Game.
- Students use microscopes to observe a variety of human body tissues and then draw and label observations.
- Students match body organ with corresponding body system by cutting and pasting accordingly
- Students draw, label, and explain how a variety of body systems work together
- Students conduct research on the different levels of biological organization within an organism and create PowerPoint or Prezi presentation to give in front of the class

Essential Questions:
How is the Human Body organized from simple to complex?

Learning Targets:
- Identify and define each level of biological organization within the Human Body.
- Differentiate between levels of biological organization within the Human Body.
Explain why organization is needed in the Human Body and living systems.

Materials:
- Organization of the Rochester City School District Student Population Activity Packet
- Multiple Molecular Model Sets
- Scissors and glue
- Microscopes
- Access to PowerPoint or Prezi through Chromebooks/Laptops/Computers

Procedures:
Bellwork – Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the Organization of the Rochester City School District Student Population Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Individual Work – Organization of the Rochester City School District Student Population Activity Packet
1. Introduction (Phase 1) – Who am I as a student in the Rochester City School District?
2. Cultural Context (Phase 2) – Students discover they are part of a special-purpose district made up of a variety of different structures serving different functions through guided investigation. During the investigation, students will include themselves in the sequenced organizational levels of the student population found within the Rochester City School District.
3. Classroom Science (Phase 3) – Human Body Organization Stations
   – Students will work through a variety of stations each providing a separate activity based upon the biological organizational level represented within each station.
4. Integration (Phase 4) – Students will develop a slide show presentation using PowerPoint or Prezi representing the biological organization sequencing of an organism.

Homework:
Work on Biological Sequence Presentation Project

Watch next videos for following activity based upon Movement and Coordination:

The Skeletal System: It's ALIVE! - CrashCourse Biology #30
https://www.youtube.com/watch?v=RW46rQKWa-g

Big Guns: The Muscular System - CrashCourse Biology #31
https://www.youtube.com/watch?v=jqy0i1KXUO4

The Nervous System - CrashCourse Biology #26
https://www.youtube.com/watch?v=x4PPZCLnVkA

Again, Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
Organization of the Rochester City School District Student Population

As an individual student walking through the hallways of your school, one might not realize the vast size and complexity that makes up the Rochester City School District (RCSD). As a member of the RCSD, you are a part of a much larger framework known as a special-purpose district. A special-purpose district is responsible to provides services to individuals living within a geographic location. Such a district is organized and divided into numerous parts and structures. Each part and structure varies in complexity and has its specific purpose and function. Think about the difference between yourself and all the students who make up the RCSD. Did you know your school district’s student population consists of:

Student Population in RCSD

- 60.1% African American/Black
- 25.6% Hispanic
- 10.2% White
- 4.1% Asian/Native American/East Indian/Other

Represented with 87 different languages spoken among students

http://rcsdk12.org/domain/8

The Rochester City School District Offers:

- 56 Pre-K Sites (Traditional and Community-based)
- 27 traditional Elementary (PreK-6 or K-6) Schools
- 14 K-8 or K-12 Schools (existing or building out)
- 25 Secondary Schools
- 1 Montessori School
- Young Mothers Program
- Family/Adult Learning Center
- A centralized Parent Information & Student Registration Center
- Parent Education and Training

http://rcsdk12.org/domain/8
During an average school year, the Rochester City School District:

- Enrolls just under 30,000 students per year
- Prepares and delivers 17,000 breakfasts and 22,000 lunches daily.
- Provides transportation for 29,875 students to and from school daily.
- Provides support (including transportation) to more than 3,200 students who attend some 100 private, parochial, and charter schools, urban-suburban sites, and home-schooling.
- Has approximately 6,100 employees, including:
  - 3,227 teachers
  - 464 administrators
  - 1,267 support personnel

With such a large overall student population, organization is necessary to provide support and services to such an enormous amount of students? Why do you think organization is necessary in a school district such as RCSD?

How is RCSD able to provide needed services on such a large scale so individual students do not miss out or get lost in the midst of a large population of students?

How do you think RCSD specifically organizes a large number of students beginning with a simple individual student all the way up to the entire student population found with the district?
Directions: Based upon the number of students and resources needed to support increasing complexity in grouping of students, arrange the items below from simple to complex:

- Multiple Schools (Elementary vs. Secondary)
- RCSD
- Grade Level (9,10,11,12)
- Individual Student
- School Building (Name of your School)
- Classroom Section

Do the type or amounts of resources along with services needed vary when comparing an individual student to a whole classroom? Specific grade level? A school building? The entire school district? (Support your answer with details)

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

How does the complexity of rules, regulations, and organization change from classroom to classroom? From school to school?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
When looking at the above sequence chart, explain how organization is necessary to maintain efficiency with increasing levels of complexity among student population.
We previously compared the Human Body to a machine and just like any machine; it can be broken down into different parts with varying complexity.

Do you think organization is necessary within the Human Body? Explain why this organization may be needed in living systems?

Like the different levels of complexity found within the RCSD, how is the Human Body organized according to structure, size, and function of its individual parts?

Explain how organization is necessary to maintain efficiency with increasing levels of complexity within the Human Body.

Predict possible levels of organization and complexity within the Human Body below:
Biological Complexity Simplified

In this activity, you will transfer from station to station and partake in activities according to the Biological level of complexity represented in each station.

If we look at the diagrams below, we can see the overall structures found within living organisms separated into various levels of complexity. Just as we arranged the student population within RCSD into various levels of complexity according to structure and function, we can also do the same for structures found within living organisms.
Does organization of the complexity within structures and function only pertain to the Human Body or can we apply the same concepts to other living organisms (single celled, plants, animals, etc.)? If so which ones? Give specific examples.

<table>
<thead>
<tr>
<th>Level of Biological Organization</th>
<th>Description</th>
<th>Animal Examples</th>
<th>Plant Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANISM</td>
<td>One individual of a species</td>
<td>Youl</td>
<td>California Poppy</td>
</tr>
<tr>
<td>Body Systems</td>
<td>Organs that work together within an animal</td>
<td>Circulatory system, Respiratory system, Digestive system, Urinary system</td>
<td>[Not Applicable]</td>
</tr>
<tr>
<td>Organs</td>
<td>A part of an organism with a special function</td>
<td>Heart, Lungs, Stomach</td>
<td>Flower, Leaf, Stem, Root</td>
</tr>
<tr>
<td>Tissues</td>
<td>Several types of cells that work together</td>
<td>Blood, Muscle, Nerve</td>
<td>Epidermis, Xylem, Phloem</td>
</tr>
<tr>
<td>Cells</td>
<td>Smallest independent unit of life</td>
<td>Red blood cell, White blood cell, Brain cell</td>
<td>Guard cell, Vessel, Root hair</td>
</tr>
<tr>
<td>Organelles</td>
<td>Small membrane-bound structures within a cell</td>
<td>Mitochondria</td>
<td>Chloroplasts, Mitochondria</td>
</tr>
<tr>
<td>Molecules</td>
<td>Chemical compound</td>
<td>Water, Sugar, Carbohydrate, Protein, Fat</td>
<td>Water, Carbon dioxide, Chlorophyll, Oxygen gas, Sugar</td>
</tr>
<tr>
<td>Subatomic</td>
<td>Particles that make an atom</td>
<td>Electron, Proton, Neutron</td>
<td>Electron, Proton, Neutron</td>
</tr>
</tbody>
</table>
Sequenced organizational levels of structures found within living organisms

- **Atoms**
  - Basic unit of matter

- **Molecules/Compunds**
  - 2 or more atoms bonded together

- **Organelles**
  - 2 or more molecules combined to perform a distinct function

- **Cell**
  - 2 or more organelles combine

- **Tissue**
  - 2 or more cells connected together with similar function

- **Organ**
  - 2 or more tissues working together to do same job

- **Organ System/Body System**
  - 2 or more organs working together to carry out a specific function

- **Living Organism**
  - Organ systems combine to form organism
If we look at the diagram above, what four elements make up most of the elements found within the Human body? What is the individual percentage for each of the four elements?

Directions: Using the Periodic Table of Elements, draw and label each atom of the elements listed below. Make sure to add the appropriate, protons, neutrons, and electrons.

How to Read the Periodic Table of Elements:

This is the atomic number. It tells how many protons are in the element.

C is the chemical symbol for Carbon.

This is the average mass of the element. Each proton and each neutron is worth one. Carbon we know has six protons so it must also have six neutrons.
How to Draw Bohr Diagrams

**Step 1:** Find Element on Periodic Table of Elements

**Step 2:** Using individual box representing specific element, identify the number of protons, neutrons, and electrons found in the element.

**Step 3:** Using information gathered in step 2, draw diagram of element:

- $\bullet$ = neutron
- $\bigcirc$ = proton
- $\bullet$ = electron
Station 2: Molecules/Compounds

Directions: Create and form molecules using Molecular Model Set. Fill in graphic organizer by drawing, coloring, and labeling each molecule formed.

Each color ball represents an Element (atom):
- **black** = carbon (C)
- **red** = oxygen (O)
- **blue** = nitrogen (N)
- white, hydrogen (H).

Sticks represent bonds between each Element (atom)

What are Molecules?

Molecules are made up of atoms that are held together by chemical bonds. These bonds form as a result of the sharing or exchange of electrons among atoms.

How can we represent Molecules?

1. **Chemical Formula**- It shows the types of atoms in the molecule, and, using subscripts, it shows how many of each type of atom is present.

   \[
   \text{Na}_2 \text{SO}_4
   \]

   Two sodium atoms
   One sulfur atom
   Four oxygen atoms

2. **Structural Formula**- shows the symbol for every atom, and it shows every bond

3. **Ball and Stick Model**- display both the three-dimensional position of the atoms and the bonds between them.

4. **Space Fill Model**- atoms are shown as spheres whose diameters are proportional to their atomic radii.
<table>
<thead>
<tr>
<th>Water</th>
<th>Methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H2O)</td>
<td>(CH4)</td>
</tr>
<tr>
<td>Structural</td>
<td>Structural</td>
</tr>
<tr>
<td>Formula:</td>
<td>Formula:</td>
</tr>
<tr>
<td>Ball and Stick:</td>
<td>Ball and Stick:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Methanol</th>
<th>Proline</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CH3OH)</td>
<td>(C5H9NO2)</td>
</tr>
<tr>
<td>Structural</td>
<td>Structural</td>
</tr>
<tr>
<td>Formula:</td>
<td>Formula:</td>
</tr>
<tr>
<td>Ball and Stick:</td>
<td>Ball and Stick:</td>
</tr>
</tbody>
</table>
Station 3: Organelles

**Directions:** Quick Review! Identify each cell organelle by labeling it correctly and then match the correct structure with its function.

Organelle- membrane-bound structure found within a cell that is specialized to perform a distinct function.

**Word Bank**

- Ribosome
- Golgi Complex
- Mitochondrion
- Lysosome
- Nucleolus
- Endoplasmic Reticulum
- Nucleus
- Centriole
- Cytoskeleton
## Matching

<table>
<thead>
<tr>
<th>Function</th>
<th>Organelle Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protects the cell, performs active transport and passive transport, moves materials in and out of the cell, communication</td>
<td>A. Lysosome</td>
</tr>
<tr>
<td>Pads and supports organelles inside the cell.</td>
<td>B. Vacuole</td>
</tr>
<tr>
<td>Controls all of the cell’s activities</td>
<td>C. Ribosome</td>
</tr>
<tr>
<td>Covers and protects the nucleus</td>
<td>D. Nucleolus</td>
</tr>
<tr>
<td>Produces ribosomes</td>
<td>E. Centriole</td>
</tr>
<tr>
<td>Transports materials like proteins around the cell</td>
<td>F. Cell Membrane</td>
</tr>
<tr>
<td>Makes proteins</td>
<td>G. Mitochondria</td>
</tr>
<tr>
<td>Supplies energy or ATP for the cell through cell respiration using glucose and oxygen</td>
<td>H. Nuclear Membrane</td>
</tr>
<tr>
<td>Storage tank for food, water, wastes or enzymes</td>
<td>I. Golgi Body</td>
</tr>
<tr>
<td>Packages and secrets proteins for use in and out of the cell</td>
<td>J. Nucleus</td>
</tr>
<tr>
<td>DIGESTS older cell parts, food or other Objects</td>
<td>K. Cytoplasm</td>
</tr>
<tr>
<td>Used with the spindle apparatus during mitosis</td>
<td>L. Endoplasmic Reticulum</td>
</tr>
</tbody>
</table>
Station 4: Cells

Directions: Complete questions below and then find a partner and play Human Body Cells Memory Game.

Pictured above are examples of cells found within the Human Body. Why do you think there are different types of cells within the Human Body?

____________________________________________________________________________________________________________________________________________

Do you know the functions of any of the cell types shown above? If so, list and give examples below:

____________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________

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Different types of cells in the human body are specialized for specific jobs. The Human Body has a number of cells and related tissues. Since the Cell is the basic unit of any tissue, it decides the type, nature and function of the tissues. A group of different types of cells form tissues in the human body and one or more types of tissues form organs. These body organs working in mutual manner form the organ systems. If any tissue is damaged, it actually means the cells and cell structure in the organ is damaged. These damaged cells decides the fate of entire tissue i.e. either to recover or die. Many cells have internal tendency to multiply and help in repair while few don’t have this property. Let’s see various cells of human body with their functions.

Types of cells based on tissue they form:

1. **Bone cells** (Osteocytes) - They are the toughest Body Cell as they are bound together by calcium and phosphate material. As one knows they give strength, support and frame-work to the body by forming organs in skeletal system i.e bones.

2. **Cartilage cells** (chondrocytes) - These cells are similar to bone cells but the surrounding material is just loose and flexible compared to those of bone cells. Hence they are freely bendable. They are present in ear bone (hence ears are fold-able), in between large bones to help them bend and move freely like in between two ribs, spinal bones, joints etc.

3. **Nerve cells** (Neurons): These cells are very long and have many branching at either ends. Their specialty is they never multiply in one’s life time. They are present all over the body and are sometimes as long as a few meters long. They are found in plenty in the brain, spinal cord, and nervous tissue.

4. **Epithelial cell**: These cells are very simple cells which form covering of other cells. These cells form covering layers of all the organs and hence are preset in skin, scalp. in the buccal cavity surface etc.

5. **Muscle cells**: These cells are of muscle tissue mostly long, large and have ability to contract and relax providing movements. They are three types as skeletal, cardiac and smooth muscles.
   - Skeletal muscles cells are attached to long bones and assist in their movement (by muscle contraction).
   - Cardiac muscles cells are present only in heart muscle and responsible for heart beats.
   - Smooth muscle cells are flexible yet, can contract and relax and are present in stomach, intestine, blood vessel walls (vascular tissue) etc. helping in movement of food through the gut.

6. **Secretory cell**: These cells as name indicates are secretory in nature. They form glands and secrete something important ex; pancreatic cells which secrete insulin, glucagon, oil on the skin etc. They are found in all secretory organs.

7. **Adipose cells**: These are fat cells and are storage in nature to store fat. Especially seen in the soles, palms, bums etc. They reduce friction to the body.

8. **Blood cells**: These cells include RBC’s, WBC, Thornbocytes etc. They are always motile and never stay in one place. They have limited life span and they never multiply to form new cells. instead new cells are formed from other cells.

Types of cells in human body based on their function:

9. **Conductive cells**: Nerve cells, muscle cells come under this category. They have internal ability to conduct an electric impulse from region to other distant region in the body.

10. **Connective cells**: Bone cells, blood cells come under this category. They help connect other cells and tissues.
11. **Glandular cells**: These cells secretory cells. They form glands like pancreas, salivary glands etc and help in production of enzymes, hormones etc.

12. **Storage cells**: Adipose cells (fat cells), some liver cells etc act to store materials for later use.

13. **Supportive cells**: These are the cells which are present as support to adjacent cells. Ex: Glial cells in the brain and spinal cord help provide nourishment to the nerve cells and also protect them from shocks and trauma.

14. **Special type of cells**: These are specialized cells with important functions in the body. They are
   
a) **Sperms**: These cells unlike other cells are haploid (one set of chromosome) present only in males, they have a tail which enables them to swim and move in female uterus. They have an enzyme namely hyaluronidase which helps penetrate uterine tissue and reach oocytes (egg cells).
   
b) **Oocytes (Egg Cells)**: Cells are haploid and present in adult female genital system before menopause.
   
c) **Stem cells**: These are basic cells or parent cells which can differentiate into any cell based on the requirement. These stem cells in human body are given so importance due to their promising role in treatment of disorders in future.
   
d) **Rods & cones**: These cells are in eye and have capacity to capture image colour and light.
   
e) **Ciliated cells**: These cells are present as lining of respiratory tract, esophagus etc. and have a pointed thread like cilia which move in one particular direction to pass material.

   Human tissue types are again dependent on the types of cells involved in their formation.
   
f) **Blood cells**: These are quite interesting cells and they are never attached to one another. They freely flow in the liquid blood. Some of them are not alive (RBC’s) while others have varied shapes like WBC, platelets (spindle shape).

* Use information above to help play game below *

**Human Body Cells and Their Function Memory Game**

**Directions**: To play the game:

1. Cut out playing pieces
2. Place picture side and function side of each playing piece facing down
3. Mix playing pieces up without looking
4. Lay out playing pieces face down in rows and columns
5. Player 1 must flip over two playing pieces trying to match cell type with cell function
   - If correct match is found, player collects two playing pieces and turn rotates to opponent.
   - If match is not found, playing pieces are flipped back over and turn rotates to opponent.
6. When all playing pieces have been collected, player with most pieces at end of game wins.
<table>
<thead>
<tr>
<th><strong>Playing Pieces</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bone Cell</strong></td>
</tr>
<tr>
<td><img src="image1" alt="Bone Cell Image" /></td>
</tr>
<tr>
<td><strong>Secretory Cell</strong></td>
</tr>
<tr>
<td><img src="image2" alt="Secretory Cell Image" /></td>
</tr>
<tr>
<td><strong>Cartilage Cell</strong></td>
</tr>
<tr>
<td><img src="image3" alt="Cartilage Cell Image" /></td>
</tr>
<tr>
<td><strong>Adipose Cell</strong></td>
</tr>
<tr>
<td><img src="image4" alt="Adipose Cell Image" /></td>
</tr>
<tr>
<td><strong>Nerve Cell (Neuron)</strong></td>
</tr>
<tr>
<td><img src="image5" alt="Nerve Cell Image" /></td>
</tr>
<tr>
<td><strong>Blood Cell</strong></td>
</tr>
<tr>
<td><img src="image6" alt="Blood Cell Image" /></td>
</tr>
<tr>
<td><strong>Epithelial Cell</strong></td>
</tr>
<tr>
<td><img src="image7" alt="Epithelial Cell Image" /></td>
</tr>
<tr>
<td><strong>Sex Cells</strong></td>
</tr>
<tr>
<td><img src="image8" alt="Sex Cells Image" /></td>
</tr>
<tr>
<td><strong>Muscle Cells</strong></td>
</tr>
<tr>
<td><img src="image9" alt="Muscle Cells Image" /></td>
</tr>
<tr>
<td><strong>Glandular Cells</strong></td>
</tr>
<tr>
<td><img src="image10" alt="Glandular Cells Image" /></td>
</tr>
</tbody>
</table>
Station 5: Tissue

Directions: Using a microscope, draw and label observation of each tissue mentioned below

The human body consists of these four tissue types:

1. **Connective tissue** is made up of cells that form the body’s structure. Examples include bone and cartilage.

2. **Epithelial tissue** is made up of cells that line inner and outer body surfaces, such as the skin and the lining of the digestive tract. Epithelial tissue protects the body and its internal organs, secretes substances such as hormones, and absorbs substances such as nutrients.
3. **Muscle tissue** is made up of cells that have the unique ability to contract, or become shorter. Muscles attached to bones enable the body to move.

4. **Nervous tissue** is made up of neurons, or nerve cells, that carry electrical messages. Nervous tissue makes up the brain and the nerves that connect the brain to all parts of the body.
Station 6: Organs and Body Systems

Organs
- A group of two or more different types of tissue that work together to perform a specific function.
- The task is generally more complex than that of the tissue.
- For example, the heart is made of muscle and connective tissues which functions to pump blood throughout the body.

Any organ that is essential to life is called a **vital organ**.

Examples:
- Heart - Pumps blood throughout the body.
- Liver - Removes toxins from the blood, produces chemicals that help in digestion.
- Lungs - Supplies oxygen to the blood and removes CO2 from blood.
- Brain - The control center of the body.

Can you identify any organs not mentioned in picture to the left?

__________________________

__________________________

__________________________

__________________________

__________________________

__________________________
Body Systems

- A group of two or more organs that work together to perform a specific function.
- Each organ system has its own function but the systems work together and depend on one another.
- There are eleven different organ systems in the human body: circulatory (cardiovascular), digestive, endocrine, excretory (urinary), Lymphatic/Immune, integumentary, muscular, nervous, reproductive, respiratory, and skeletal.

The Human Body Team

How does the body get the systems to work together?

Your body works similarly to a machine, with different systems that make up your body and allow it to run effectively. Like a machine, if one system is not running properly, your whole body will be affected. These systems perform different tasks in the body and encompass different organs. The organization of structures and functions along with increasing complexity within the human body provides an avenue in which human body systems can work together efficiently.

Looking at the 11 body systems above, what systems do you think work together? (Give 3 examples and explain why)
**Directions:** Read each body system function and determine what organs would support it by cutting and pasting each organ to its corresponding System.

<table>
<thead>
<tr>
<th>Brain</th>
<th>Pituitary Gland</th>
<th>Skin</th>
<th>Kidneys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymph Vessels</td>
<td>Liver</td>
<td>Testes</td>
<td>Bones</td>
</tr>
<tr>
<td>Mouth</td>
<td>Skeletal Muscles with tendons</td>
<td>Peripheral nerves</td>
<td>Spinal Cord</td>
</tr>
<tr>
<td>Pharynx</td>
<td>Ovaries</td>
<td>Vagina</td>
<td>Thyroid Gland</td>
</tr>
<tr>
<td>Bladder</td>
<td>Stomach</td>
<td>Ligaments</td>
<td>Lungs</td>
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<tr>
<td>Heart</td>
<td>Penis</td>
<td>Large Intestine</td>
<td>Fallopian Tubes</td>
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<tr>
<td>Vas Deferens</td>
<td>Bronchi</td>
<td>Arteries</td>
<td>Esophagus</td>
</tr>
<tr>
<td>Hair/Nails</td>
<td>Urethra</td>
<td>Small Intestine</td>
<td>Diaphragm</td>
</tr>
<tr>
<td>Hypothalamus</td>
<td>Veins</td>
<td>Ureters</td>
<td>Seminal Vesicles</td>
</tr>
<tr>
<td>Uterus</td>
<td>Trachea</td>
<td>Prostate</td>
<td>Spleen</td>
</tr>
<tr>
<td>Capillaries</td>
<td>Larynx</td>
<td>Rectum</td>
<td>Anus</td>
</tr>
<tr>
<td>System</td>
<td>Function</td>
<td></td>
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<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circulatory/Cardiovascular</td>
<td>transports nutrients, chemical messengers, gases and wastes throughout</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory System</td>
<td>adds oxygen to the blood and removes carbon dioxide from blood.</td>
<td></td>
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</tr>
<tr>
<td>Nervous System</td>
<td>Controls and coordinates functions throughout the body and responds to</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>internal and external stimuli</td>
<td></td>
<td></td>
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<tr>
<td>Excretory System</td>
<td>Eliminates metabolic wastes in the body</td>
<td></td>
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<tr>
<td>Digestive System</td>
<td>Breaks down food into nutrients that can be passed to the cells that</td>
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</tr>
<tr>
<td></td>
<td>need them</td>
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<tr>
<td><strong>Endocrine System</strong></td>
<td></td>
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<td>---------------------</td>
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<tr>
<td>controls cell function with hormones by broadcasting messages throughout the body</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Reproductive System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>produces, stores, and releases specialized sex cells known as gametes</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Immune/Lymphatic System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>detects, filters, and eliminates disease causing pathogens. returns fluid to cardiovascular system,</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>Muscular System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>moves bones and maintains posture</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Skeleton System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>protects major organs, provides levers and support for body movement</td>
</tr>
</tbody>
</table>
**Integumentary System**

provides a protective barrier for the body, contains sensory receptors for pain, touch, temperature

---

**Directions:** First choose 2 examples from below. Then draw, label, and explain how the body systems work together.

- Circulatory (Cardiovascular) and Respiratory
- Digestive and Excretory
- Endocrine and Immune System
- Integumentary and Nervous System
- Skeletal and Muscular System
Biological Sequence Presentation Project

Students will conduct research on an organism and create a PowerPoint or Prezi Presentation representing different levels of biological organization for their organism. This presentation must include title slide, a slide for each level of organization with pictures and written description, and a final slide or two with levels represented in a sequenced fashion. Students will present project to rest of class.

**Step 1:** Choose method of presentation
1. PowerPoint
2. Prezi (www.prezi.com)

**Step 2:** Create Slides (This is where you conduct research)

1) Title Slide/Introduce Organism (name and picture)

2) Identify and define each level of biological organization (1 slide per level of organization)
   - Each slide must have label, definition, picture, and explanation of why you chose item/image to represent biological level of complexity for organism chosen.
   - Must include each of the following levels: Atom, Molecule, Organelle, Cell, Tissue, Organ, Organ System/Body System, Organism (8 slides total)

3) Sequence the levels of biological organization found within your organism on the final slide (1-2 slides)

**Step 3:** Give oral presentation of project to class (This is where you present)

**Reminder:** Be Creative! Originality will be included in final grade! (No Cloned Projects Allowed)
Lesson 4: Lesson Plan

Brian Walker
Lesson Title: Top 10 Most Popular Dance Moves
Time Estimation: 90+ minutes

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).
   1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

Purpose:
While investigating pop culture, traditional, cultural and formal dance moves, students gain understanding of how the skeletal, muscular, and nervous systems all work together to provide an individual or organism the necessary coordination and ability for movement to take place.

Student Objective:
- Students explore a variety of dance moves by completing Top 10 Popular Dance Moves Activity.
- Students examine a variety of tissue types through the use of microscopes.
- Students collaborate with partner/group and design dance or describe alternative movement, such as a jump shot, by performing and drawing step by step instructions.
- Students draw, label, and describe muscles, bones, and joints involved in each step by step dance movement.

Essential Questions:
How is the human body organized to maintain life?

Learning Targets:
- Identify and label structures of the Skeletal, Muscular, and Nervous Systems
- Describe the functions of the Skeletal, Muscular, and Nervous Systems.
- Explain how Skeletal, Muscular, and Nervous Systems work together to provide coordination and movement for the human body.

Materials:
- Top 10 Most Popular Dance Moves Activity Packet
- Internet access through Chromebook/Laptop/Computer
- Microscopes with muscle tissue slides and bone tissue slides

Procedures:
Bellwork – Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the Top 10 Most Popular Dance Moves Activity Packet. During activity teacher acts as a facilitator and provides
Independent work – Students complete Top 10 Most Popular Dance Moves Activity Packet

1. Introduction (Phase 1) – Popular Dance Moves and Songs are watched and listened to while students fill out graphic organizer.

2. Cultural Context (Phase 2) – Students reflect on importance of dance and music in own life by guided questions.

3. Classroom Science (Phase 3) – Students are led through a tour of the Skeletal, Muscular, and Nervous Systems by guest speakers found within activity packet. Students will also look at slides through microscope of different tissue types.

Partner/Group work –

4. Integration (Phase 4) - Students design a dance or describe alternative movement by performing and drawing step by step instructions. Students will also provide detailed description of muscles, bones, and joint type involved in each step of movement.

**Homework:**
Finish Dance Moves Project

Watch next video for following activity based upon Circulation and Respiration

Circulatory & Respiratory Systems - CrashCourse Biology #27
https://www.youtube.com/watch?v=9fxm85Fy4sQ

Again, Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
Top 10 Most Popular Dance Moves

Listed below are ten pop culture dance moves from the past few years. Go to the website below and list the dance moves in the order in which they appear on the site as the top 10 popular dance moves in table below.

http://top10rate.com/top-10-most-popular-dance-moves-written/entertainment

Cotton Eye Joe

The Dougie

Cotton Eye Joe

The Cat Daddy

The John Wall

Macarena

The Bernie

Gangnam Style

The Wobble

Shuffling

YMCA
<table>
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<td>9.</td>
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<td>10.</td>
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</table>
What makes the dance moves different from each other?

Are there any similarities between the dances? If so what?

Can you list any other dance moves you may know that were not listed on the top 10 list?

Other than dance moves for modern pop culture, are there any other formal/cultural/historical/traditional dance moves that you know? Do you still perform them? If so, when would you use them?
Although movement and coordination allow us to partake in fun events such as dancing, are their other ways movement and coordination of our bodies assist us as living organisms (give examples)?

The three main Human Body Systems responsible for movement and coordination are the **Skeletal System**, **Muscular System**, and **Nervous System**. In combination, these three body systems work together in producing movement and coordination for each individual. The Skeletal System and Muscular System are responsible for movement while the Nervous System is responsible for the coordination of such movements. Joints in the Skeletal System provide bones the ability to move in certain directions. Muscles attached to bones pull in different directions and cause specific movements. Nerve cells (Neurons) send electrical messages called impulses back and forth from brain and receptor cells in order to synchronize movements. All three systems work together in allowing an individual to perform the various dance moves shown above.
Skeletal System

“Hi, my name is Bones and I will be your tour guide through the structure and function of the Human Skeletal System.”

Intro:
In order to begin our journey, we must first understand the Skeletal System includes all the bones and joints located within the body. This should be evident after viewing my beautiful self-portrait above. With this helpful piece of information, we can move on gaining insight about the composition of bones and how the structure of the human skeletal system is arranged. We will then transition over to a discussion about the function and purpose of the skeletal system before finally ending by mentioning some diseases of the Skeletal System.

Bones and Joints:
The skeleton of humans is composed of a special connective tissue called bone. Each bone is a complex living organ that is made up of many cells, protein fibers, and minerals. Bones are made up of two basic types of tissue called compact bone and spongy bone. Each bone can be classified by their shape and fall into one of the following four categories: long bones, flat bones, short bones, and irregular bones. There are 206 bones in the human body. Bones connect/meet with each other at locations called joints. A substance called cartilage keep bones far enough apart so they do not rub against each other as they move. The two major types of joints are immovable joints (fixed joints) and movable joints. Examples of immovable joints are located in the skull and ribs. Examples of movable joints are:

1. Ball-and-Socket joint (shoulder and hips)
2. Hinge joint (knees and elbows)
3. Pivot joint (neck in between vertebrae)
4. Gliding joint (wrist and ankle).
Muscles attach to bone via connective tissue called **TENDONS**

Bones attach to bones via connective tissue called **LIGAMENTS**

---

**Function/Purpose of the Skeletal System:**

1. **Support** - it forms the body's framework to support the muscles and organs.
2. **Protection** - the skeletal systems protects by forming the bony cavities around organs,
   a. the thoracic cavity protects the heart and lungs
   b. the cranial cavity protects the brain.
   - the yellow marrow in bones produces white blood cells which protect against invading microorganisms.
3. **Movement** - bones form joints which provide levers for movement such as walking, lifting, etc.
4. **Hematopoiesis** (blood cell production) - the red marrow produces red blood cells.
5. **Mineral storage and homeostasis** - the skeleton forms a reservoir of minerals, especially calcium, for maintenance of homeostasis.

**Bone Disorders/Diseases:**

1. Fractures- broken bones: closed (simple) which remains under the skin or open (compound) which sticks out through the skin.
2. Arthritis- is an inflammatory condition that affects your joints, such as the knees, or a portion of your spinal column. Typical symptoms of this condition include joint pain, swelling and stiffness accompanied by a reduction in the ability to freely move your joints
3. Sprain- tearing or stretching of ligaments that hold together the bone end in joints
4. Leukemia- is a form of cancer that originates in the bone marrow and affects the lymphatic system. This disease results in the formation of abnormal, malfunctioning white blood cells, which interferes with the ability of your body to fight infection.
5. Osteoporosis-condition in which bones become brittle and weak due to the extensive loss of bone tissue.
6. Bone Cancer- is cancer that originates within a bone of your body causing bones to weaken.
Your friend **Bones** here just wanting to let you know our tour of the Skeletal System is almost complete. I will reward you for your patience by allowing you to take a quick break and watch this review rap on the Skeletal System (make sure to focus on the lyrics):  
[http://www.youtube.com/watch?v=aRXv3qOt84](http://www.youtube.com/watch?v=aRXv3qOt84)

You are now ready for the exit survey. Please completely fill out the survey below before moving onto meeting my friend who will discuss the Muscular System.

Is your Skeletal System made of living tissue? Give details to support your answer

________________________________________

________________________________________

________________________________________

List four functions of bones:

________________________________________

________________________________________

________________________________________

Name the main groups of bones that form the axial skeleton: ______________________  ______________________

Name a location in the body where you would find a ball and socket joint ______________________

Name a location in the body where you would find a hinge joint ______________________

Name a location in the body where you would find a gliding joint ______________________

Name a location in the body where you would find a suture, or immovable joint ______________________

Give an example where a sprain may take place: __________________________________________

What is another name for a broken bone that sticks outside of the skin: ______________________

**True or False**

Bones surround vital organs to protect them. __________

Bones store most of the calcium supply of the body. __________

The Appendicular Skeleton forms the main trunk of the body. __________
Muscular System

So you like to dance do you? Without muscles you would not be able to move. Without muscles you would not be able to breathe. Without muscles you would not be able to digest your food. All these activities are important if you are going to enjoy dancing. As you can see, muscles play a key role in providing you the ability to enjoy your daily leisure pursuits along with straight up survival.

I’m doing my friend Bones a favor by taking the time to share with you my favorite topic of muscles. So I’m going to make this quick and easy not wasting anymore time because I need to hurry and get back to the weight room ASP.

We will begin our discussion with the three types of muscle tissue. These muscle tissues consist of skeletal, smooth, and cardiac. (Feel free to look at slides of muscle tissue on microscopes)

1) Skeletal muscle
   - Attached to the bones of your skeleton. At the end of each skeletal muscle is a tendon (strong connective tissue) which connects the muscle to bone.
   - Skeletal muscle is considered a voluntary muscle. Voluntary muscles are under your control and cause you to move your body. If you were to practice or perform any of the dance moves from the top ten, you would be using skeletal muscles:

2) Smooth Muscle
   - Found inside many internal organs of the body, such as the stomach and blood vessels.
   - Smooth muscles are considered an involuntary muscle. Involuntary muscles are not under your conscious control. These muscles are responsible for activities such as breathing and digesting your food. Most of us don’t think about breathing and digesting food because our bodies are able to perform such activities without our conscious control. On the contrary, we can have conscious control over our skeletal muscles.
Cardiac Muscle
- Found only in the heart.
- Considered an involuntary muscle
- Do not get tired and they contract repeatedly

Since dancing was your focus at the beginning, let’s move on to discussing how muscles and bones interact. Which one of the three muscle types mentioned above will we be discussing if we are talking about muscles interacting with bones? If you said skeletal muscles you are right on and deserve a protein smoothie. If you said smooth or cardiac muscle, well drop and give me fifty pushups. Below is a diagram of common skeletal muscles:
How Muscles and Bones Interact:

1. Skeletal muscles generate force and produce movement only by contracting or pulling on body parts.
2. Individual muscles can only pull; they cannot push.
3. Skeleton muscles are joined to bone by tough connective tissue called tendons.
4. Tendons are attached in such a way that they pull on the bones and make them work like levers. The movements of the muscles and joints enable the bones to act as levers.

Muscles that work in Pairs:

To the left is a picture of me without skin. I will now demonstrate how muscles work in pairs by using the muscles in the upper arm.

- Most skeletal muscles work in pairs.
- When one muscle or set of muscles contracts, the other relaxes.
- The muscles of the upper arm are a good example of this dual action: a **flexor** is a muscle that bends a joint, while an **extensor** is a muscle that straightens a joint.
  a. when the biceps muscle (on the front of the upper arm, **flexor**) contracts, it bends or flexes the elbow joint.
  b. when the triceps muscle (on the back of the upper arm, **extensor**) contracts, it opens or extends the elbow joint.
  c. a controlled movement requires contraction by both muscles

Muscle Disorders

**Hernia**

- organ or tissue sticks out through a weak area in the muscle or other tissue that contains it
- cause: usually a weakness in the wall
- 1st symptom: bulge in the wall
Tendonitis
- inflammation of **tendon**
- usually at bone junction
- pain in wrist or ankle after extensive use (running or using a computer)
- common in athletes

Well you made it through muscles 101. Great Job! Before you leave make sure to take the exit survey below or else I will come looking for you!!!

**Exit Survey:**
1. Which letter in the diagram on the right indicates a ligament?

Base your answers to questions 2 and 3 on the diagram of the human arm

2. Movement of the lower arm bones in the direction indicated by the arrow results from the contraction of
   1. the extensor, but not the flexor  3. both the extensor and the flexor
   2. the flexor, but not the extensor  4. neither the extensor nor the flexor

3. The structures labeled X represent
   1. ligaments  2. tendons  3. bones  4. joints

4. Structures 1, 2, and 3 in the diagram are connected to striated muscles by connective tissue. An inflammation of this connective tissue is known as
   1. tendonitis  3. polio
   2. gout  4. angina pectoris

Fill in table below:

<table>
<thead>
<tr>
<th>Type of Muscle</th>
<th>Nervous Control</th>
<th>Type of Control</th>
<th>Example of movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth</td>
<td>Controlled by ANS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>Regulated by ANS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal</td>
<td>Controlled by SNS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interaction between
The Nervous System and Muscular
System

Hi, my name is Neural the Neuron, and I am a little neurotic after seeing the size of Buff’s muscles. Anyways, the size of Buff’s muscles are not so intimidating without the aid of neurons like me. What is a neuron you may ask? A Neuron is the technical term for the basic functional unit of the human nervous system otherwise known as a nerve cell. I am responsible for transmitting electrical signals (nerve impulses) throughout the body. The transfer of electrical signals is imperative with aiding in coordination. So you see, without the aid of my fellow neurons and I, Buff’s skeletal muscles would not be able to contract thus causing him to be unable to move. Unfortunately if this were the case he would not be able to enjoy the gym and weight room as much as he does.

Neuron
- neuron: nerve cell; basic unit of nervous system
  - receives impulses and sends them up the nerves, brain, spinal cord, and receptors
    - cell body: nucleus & cytoplasm (group of these = ganglia)
    - dendrites: branched parts of cell body; receives impulses and send them to cell body
    - axon: single, long fiber that carries impulses away from cell body
- synapse: space between dendrites and axon; impulses crossed by chemical neurotransmitters
  - acetylcholine - primarily muscle stimulation; Alzheimer’s
  - norepinephrine - nervous system into “high alert”; form memory
  - dopamine - reward mechanism in brain, focus; schizophrenia, Parkinson’s
  - serotonin - emotion and mood; OCD, trouble sleeping, suicide
- nerve: bundle of neurons or parts of neurons held together by protective membrane
  - like a telephone cable line carrying messages to and from your home
- sensory neurons: carry impulses to the CNS
- motor neurons: carry impulses from CNS to various body parts (ex: muscles; glands)
Nervous System
- Nervous system divided into:
  o **central** nervous system (CNS)
    ▪ brain
    ▪ spinal cord
  o **peripheral** nervous system (PNS)
    ▪ somatic nervous system: in charge of **voluntary** skeletal muscles
    ▪ autonomic nervous system: in charge of **involuntary** smooth and cardiac muscles
      • ex: heart and digestion

- 3 parts to nerve regulation:
  o **stimulus**: change in environment that affect the nervous system
    • ex: heat from the stove
  o **response**: action to the stimulus
    • ex: removing your hand away from stove
  o **impulse**: electrical or chemical message
    • impulse carried by nerve cells
    • impulses transferred to central nervous system (**CNS**) (CNS)
      o sorts and interprets the impulses
      o impulses sent to organs or glands
    • response carried out by these organs and glands

Behaviors
- total response of an organism to stimuli
  o **Voluntary**: requires thinking
    ▪ impulses start in brain and carried by nerve cells to muscles or glands
    ▪ muscles or glands respond in certain way
    ▪ ex: picking up a book, speaking
  o **Involuntary**: occurs automatically without conscious control
    ▪ learned: acquired through repetition
      • writing one’s name
      • riding a bike
      • playing an instrument
    ▪ inborn
      • contractions of heart and diaphragm
      • secretion of glands
      • simple reflexes: nerve impulses travel in a set pathways (reflex arc)
        • knee jerk & iris movement
  • responses can’t be random, must be **coordinated** by the CNS
    o must be carried out as quickly as possible
    o impulses from sensory nerves → spinal cord and/or brain → response by motor nerve cells → muscles/glands
**Reflex Arc**
The route followed by nerve impulses to produce a reflex action

Steps in reflex arc:
1. **Receptor**: nerve endings in knee receive messages
   - sense organ in skin, muscle, or other organ
2. **Sensory neuron**: carries impulse towards CNS
3. **Interneuron**: carries impulse within CNS
4. **Motor neuron**: carries impulse away from CNS
   - sends message to muscle
5. **Effector**: structure by which animal responds
   - muscle, gland, etc.

**Disorders**
- **Meningitis**: inflammation, caused by bacteria, of the membranes that surround the brain and spinal cord
  - severe headaches, stiffness of neck; can be fatal
- **Cerebral Palsy**: group of birth disorders; disturbance of motor functions
  - treatment still experimental
- **Polio**: viral disease of CNS
  - can cause paralysis; prevented by immunization
- **Stroke**: brain damaged by cerebral hemorrhage (broken blood vessel) or a blood clot in brain
- **Paralysis**: severe damage to spinal cord
  - loss of feeling and muscle function in parts of body
  - impulses to and from body muscles can’t be transmitted to brain
- **Alzheimer’s**: degenerative disease; neurons in brain destroyed
  - forgetfulness, mood swings, and unusual behavior
In this activity, you will work with a partner or in a group (your choice). Your group will design a new dance based upon your new found fame as a Dance Machine Extraordinaire. Your dance must include:

1. Name of Dance
2. Dance Description:
   a. Song it will coincide with
   b. Music genre (Hip Hop, Rap, Rave, Country, etc.)
   c. Dance Category (traditional, cultural, pop culture, formal)
3. Steps (like in “The Dougie” video on above top 10 website); Make sure to include and list all steps with names and descriptions
4. Break down of steps (must describe at least 5) into which bones, joint type, and muscles were used to perform each step.
5. All information will be recorded in graphic organizer below

Differentiation: If dancing is not your thing, you must choose to describe an alternative movement. Other choices may include steps and movements within a jump shot, different styles in martial arts, or you favorite WWE wrestling moves.
**Graphic Organizer**

**Directions:** Fill in Graphic organizer using below model as example. Make sure to take notice how the category titles have changed within our graphic organizer compared to one below in order to best suite our project’s needs.

### Dance Background:

**Name:** _________________________________________________________________

**Song:** ______________________________________________________________________________

**Music Genre:** ______________________________________________________________________________

(Hip Hop, Rap, Rave, Country, etc.)

**Dance Category:** ______________________________________________________________________________

(Traditional, cultural, pop culture, formal)

**Movement sketches and drawings:**
Description and Details:

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<th>Step #</th>
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<th>Bones and joints involved in Movement</th>
<th>Muscles involved in Movement</th>
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Lesson 5: Lesson Plan

Brian Walker  
9th Grade Living Environment

Lesson Title: Organization of the Rochester City

Time Estimation: 90+ minutes

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

Purpose:
Students begin to look at the Rochester Regional Transit Service (RTS) and how it benefits their daily lives. As students begin to realize how the RTS bus system aids in their transportation and circulation throughout the city of Rochester, they will make connections with the structures and functions of the Human Circulatory System.

Student Objective:
- Students read background information on the History of Rochester’s Regional Transit Service (RTS).
- Students identify which bus routes they use the most by looking at regional maps and drawing from experience while recording them in their From One Place to Another Activity Packet.
- Students discover similarities between Rochester’s Regional Transit Service (RTS) and the human circulatory system by reading the story A Journey of Two.
- Students determine which bus routes represent different blood vessels found within the human circulatory system by filling out graphic organizers and looking at bus maps and schedules.
- Students create personalized transportation and circulation map making connections with the bus maps, locations, and components found within Rochester’s Regional Transit Service (RTS) and the human body circulatory system.

Essential Questions:
How is the human body organized to maintain life?

Learning Targets:
- Identify and label structures found within the human circulatory system
- Describe the functions of the circulatory system
- Explain how the circulatory system provides a means of transportation and circulation of vital elements the human body needs along with transporting waste items to be removed.

Materials:
- From One Place To Another Activity Packet
- RTS (Regional Transit Service) Bus Maps/Schedules
- Access to internet through Chromebook/Laptop/Computer
- Butcher Paper/Poster Paper
Procedures:
Bellwork - Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the From One Place to Another Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Independent Work – Students complete From One Place to Another Activity Packet.
1. Introduction (Phase 1) – Students introduced to Rochester’s public transportation system known as RTS or Regional Transit Authority. Students ride buses to and from School along with personal use.
2. Cultural Context (Phase 2) – Students reflect on the importance of the RTS Bus System in their own life through guided questions.
3. Classroom Science (Phase 3) – Students introduced to Circulatory System and concept of circulation and transport through reading a story A Journey of Two! Students make connections between structures in the RTS Bus System and the Human Circulatory System. Students fill out graphic organizers by using RTS Bus schedules and maps.

Homework:
Work on personalized circulation and transportation map

Watch next video for following activity based upon Digestion and Excretion:

The Digestive System: CrashCourse Biology #28
https://www.youtube.com/watch?v=s06XzaKqELk

The Excretory System: From Your Heart to the Toilet - CrashCourse Biology #29
https://www.youtube.com/watch?v=WtrYotjYvtU

Again, Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
FROM ONE PLACE TO ANOTHER

Beep! Beep! Beep! Beep! Beep! Its 6:30am as you turn to look at your alarm clock. Wow, morning sure does come early when you were up all night doing your homework. As you think to yourself, time to start getting ready for another day of school. You begin to roll out of bed or off the couch and say to yourself “must accomplish the morning routine step by step.” As you begin to make it to the door, a thought pops into your head reminding you not to forget your bus pass or you will be arriving late to school today. Standing at the bus stop, you look up and see the RTS bus pull up.

Regional Transit Service (RTS)

What is the purpose or function of the Regional Transit Service (RTS) in Rochester, NY?

What does the RTS consist of? What are the components that help the RTS run smoothly and provide service to numerous Rochestarians?
History of RTS

RTS is a community institution. We provide service to over 18 million customers annually, and, consistently report increasing levels of customer satisfaction. RTS also enjoys a national reputation for our innovative Transit Operations Performance Management System, TOPS, and changed public transportation in Rochester forever with the opening of a modern transit center that revolutionized the way we provide service.

But this is hardly news for RTS. We have a tradition of making public transportation in Rochester better.

Even though public transportation had been available in Rochester since 1825 – with the earliest bus lines in operation by 1905 – it frequently fell far short of success.

Rochester City Lines, one of Rochester’s first bus services, opened in 1923 but went bankrupt shortly after.

Following Rochester City Lines, Rochester Transit Corporation re-established a mass transit system in 1938 and increased their ridership to nearly 10 million before financial trouble caught up with them, too.

That’s when the City of Rochester stepped in, and we saw the first signs of the bright future of public transportation to come. Unwilling to deprive its citizens of affordable public transportation, the City of Rochester absorbed Rochester Transit Corporation and renamed it Rochester Transit Service (RTS), which later became Regional Transit Service.

Then, in 1969, following years of consistent and reliable service, sweeping statewide legislation consolidated RTS and the bus services of six other counties into the bus company that many are familiar with today – the Rochester-Genesee Regional Transportation Authority (RGRTA). On August 1, 2014 RGRTA welcomed Ontario County to the family.

RGRTA oversees public transportation in Monroe, Genesee, Livingston, Ontario, Orleans, Seneca, Wayne and Wyoming counties and has a standing reputation for efficiency and customer satisfaction.

Today, RTS is serving customers in all eight counties overseen by RGRTA. And we’re applying the same tradition of better public transportation to give our customers the very best experience – every day.

See more at: http://www.myrts.com/About-Us/History#sthash.uN4uCtQk.dpuf
Look at the map above! Which route(s) do you ride on in order to get to school? Do you have to transfer anywhere? If so where? Are there any bus routes not listed above you ride on? If so which ones?

What other bus routes do you typically ride to get from place to place?
Look at the map above! Which route(s) do you ride on in order to get to school? Do you have to transfer anywhere? If so where? Are there any bus routes not listed above you ride on? If so which ones?

What other bus routes do you typically ride to get from place to place?
Look at the map above! Which route(s) do you ride on in order to get to school? Do you have to transfer anywhere? If so where? Are there any bus routes not listed above you ride on? If so which ones?

What other bus routes do you typically ride to get from place to place?
Look at the map above! Which route(s) do you ride on in order to get to school? Do you have to transfer anywhere? If so where? Are there any bus routes not listed above you ride on? If so which ones?

What other bus routes do you typically ride to get from place to place?
Did you know your body has its own transportation/circulation system? Just like the RTS, the Human Circulatory System aids in the process of transportation and circulation. Whereas the RTS specializes in the transport of humans and their belongings, the Circulatory System transports oxygen, carbon dioxide, nutrients, hormones, and wastes. The RTS uses buses, bus stops, transit centers, bus routes, and bus garages (repair, refuel, and maintenance) in order to aid in the transport of individuals throughout Rochester and Monroe County. Our Circulatory System uses the heart, blood vessels (arteries, veins, and capillaries), red blood cells, platelets, and lymphatic vessels to transfer items to various organs, tissues, and cells throughout the body.
This is a tale of two travelers both with the name Ruby! Our first traveler is Ruby the Red Blood Cell and our other traveler is Ruby the RTS Bus. Each individual has daily responsibilities and lives a life in which they serve a specific purpose and function. One function our travelers have in common is transportation. Each Ruby is a means in which items can be transported from place to place within a specific environment. Ruby the Red Blood Cell lives in our Circulatory System within our human bodies. She is responsible for transporting oxygen, carbon dioxide, nutrients, hormones, and wastes throughout the body. Ruby the RTS Bus lives within the Regional Transit Service located in the city of Rochester, NY. She is responsible for transporting humans along with their belongings from place to place within the city of Rochester. The word transport can be defined as to carry, move, or convey from one place to another. So how do our two travelers move around within their allotted environments?

Each Ruby needs to move around so they both have a method of circulating through their environments in order to transport specific items. The word circulate can be defined as to move or flow in a circle or circuit; move or pass through a circuit back to the starting point. Ruby the Red Blood Cell is able to transport items from place to place within the human body through the Circulatory System. Ruby the RTS Bus is able to transport individuals and their belongings from place to place through the Regional Transit Service. Both systems provide a way in which each Ruby is able to move around and circulate in order to achieve their function of transporting items from place to place.

Ruby the Red Blood Cell’s journey begins in the heart. The heart is a strong muscle that pumps blood through the circulatory system. Blood is either traveling towards the heart or away from it. The heart is broken into four chambers: right atrium, right ventricle, left atrium, and left ventricle. The right side of the heart contains deoxygenated blood (without oxygen) and the left side contains oxygenated blood (with oxygen). From the heart extend blood vessels, or tube like structures, in which blood is able to flow to other parts of the body. The names of these tubes are determined by the direction blood is flowing in regards to the heart. Blood Vessels that allow for blood to flow away from the heart are called arteries (begins with letter a for “away”). Blood Vessels that allow blood to return to the heart are called veins. Capillaries are extremely tiny blood vessels that connect arteries with veins and allow for the exchange of items from blood to cells and cells to blood.
As Ruby returns to the heart through the Inferior or Superior Vena Cava Vein, she contains no oxygen, but does have carbon dioxide. As a result, she needs to be sent to the lungs in order to drop off carbon dioxide and pick up oxygen. Once Ruby enters into the right side of the heart, she then is pumped into the pulmonary artery on her way to the lungs. Remember, arteries take blood away from the heart and the pulmonary artery is the only artery that pump deoxygenated blood (without oxygen) away from the heart. All other arteries contain oxygenated blood. Once Ruby enters into the Pulmonary Artery, her next stop will be the lungs. As she passes through the lungs she enters into tiny blood vessels called capillaries where, she drops off carbon dioxide and picks up oxygen. She then returns to the heart through the pulmonary vein. Remember veins carry deoxygenated blood back to the heart; however the pulmonary vein is the only vein that carries oxygenated blood.

As Ruby returns to the heart through the Inferior or Superior Vena Cava Vein, she contains no oxygen, but does have carbon dioxide. As a result, she needs to be sent to the lungs in order to drop off carbon dioxide and pick up oxygen. Once Ruby enters into the right side of the heart, she then is pumped into the pulmonary artery on her way to the lungs. Remember, arteries take blood away from the heart and the pulmonary artery is the only artery that pumps deoxygenated blood (without oxygen) away from the heart. All other arteries contain oxygenated blood. Once Ruby enters into the Pulmonary Artery, her next stop will be the lungs. As she passes through the lungs she enters into tiny blood vessels called capillaries where, she drops off carbon dioxide and picks up oxygen. She then returns to the heart through the pulmonary vein. Remember veins carry deoxygenated blood back to the heart; however the pulmonary vein is the only vein that carries oxygenated blood.

Ruby travels to the digestive tract including the stomach and intestines in order to pick up nutrients from the food and beverages consumed by an individual. She will then bring those nutrients to the rest of the body and distribute as needed. Along with bringing individual cells nutrients and oxygen, Ruby will also be busy collecting waste products from each cell. She will then bring such waste to places such as the liver and kidneys. Once she drops off waste products, she may also pick up chemicals and substance from the liver and kidney that may be needed elsewhere in the body. Ruby will also transport oxygen and nutrients to vital organs such as muscles and the brain. Ruby has an important role and function transporting numerous items to individual cells throughout the entire body. When she eventually makes here circuit around, she will then head back to the heart through veins and begin the whole journey all over again.
Wow, enough about Ruby the Red Blood Cell! What about Ruby the RTS Bus? Ruby the RTS Bus’s journey begins at the RTS Main Office Building located on 1372 E Main ST. At this location, Ruby the RTS Bus gets all maintenance done on her. She receives services such as cleaning, refueling, and any other maintenance type work. It is from here she begins her journey to center city downtown where she will arrive at the Regional Transit Center.

The Regional Transit Center is located on Mortimer St. in between Clinton Avenue and St. Paul St. This transit center is equipped with 30 bus bays which receive and release RTS buses from all over the city of Rochester and surrounding Monroe County. It has the capacity to accommodate 100 buses per hour. As Ruby pulls into one of the bus bays, she receives her route and first group of passengers for the day. Once all passengers have boarded, she leaves the Regional Transit Center and begins her journey to her destination point based upon route received for the day. Today she will be traveling to Ontario Beach Park.

On her travels towards her destination, she maintains a specific path determined by her assigned route. This allows Ruby to maintain direction and not veer off onto another route. Within her route, she will have numerous stops in which she will have an exchange of passengers. Each passenger boards or exits the bus with a distinct purpose and direction. The bus stops are specific and have also been predetermined by the assigned route. Some of the stops may be connected with other bus routes which allow for passengers to change direction. These connecting routes may take individuals across town on bus routes that never enter downtown but remain in an outlying area surrounding the city. Connecting routes can also link separate routes leading to and from downtown.

After traveling along her route, Ruby finally reaches her destination point and pulls in at Ontario Beach Park. Once there, she turns around and begins to head back downtown to the Regional Transit Center. As she travels back to downtown, she continues transporting individuals with various materials and belongings. Once she arrives at the Regional Transit Center in downtown, she will exchange passengers and begin to circulate through her route all over again.
Make the Connection

**Directions:** Match items according to their corresponding function by drawing a line from one picture to the other.

**Regional Transit Service (RTS)**
- Buses
- RTS Transit Center (Downtown)
- Bus Stops
- Bus Routes

**The Human Circulatory System**

**Blood vessels**
- There are three types of blood vessels, as shown in this magnified part of the circulatory system.
  - **artery** carries blood away from the heart
  - **capillary** carries blood to and from the body’s cells
  - **vein** carries blood back into the heart

**Why are there different types of blood vessels?**

**Human Organs**

**Red Blood Cells**

**The Human Heart**

**Oxygenated Blood**
- Red in color

**De-Oxygenated Blood**
- Blue in color
In this exercise, you will identify the three types of blood vessels and relate them to the RTS use of buses, main transit center (downtown), bus schedules, and route maps. You will determine which bus routes represent arteries, veins, and capillaries within the RTS busing system by looking and examining bus schedules and maps. We will use the RTS Transit Center located in Center City on Mortimer St. between Clinton Avenue and St Paul Street to represent the heart of the Regional Transit Service.

Blood Vessels Structure and Function

There are three main types of blood vessels:

- **Arteries.** They begin with the aorta, the large artery leaving the heart. Arteries carry oxygen-rich blood away from the heart to all of the body’s tissues. They branch several times, becoming smaller and smaller as they carry blood farther from the heart.

- **Capillaries.** These are small, thin blood vessels that connect the arteries and the veins. Their thin walls allow oxygen, nutrients, carbon dioxide, and other waste products to pass to and from our organ’s cells.

- **Veins.** These are blood vessels that take blood back to/toward the heart; this blood lacks oxygen (oxygen-poor) and is rich in waste products that are to be excreted or removed from the body. Veins become larger and larger as they get closer to the heart. The superior vena cava is the large vein that brings blood from the head and arms to the heart, and the inferior vena cava brings blood from the abdomen and legs into the heart.

This vast system of blood vessels -- arteries, veins, and capillaries -- is over 60,000 miles long. That's long enough to go around the world more than twice!

Blood flows continuously through your body's blood vessels. Your heart is the pump that makes it all possible.

(http://www.webmd.com/heart-disease/high-cholesterol-healthy-heart)
Directions: Use Any RTS Bus Route Map and Schedule to Answer the Following Questions

A. Can Use Any Physical RTS Bus Map and/or

1) Choose five separate bus numbers that use the Regional Transit Center located in downtown Rochester and list them by number and name below:

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<th>Bus Number and Name</th>
<th>Artery Bus Route</th>
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2) Using the five bus numbers chosen from question 1; determine which routes within each bus number would be considered an **Artery** within the Regional Transit Service (RTS):

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3) Using the five bus numbers chosen from question 1; determine which routes within each bus number would be considered a *Vein* within the Regional Transit Service (RTS):

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<th>Bus Number and Name</th>
<th>Vein Bus Route</th>
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4) Choose two bus numbers that could function as capillaries within the Regional Transit Service and list them by name and number below. Explain the characteristic of each bus number and why you chose them to represent capillaries within RTS.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
My Transport and Circulation Map

For this assignment, you will be responsible to draw/create/label your own RTS transportation map. You will choose five of your favorite places you ride the RTS bus to. If you don’t have five favorites, you can choose options or places you may want to go in future outings. You must label the map using both RTS and Circulatory System terminology while making the connection between similar structures and functions. Proper identification of which routes are considered arteries, veins, and capillaries will be taken into consideration, along with proper identification of main organs with their corresponding building structures, when determining your final grade.

Materials:
Bus Maps/Schedules or http://www.myrts.com/Maps-Schedules/RTS-Monroe/Schedule-pdfs
Butcher Paper
Art Supplies for coloring, labeling, cutting, and gluing
Pictures (drawn, printed from computer, taken with cell phone or camera)

Necessities to include:
- Correct Bus Numbers and Names
- Must have Bus Routes representing all blood vessels including arteries, veins and capillaries
- A Heart (Regional Transit Center)
- 5 Destinations (pictures: drawn, printed up, or taken with camera)
- Labels, labels, labels: make sure everything is labeled and has description if necessary!
  A. Street Names
  B. Building Structures/Locations
  C. Circulatory System identification of structures
  D. Bus Stops
Lesson 6: Lesson Plan

Brian Walker
Lesson Title: Please Pass The Pepto!
Time Estimation: 60+ minutes

9th Grade Living Environment
Topic II: Human Structure and Function

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

Purpose:
Students examine a variety of over-the-counter medicines which aid in helping relieve common digestive disorders within the human body. Through further investigation, knowledge of the structures and functions of the digestive system are discovered.

Student Objective:
➢ Students visit websites representing a variety of over-the-counter medicines and fill out graphic organizers found within the Please Pass the Pepto Activity Packet.
➢ Students write a descriptive story pretending they are a Cheeto, Frito, or Dorito traveling through the human digestive system and then use comic strip programs (Comic Life or Comic Strip It Pro) or draw pictures to represent the story.

Essential Questions:
How is the human body organized to maintain life?

Learning Targets:
➢ Identify and label structures of the digestive system
➢ Describe the function of the digestive system
➢ Explain how the different organs within the digestive system work together to bring about the desired goal of digestion.

Materials:
- Please Pass the Pepto Activity Packet
- Internet Access through Chromebook/Laptop/Computer
- Comic Strip Programs: Comic Life or Comic Strip It Pro
- Poster Paper/Butcher Paper (for those who want to draw and label)
- Drawing supplies such as colored pencils, markers, pencils, etc.

120
**Procedures:**
Bellwork - Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the Please Pass the Pepto Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Independent work - Students will need internet access through computer/laptop/Chromebook/IPad and will begin working on Please Pass the Pepto Activity Packet.
   1. Introduction (Phase 1) – Students are provided pictures of some over-the-counter medication.
   2. Cultural Context (Phase 2) – Students go to websites of over-the-counter medications and fill out graphic organizers.
   3. Classroom Science (Phase 3) – Students draw from information found and discover structures and functions of the Digestive System

Independent work – Students work on descriptive story of traveling through the digestive system as Cheeto, Frito, or Dorito.
   4. Integration (Phase 4) - Students will need access to computer programs Comic Life or Comic Strip It Pro! For those students who choose to draw comic strip in order to represent Descriptive story, they will need access to art supplies.

**Homework:**
Work on any incomplete work from Please Pass the Pepto Activity

Watch next video for the following activity based upon Feedback Mechanisms:

Great Glands - Your Endocrine System: CrashCourse Biology #33
[https://www.youtube.com/watch?v=WVrlHH14q3o](https://www.youtube.com/watch?v=WVrlHH14q3o)

Again, Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
Above are examples of some medicines found on the shelves at your local grocery store, drugstore, Walmart, Target, or even some local corner stores. Why might an individual purchase any of the above medicines? List as many reasons as you can think of and be as specific as possible (“because somebody doesn’t feel good” is not an acceptable answer!)
Disorders?

In this activity, we will investigate some common over-the-counter medicines individuals take for certain health disorders. Disorders can be defined as a disturbance in physical or mental health or functions. Certain over-the-counter remedies have been developed to help relieve common disorders of the Human Body.

**Directions:** Fill out the graphic organizers below for each medicine by logging onto its corresponding website.

**Pepto Bismol**

[http://www.pepto-bismol.com](http://www.pepto-bismol.com)

<table>
<thead>
<tr>
<th>1. What disorders are treated by this medicine?</th>
<th>2. What are the symptoms of such disorders?</th>
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<th>3. What are the Causes of the Disorders?</th>
<th>4. What organs are affected by such disorders?</th>
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### Imodium A-D

http://www.imodium.com

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<th>1. What disorders are treated by this medicine?</th>
<th>2. What are the symptoms of such disorders?</th>
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### Milk of Magnesia (MOM)

https://www.phillipsrelief.com/products/milk-magnesia/

<table>
<thead>
<tr>
<th>1. What disorders are treated by this medicine?</th>
<th>2. What are the symptoms of such disorders?</th>
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<th>3. What are the Causes of the Disorders?</th>
<th>4. What organs are affected by such disorders?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Mylanta
http://www.mylanta.com

<table>
<thead>
<tr>
<th>1. What disorders are treated by this medicine?</th>
<th>2. What are the symptoms of such disorders?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
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</table>

### Tums
http://www.tums.com

<table>
<thead>
<tr>
<th>1. What disorders are treated by this medicine?</th>
<th>2. What are the symptoms of such disorders?</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
List all organs mentioned in above graphic organizers. As you look over the list of organs, what Human Body System do you think is affected by such disorders and medicine and describe why?

How can such disorders be harmful to the Bodily System mentioned above (Think about the function of the Body System you chose to represent the list of organs)?
Are there other organs not mentioned in the list above that are part of the same Body System? If so which ones?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

Apart from the medicines mentioned above, are there other ways of dealing with the same symptoms?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

If for some reason you did not have access to medicines above, how would you deal with the symptoms?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

Does your family or relatives have knowledge of possible natural remedies to help cope with such disorders?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________
**Human Digestive System**

Your digestive system is uniquely designed to turn the food you eat into nutrients, which the body uses for energy, growth and cell repair. The Human digestive system consists of the mouth, salivary glands, throat, esophagus, stomach, small intestine, large intestine (also called the colon and bowel), rectum, and anus. Amongst the organs whose function is to support the digestive system are the gallbladder, liver, and pancreas. Each organ of the digestive system has a specific and important role to play in the digestion of the material (carbohydrates, proteins, and lipids) we ingest. The loss of function in any of the support organs within the Digestive System can cause serious health issues and complications, and even death.

**Digestive Organs**

Mouth – mechanical breakdown of food begins; saliva also mixes with food to aid in breakdown

Esophagus – muscular tube that brings food from your mouth to your stomach

Stomach – sac-like structure with strong muscular walls; mechanical (mixer and grinder) and chemical (secretes acid) breakdown of food

Small intestine – where most of the chemical digestion and absorption of food/nutrients occurs

Large intestine – Stool, or waste left over from the digestive process is passed through where water gets removed

**Mechanical and Chemical Digestion**

1. Chemical Digestion: --Chemical breakdown of food; Enzymes are used to produce new smaller molecules

2. Physical/Mechanical Digestion: -- Physical break down of food; Increases surface area so enzymes can work on them.
First:

Pretend you are a Frito, Cheeto, or Dorito and write a descriptive story for your journey through the Human Digestive System. Put yourself in the place of the Frito, Cheeto, or Dorito and tell about your journey. Be sure to include at least five structures/organs found in the Human Digestive System. Make sure to also mention when and how mechanical and/or chemical digestion takes place.

Second:

Summarize your descriptive story through A Comic Strip. You can choose one of the three options below:

1. Draw your own Comic Strip

2. Comic Life computer program for PC or Mac

3. Comic Strip It Plus APP
**Bonus**

As Pepto-Bismol is pink, so too is the lake in the picture below; what is the name of the lake and where is it located?
Lesson 7: Lesson Plan

Brian Walker
Lesson Title: I Need My Energy Drink
Time Estimation: 120+ minutes

9th Grade Living Environment
Topic II: Human Structure and Function

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

Purpose:
Students will investigate popular energy drinks in order to realize ingredients found within these drinks may disrupt their internal Homeostasis. Students are led to discover their bodies have control mechanisms that can counteract such changes leading back to internal Homeostasis.

Student Objective:
- Students complete Energy Drink Ingredients graphic organizer with name of ingredient and its effect on the body.
- Students analyze the results within 24 hours on the average body after drinking an energy drink.
- Students identify glands by matching them with the desired results in which their hormones produce.
- Students investigate blood sugar regulation and the negative feedback mechanism responsible for maintaining stable blood sugar levels through completing I Need My Energy Drink Activity.
- Students discuss risk factors for Type 2 Diabetes and develop preventative strategies individuals could incorporate within their lifestyles through guided investigation of the disease Type 2 Diabetes.
- Students draw/label flow chart models of negative feedback and positive feedback mechanisms in the endocrine system including glands, organs, hormones, and steps (stimulus, receptor, control center, effector, and feedback).

Essential Questions:
How do biological systems achieve homeostasis through feedback mechanisms?

Learning Targets:
- Discover how the endocrine system is responsible for maintaining Homeostasis
- Demonstrate how equilibrium is maintained through feedback mechanisms
- Identify and Analyze Feedback Mechanism Components
- Construct negative and positive feedback loop flow charts

Materials:
- I Need My Energy Drink Activity Packet
- Internet Access through Chromebook/Laptop/Computer
o Butcher Paper/Construction Paper/Poster Paper
o Drawing Supplies/Printed Pictures

**Procedures:**
Bellwork - Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the I Need My Energy Drink Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Partner/Group Work – Students work on completing I Need My Energy Drink Activity Packet up until Human Body Regulation Section
1. Introduction (Phase 1) – Students introduced to Energy Drinks
2. Cultural Context (Phase 2) – Students investigate what ingredients are found in average energy drinks and discover their effects on the body up to 24 hours after drinking one.

Independent Work – Students will complete remainder of I Need My Energy Drink Activity Packet independently.
3. Classroom Science (Phase 3) – Students are introduced to Human Body Regulation and the Endocrine System through matching, fill in the blank, and short answer exercises in activity packet.
4. Integration (Phase 4) – Students design and create own human body feedback mechanism flow charts

**Homework:**
Finish Both Feedback Mechanism Flow Charts

Watch next for following topic based upon disruption of Homeostasis – Disease and the Immune System

Your Immune System: Natural Born Killer - Crash Course Biology #32
[https://www.youtube.com/watch?v=CeVtPDjJBPU](https://www.youtube.com/watch?v=CeVtPDjJBPU)

Again, Teacher could take liberty to create own instructional video for students to watch and place on classroom website, Google classroom, or email to students’ district email account.
Americans have been reaching for energy drinks to meet the demands of their ever increasing busy lives. In today’s fast-paced society, it can be really easy to feel burnt out. Busy lifestyles and hectic schedules require more energy from our bodies, and often decrease the amount of time we have to sleep. This is why so many people have started to rely on energy drinks to help them get through the day. Energy drinks are both popular and questioned. As the popularity of energy drinks spikes, so do concerns on the possible health hazards they pose. They are popular because they are an easy and quick way to boost energy levels. They are questioned because some people wonder about the ingredients and health effects. Popular brands of energy drinks are consumed millions of times each day all across America, Europe, Asia, and just about everywhere else around the world.

Have you ever consumed an energy drink before? If so, what kind(s)? (List all that apply)

If you have never had an energy drink before, why not? What are some reasons you may have avoided them or not purchased any?

On average, how many energy drinks do you consume in a day? A week? A month?
## Top Selling Energy Drinks

<table>
<thead>
<tr>
<th>Energy Drink Sales</th>
<th>Sales 2011</th>
<th>Sales 2012</th>
<th>Sales 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Bull</td>
<td>$2.3 billion</td>
<td>$2.95 billion</td>
<td>$6.927 billion</td>
</tr>
<tr>
<td>Monster</td>
<td>$1.9 billion</td>
<td>$2.6 billion</td>
<td>$3.147 billion</td>
</tr>
<tr>
<td>Rockstar</td>
<td>$660 million</td>
<td>$780 million</td>
<td>$821 million</td>
</tr>
<tr>
<td>NOS</td>
<td>$220 million</td>
<td>$250 million</td>
<td>$274 million</td>
</tr>
<tr>
<td>AMP</td>
<td>$330 million</td>
<td>$300 million</td>
<td>$239 million</td>
</tr>
<tr>
<td>Full Throttle</td>
<td>$130 million</td>
<td>$140 million</td>
<td>$104 million</td>
</tr>
<tr>
<td>Xyience Xenergy</td>
<td>$30 million</td>
<td>$40 million</td>
<td>$43 million</td>
</tr>
</tbody>
</table>


Looking at the table above, what is the difference in sales between the top two selling energy drinks in 2013?

How much more in sales did Red Bull make in 2014 compared to 2011? What type of inferences can be made about the energy drink industry as a result of the difference between Red Bull’s sales from 2011-2013?

Looking at the graph on the right, what percentage of the energy drink market does Red Bull and Monster Energy Drink encompass?

Why do you think Monster Energy and Red Bull have such a large portion of the energy drink market? What factors play a role in their success?

Let’s take a look at what we can find inside energy drinks!

Energy drinks contain a variety of ingredients that are proposed to increase one’s alertness and stamina along with boosting performance. Since most energy drinks are served cold, they can be ingested rapidly and begin to have an effect within just a few minutes. Athletes who endure serious workouts, students who spend enormous amounts of time studying for final exams, and individuals who work long hours at their job tend to reach for energy drinks to assist them when fatigue or a lack of concentration sets in. What is found in energy drinks that actually gives an individual that added boost they are looking for? Have you ever thought about what ingredients are found within energy drinks and how they may affect your body? Let’s investigate:

2. Fill out Graphic Organizer below by listing ingredients and two influences each one has on the body

**ENERGY DRINK INGREDIENTS**

| C | _____________________________________________ |
| 1. | _____________________________________________ |
| 2. | _____________________________________________ |

| T | _____________________________________________ |
| 1. | _____________________________________________ |
| 2. | _____________________________________________ |
Besides the active ingredients in energy drinks, there are other chemicals placed in energy drinks to give them a longer shelf-life (Preservatives) and a more vibrant color (Artificial Colors).
What happens 24 hours after drinking an energy drink?

Let’s Take a Sip!

What do you think are two or three possible challenges the human body faces after consuming an energy drink?

What Body Systems do you think are influenced after one gulps down an energy drink?

Directions: Use labeled diagram to help answer questions below

What is one of the first effects caffeine has on your body?

On average, how long does it generally take for an individual’s body to remove caffeine out of the bloodstream?

What is meant by the half-life of caffeine?

Why do you think an individual experiences a sugar crash 1 hour after drinking an energy drink?
WHAT HAPPENS 24 HOURS AFTER DRINKING AN ENERGY DRINK

We look at what happens to your body after drinking an energy drink, from the moment it hits your lips to the buzz to the withdrawal symptoms.

1. 10 MINUTES
Once you consume an energy drink it takes around 10 minutes for the caffeine to enter your bloodstream. Your heart rate & blood pressure start to rise.

2. 15-45 MINUTES
The time your caffeine level peaks in your bloodstream. You’ll feel more alert as the stimulant starts to affect you, improving not only concentration but how alert you are.

3. 30-50 MINUTES
All of the caffeine is fully absorbed. Your liver also responds by absorbing more sugar into the bloodstream.

4. 1 HOUR
Your body starts to experience a sugar crash as well as the effects of the caffeine dying down; you’ll start to feel tired and energy levels will start to feel low.

5. 5-6 HOURS
This is the half life of caffeine, meaning it takes 5-6 hours for your body to reduce the content of caffeine in your bloodstream by 50%. Women on birth control tablets require double the length for their body to reduce it.

6. 12 HOURS
The time that it takes most people to fully remove caffeine from their bloodstream. The speed at which this happens does depend on many factors from age to activity.

7. 12-24 HOURS
As caffeine is a drug those that regularly drink items with it in can feel withdrawl symptoms 12-24 hours after the last dose; these often include headaches, irritability and constipation.

8. 7-12 DAYS
Studies have shown this to be the time frame for your body to become tolerant to your regular caffeine dosage. Meaning you’ll get used to it and so won’t feel the effects as much.

SO IS IT GOOD OR BAD TO DRINK ENERGY DRINKS?

Often high in sugar and calories there are other ingredients which can have bad effects on you, these include caffeine, a stimulant drug, which can cause anxiety, stomach upsets, dehydration and increased heart rate.

Although high in caffeine, energy drinks like Redbull are well within the guideline maximum 400 milligrams with a typical 250ml can containing 80 milligrams.

In America, admissions to emergency departments which were energy drink related doubled from 2007-2014 according to the Substance Abuse and Mental Health Services Administration’s Dawn Report.

Energy drink companies often compare their drinks to coffee with many options at coffee shops being higher in caffeine, such as a Starbucks Venti Caffe Americano which contains 300 mg of caffeine.

As with most things in life, energy drinks are fine in moderation and as part of a balanced diet.

Sources can be seen: http://www.Personalise.co.uk/blog/what-happens-24-hours-after-drinking-an-energy-drink

Infographic produced by: PERSONALISE.co.uk
How do you think the body is able to protect itself from an overabundance of sugar being ingested all at once?

One of the major ingredients in energy drinks is sugar. The American Heart Association tells consumers to have no more than 6 teaspoons or 24 grams (women) or 9 teaspoons or 36 grams (men) of refined sugars each day. A typical 16 fl. oz. energy drink contains around 50-60 grams of sugar. This is about 10-12 teaspoons of sugar. Some drinks have as much sugar as several Snickers candy bars. Ingesting sugar in such large quantities can send your blood sugar levels skyrocketing. With an individual ingesting such a large amount of sugar into their body at one time, we must ask the question:

How does the human body return to homeostasis after drinking a sugar loaded energy drink?
Regulation is defined as the life function by which an organism controls and coordinates its other life functions to maintain homeostasis. Our environment (both inside and outside of the body) is constantly changing. Within the human body, both the Nervous System and Endocrine System are used to control and coordinate body activities necessary to adapt to these external and internal changes. Although they are not the only body systems that aid in regulation, they are of utmost importance in commanding other body cells, organs, and systems to respond to internal or external stimuli. For example, the Endocrine System has a regulatory effect on other organ systems such as the muscular system by producing hormones that adjust muscle metabolism, energy production, and growth. When homeostasis is interrupted, your body can correct or intensify the problem based on certain influences through the process of regulation. The Nervous and Endocrine Systems work together through the process of regulation (responding to environmental changes) to maintain homeostasis.

Let’s first take a look at some of the differences between the Nervous and Endocrine System.

### The Nervous System vs. The Endocrine System

<table>
<thead>
<tr>
<th>The Nervous System</th>
<th>The Endocrine System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses (mostly) Electrical Messages</td>
<td>Uses Chemical Messages (Hormones)</td>
</tr>
<tr>
<td>Fast Acting</td>
<td>Generally Slow Acting</td>
</tr>
<tr>
<td>Reversible changes</td>
<td>Generally Irreversible changes</td>
</tr>
<tr>
<td>Dedicated signal system (nerves)</td>
<td>Uses Blood System to spread hormones</td>
</tr>
</tbody>
</table>

What is the difference between the types of messages the Nervous and Endocrine system send?

What is the difference between the pathways in which the messages are send between both body systems?
Endocrine System in Detail:
- responsible for chemical regulation in body
- stimuli cause certain glands to secrete chemical messengers called **hormones**
- hormones coordinate the response of body parts
- endocrine glands + hormones = endocrine system
- **ductless** glands
  - no ducts (tube-like structures)
  - hormones released directly into **bloodstream**
  - Nervous system responses are fast and short lived, endocrine responses are slow and long lasting
- hormones transported throughout the body to **target** tissues
- target tissue has **specific** hormone receptors

- ex: pancreas secretes insulin- enables glucose from blood to enter body cells; control glucose level in body cells
  - diabetes: under secretion of insulin; too much blood sugar in body cells

The Endocrine System Regulates:

How does the Endocrine System influence the life functions mentioned above? The foundations of the endocrine system are the glands and hormones they produce. Each gland produces specific hormones (chemical messengers). When released into the circulatory system, these hormones travel throughout the body but affect only specific target cells and organs. Let’s go over examples of the different glands and their hormones and see how they **control** and **coordinate** different life functions:
<table>
<thead>
<tr>
<th>Gland</th>
<th>Location</th>
<th>Hormone</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothalamus</td>
<td>Small gland located within the brain.</td>
<td>The hormonal secretions of the hypothalamus control the pituitary gland.</td>
<td><img src="image1.png" alt="Hypothalamus" /></td>
</tr>
</tbody>
</table>
| Pituitary Gland | Located under the brain. Known as the master gland since such a large number of hormones are produced there. | **Growth Hormone** – targets all cells and affects growth of long bones.  
- **Follicle Stimulating Hormone** – targets gonads and affects females monthly cycle, production of female sex hormones and male gametes.  
- **Thyroid Stimulating Hormone** – Targets thyroid gland and affects production and release of thyroxin. | ![Pituitary Gland](image2.png) |
<table>
<thead>
<tr>
<th><strong>Thyroid Gland</strong></th>
<th>Located in the neck, surrounding the trachea.</th>
<th>Produces and releases <strong>thyroxin</strong>, a hormone which regulates the metabolic rate.</th>
</tr>
</thead>
</table>
| **Parathyroid Gland** | located inside the thyroid gland | The parathyroid produces and secretes **parathormone**.  
**Parathormone** targets bone and controls the metabolism of calcium in the body. |
| **Adrenal Glands** | Located in the kidneys and consist of two separate regions:  
1) Adrenal Cortex (outer region)  
2) Adrenal Medulla (inner region) | **Adrenal Cortex** (outer) secretes:  
**Aldosterone**- which targets the kidneys and controls blood pressure in the body.  
b) **Cortisol**-which targets the liver and controls the conversion of stored starches (glycogen) into simple sugars (glucose)  
**Adrenal Medulla** (inner) secretes:  
**Adrenalin** which affects the body’s response to danger.  
- Adrenalin increases the breathing rate, heart rate, and metabolism.  
- It also stimulates the conversion of glycogen into simple sugars used for a quick source of fuel. |
| **Pancreas**  
(Islets of Langerhans) | Gland tissue scattered throughout the pancreas. | Produces both **insulin** and **glucagon**; **Insulin** and **glucagon** have opposite effects on the body’s storage of sugar.  
**Insulin** promotes sugar storage in the liver  
Sugar travels from Blood to Liver (Lowers blood sugar)  
**Glucagon** promotes the release of stored sugar from the liver. Sugars |
<table>
<thead>
<tr>
<th>Gonads (Sex Glands)</th>
<th>travel from Liver to Blood (Increases blood sugar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gonads are the testes</td>
<td>Male Reproductive System</td>
</tr>
<tr>
<td>Female gonads are the ovaries</td>
<td>Female Reproductive System</td>
</tr>
<tr>
<td>Testes produce Testosterone Testosterone targets male sex organs and affects gamete (sperm) production, and male secondary sex characteristics.</td>
<td></td>
</tr>
<tr>
<td>Ovaries produce estrogen and progesterone: These hormones control female secondary sexual characteristics and female sexual functions (menstrual cycle and pregnancy).</td>
<td></td>
</tr>
</tbody>
</table>

### Matching

**Directions:** Identify the correct gland that produces the hormone which has the desired effects below.

(Glands may be used more than once)

- _____ 1) Sperm production and male secondary sex characteristics
- _____ 2) Regulates metabolic rate
- _____ 3) Targets all cells and affects growth of long bones
- _____ 4) Effects on body’s storage of sugar
- _____ 5) Control Female sexual functions (menstrual cycle and pregnancy)
- _____ 6) Controls Blood Pressure and water balance
- _____ 7) Hormonal Secretions control the Pituitary Gland
- _____ 8) Effects the Body’s response to danger
- _____ 9) Known as the Master Gland
- _____ 10) Targets the Liver and controls conversion of stored starches
- _____ 11) Targets gonads and affects females monthly cycle, production of female sex hormones and male gametes

A. Adrenal Gland

B. Pancreas

C. Hypothalamus

D. Parathyroid Gland

E. Testis

F. Pituitary Gland

G. Thyroid Gland

H. Ovaries
The Endocrine System uses Feedback Mechanisms:

Homeostasis is maintained by the endocrine system through the use of various feedback mechanisms.

- **feedback mechanism**
  - detect changes from normal state and take corrective actions to return their systems to the normal range
  - two types
    - Negative Feedback Mechanism- occurs when the response to a stimulus reduces the original stimulus.
    - Positive Feedback Mechanism- occurs when the response to a stimulus increases the original stimulus.

- A **feedback mechanism system** consists of the following components:
  1. A **Stimulus**, or stress, which initiates the chain of events (eg. an environmental or internal change).
  2. A **Receptor** which detects the change and sends a signal to a control center.
  3. A **Control Center**, or integrator, (which has set the range of values within which a variable should be maintained) receives information from the sensor, integrates this information, and sends information to the effectors indicating the sequence of events to follow.
  4. An **Effector**, or regulator, which receives information from the control center, resulting in a change to a variable, and thus, a response to the initial stimulus; returns variable to homeostasis
  5. **Feedback** reports to the control center about the success of the response.

Can you identify any body parts that may act as one of the following components?

**Receptor =**
________________________________________________________________________________

**Control Center =** ____________________________________________________________________________

**Effector =** _____________________________________________________________________

---

| Input: Information sent along afferent pathway to Control center |
| Control center |
| Output: Information sent along efferent pathway to Effector |
| Receptor (sensor) |
| Effector |
| Variable (in homeostasis) |
| Response of effector feeds back to influence magnitude of stimulus and returns variable to homeostasis |

Can you identify any body parts that may act as one of the following components?

**Receptor =**
________________________________________________________________________________

**Control Center =** ____________________________________________________________________________

**Effector =** _____________________________________________________________________

---

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How does the human body return to homeostasis after drinking a sugar loaded energy drink?

- Control of blood glucose (sugar) level is an example of a **Negative Feedback Mechanism**.
- Below are two examples of **Negative Feedback Mechanism** Flow Charts representing blood sugar regulation:

![Flow Charts](image)

**Endocrine System Control Regulation of Blood Sugar**

**Feedback**

**Steps in Blood Sugar Regulation for Individual Who Just Drank an Energy Drink and has High Blood Sugar:**

1. Individual drinks Energy Drink
2. Blood sugar levels spike above baseline level of 90mg/100ml as sugar is absorbed into blood stream.
3. Pancreas detects high blood sugar levels and secretes the hormone insulin
4. Insulin causes body cells to absorb excessive sugar from blood; liver absorbs sugar and stores it as glycogen
5. Blood sugar returns to baseline level of 90mg/100ml
High or Low Blood Sugar is just one way our body’s homeostasis might be disrupted. Can you think of other stimuli that might alter, change, or disrupt one’s homeostasis?

Blood Glucose (sugar) regulation is just one example of negative feedback mechanisms within our body, can you think of a few more? Give examples of changes in your own body and think about how your body may respond!!!!

What do you think would happen if the receptors, control center, or effectors did not function properly? How would this affect the overall wellbeing of the individual?
The Effects of Diabetes on the Body
(http://www.healthline.com/health/diabetes/effects-on-body)

After you eat or drink, your body breaks down the sugars in your blood and turns it into glucose. The glucose travels through your bloodstream and provides your body with energy. To accomplish this, your pancreas needs to produce a hormone called insulin. In a person with diabetes (diabetes mellitus), the pancreas either produces too little insulin or none at all, or the insulin can’t be used effectively. This allows blood glucose levels to rise while the rest of your cells are deprived of much needed energy. This can lead to a wide variety of problems affecting nearly every part of your body.

There are two main types of diabetes. **Type 1**, also known as juvenile diabetes or insulin-dependent diabetes, is an immune system disorder. In Type 1 diabetes, the patient’s own immune system attacks the insulin-producing cells in the pancreas, destroying the ability to manufacture insulin. People with Type 1 diabetes must take insulin to live. Most people with Type 1 diabetes are diagnosed as children or young adults.

The main problem in **Type 2 diabetes** is the presence of what is called insulin resistance. In this sort of diabetes, the pancreas starts off robust in its production of insulin. However, cells that need energy don’t respond normally to the usual amounts of insulin. The pancreas has to produce much higher levels of the hormone in order to manage blood glucose levels. Over time, the insulin-producing cells in the pancreas can burn themselves out due to this
overproduction. At this point a person with Type 2 diabetes begins to require insulin medication. However, in earlier phases of this more common type of diabetes, the illness can be effectively managed with diet, exercise, and careful monitoring of blood sugars. Some people with Type 2 diabetes may require a variety of oral medications and eventually, as described above, some will eventually need insulin.

Gestational diabetes is high blood sugar that develops during pregnancy. Most of the time, gestational diabetes can be controlled through diet and exercise, and it typically resolves after the baby is delivered.

Common symptoms of diabetes include excessive thirst, frequent urination, and sluggishness. Blood tests will reveal high sugar levels.

**Risk Factors for Type 2 Diabetes:**

- Obesity
- Sedentary Lifestyle
- Unhealthy Eating Habits
- Family History and Genetics
- Increase Age
- High Blood Pressure and High Cholesterol
- History of Gestational Diabetes

Looking at the list of Type 2 Diabetes risk factors on the left, are there any factors that can be prevented? Explain?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What are some Preventative Strategies an individual could apply to their lifestyle that may prevent Type 2 Diabetes from developing?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Create Your Own Feedback Mechanism
Flow Charts

Directions: Choose any two Negative Feedback Mechanisms and any one Positive Feedback Mechanism and design and create flow charts representing each feedback mechanism. Each flow chart must include Stimulus/Stimuli, Receptors, Control Center, Effectors, and Feedback as seen in the diagram below. All five components must be represented by corresponding body parts found within the actual Feedback Mechanism. Be specific when labeling human body structures.

Negative Feedback Loop
- Body Temperature
- Blood pressure
- Blood pH
- O2 and CO2 concentration
- Osmoregulation-Water balance
- Calcium Regulation

Positive Feedback Loop
- Contractions in Childbirth
- Lactation
- Spike in Estrogen during follicular phase of Menstruation Cycle
Lesson 8: Lesson Plan

Brian Walker                                      9th Grade Living Environment
Lesson Title: Tattoo Terror                       Topic II: Human Structure and Function
Time Estimation: 45+ minutes

NY State Standards:
Standard 4: Living Environment
Key Idea 1: Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).
1.2d If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.

Purpose:
Students are introduced to pathogens by investigating a local story in Rochester, NY of a mysterious outbreak that began to surface within individuals who recently received new tattoos. The CDC was called and conducted investigation linking infections within tattooed areas to contaminated ink used at a local tattoo parlor. Students discover pathogens can disrupt homeostasis

Student Objective:
- Students read past articles while investigating an unusual rash occurring over recently new tattoos which sent individuals to the hospital with symptoms of some form of outbreak.
- Students gain experience using CDC website while filling out graphic organizer on Mycobacterium chlonae abscessus.
- Students manipulate pathogens and boost risk factors in order to compromise an individual’s different body systems preventing doctors from creating a cure within the game/app BIO INC.

Essential Questions:
How do diseases disrupt Homeostasis?

Learning Targets:
- Define what is a pathogen?
- Identify different types of pathogens
- Explain how pathogens disrupt homeostasis

Materials:
- Tattoo Terror Activity Packet
- Internet access through Chromebook/Laptop/Computer
- IPADs or Android device that contain BIO INC. App/game

Procedures:
Bellwork - Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the Tattoo Terror Activity
Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Partner Work/Group Discussion – Students work together on completing Tattoo Terror Activity Packet; at specific times during activity, students will pause and group discussion led by teacher will ensue.

1. Introduction (Phase 1) – Local Story in Rochester New York about individuals receiving tattoos from a specific tattoo parlor and rashes breaking out with infections. CDC called in to investigate.

2. Cultural Context (Phase 2) – Students investigate the cause of the infections and rash outbreaks among individuals from tattoo parlor and use CDC website to conduct research on *Mycobacterium chelonae abscessus*.

3. Classroom Science (Phase 3) – After research on Mycobacterium chelonae abscessus, students are introduced to pathogens by continued completion of Tattoo Terror Activity Packet through guided questions. What is a pathogen? What kinds of pathogens exist.

Independent Work – Students play BIO INC.

4. Integration (Phase 4) – students individually play game providing opportunity to make individual choices how to use a variety of pathogens and change and alter risk factors in order to infect an individual’s body systems preventing them from recovery. Students strive to disrupt homeostasis and accomplish body system failures in order to bring the overall health and well-being of individual to its demise.

**Homework:**
Homework will depend upon what modules are decided upon in order to represent Immune System and Lymphatic System.

Opportunity for any missing assignments to be completed and turned in!
Tattoo Terror!

In October 2011, Samuel decided it was time for a new tattoo. He went to his favorite tattoo parlor in Rochester, NY and got inked. During this time, Samuel was a healthy 20 year old male and had multiple tattoos. He never had any health related difficulties or issues with his prior tattoos. However, after receiving the most recent tattoo, Samuel began to develop a persistent rash over the area of his new tattoo. The rash was red in color and contained itchy puss filled blisters. The rash continued over a period of weeks without any improvement and Samuel was forced to seek medical intervention. What do you think may be the cause of the rash?
Read these articles and take detailed notes on what happened


1) What is *Mycobacterium chelonae abscessus* and where is it found?  

2) How does Infection with *Mycobacterium chelonae abscessus* occur?  

3) Who are at risk to contracting *Mycobacterium chelonae abscessus*?  

4) What are symptoms associated with *Mycobacterium chelonae abscessus*?  

5) Diagnosis and Detection  

6) Treatment
What is a pathogen?

Identify other pathogens other than bacteria?

How can pathogens disrupt homeostasis?

Does our body have its own way of protecting itself from pathogens? If so how does the human body protect itself?

How else can one protect themselves from pathogens?
Pathogens

Any agent causing disease. Usually a living microorganism. Capable of producing infection. Poisons like Arsenic would be excluded.

VIRUSES
- Multi-celled but can only reproduce inside a plant, animal, or person.
  - Hepatitis
  - Herpes, Mono
  - Warts
  - Chicken Pox
  - Small Pox
  - Bird Flu H5N1
  - Norovirus
  - Yellow Fever
  - Ebola Hemorrhagic Fever

BACTERIA
- Tiny one-celled creatures
  - Can live inside or outside the body.
  - Tuberculosis
  - Pneumonia
  - Anthrax
  - Urinary Tract Infection
  - Staph
  - Peritonitis
  - E.Coli
  - Strep Throat
  - Typhoid
  - Stomach Ulcers
  - Salmonella
  - Tularemia
  - Morgellons ? Lyme Disease

Fungi
- Multi-celled but plant-like similar to tree fungus. Takes nutrition from a plant, tree, or animal.
  - Ringworm
  - Adv Pneumonia
  - Candidiasis
  - Yeast Infection
  - Histoplasmosis
  - Cryptococcosis

Protozoa
- One-celled creatures. Usually spread through water.
  - Malaria
  - Giardiasis
  - Chagas Disease
  - Cryptosporidiosis

Parasites
- Actual complex living organism.
  - Can live in intestinal tract or blood stream.
  - Round Worm
  - Tape Worm
  - Morgellons ?
  - Trichinosis

Protein
- Multi-celled but can only reproduce inside a plant, animal, or person.
  - BSE Mad Cow Disease
  - vCJD Disease

Incomplete list gathered from various medical books.
Bio Inc. is a biomedical strategy simulator in which you determine the ultimate fate of a victim by developing the most lethal illness possible. Your objective in this game is to upgrade your diseases, boost risk factors and slow down your victim’s recovery before a team of highly motivated doctors can find a cure and save...

In this simulation style game, you will work with pathogens such as: Bacteria, Virus, Fungus, Parasite, and Prions. Your goal will be to bring the different body systems (Circulatory, Respiratory, Digestive, Nervous, Muscular, Excretory, Skeletal, and Immune) found within the Human Body to a weakened state.

As you race against the body’s ability to recover and the medical teams ability to create a cure, you will be able to witness the affect your pathogen has on different aspects of the body along with the capacity to monitor such. You will choose different diseases that can affect the various body systems as the game progresses, thus increasing the likelihood your individual will not recover.

**Procedure:**
1. Play Trailer (in order to get a feel for the game)
2. Begin Game
3. Choose Stage (Depends upon specific characteristics of the individual being infected)
4. Remember you can both increase risk factors and upgrade diseases
5. Fill in Table below and answer following questions
**Directions:** Fill in Table Below and Answer the Following Questions

<table>
<thead>
<tr>
<th>List Risk Factors Chosen In Simulation</th>
<th>List Disease Upgrades Made During Simulation</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
1) Select 3 Risk Factors chosen during the Simulation and explain why decision was made to use each one

2) Select 5 Disease Upgrades and list what Body System they affected and how they disrupted Homeostasis (Must have at least three separate Body Systems represented in answer)
Lesson 9: Lesson Plan

Brian Walker                                                                                             9th Grade Living Environment
Lesson Title: Web of Connections Topic II: Human Structure and Function
Time Estimation: 120+ minutes

NY State Standards:
Standard 4:   Living Environment
Key Idea 1:   Living things are both similar to and different from each other and from non-living things.
Performance Indicator 1.2   Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).
   1.2b   Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.
   1.2e   The organs and the systems of the body help to provide all the cells with their basic needs. The cells of the body are different kinds and are grouped in ways that enhance how they function together.

Purpose:
Students will investigate the design of the internet, World Wide Web, social media, and social networking to gain understanding of the structure and function of networks in order to make connection with Human Body Systems and their interdependency of working together within their own network structure in order to maintain Homeostasis.

Student Objective:
➢ Analyze internet, World Wide Web, and Social Media/Social Networks and determine structure and function of whole networks and individual components of such networks.
➢ Students design their own Web of Connections in order to represent their comprehensive knowledge of how human body systems work together as a functioning network in order to maintain homeostasis and perform the life functions needed for individual to survive.

Essential Questions:
How do systems function to support each other at the microscopic and macroscopic levels?

Learning Targets:
➢ Identify human body systems.
➢ Determine connections between human body systems
➢ Describe how human body systems work together in order to maintain Homeostasis

Materials:
 o Butcher paper or poster boards
 o Art supplies
 o Laptops
 o Previous Human Body Structure and Function Modules
**Procedures:**  
Bellwork - Students enter classroom and fill out questionnaire on videos from prior night’s homework and/or previous day’s information.

Teacher’s Role: Teacher will introduce activity and direct students into working on the Web of Connections Activity Packet. During activity teacher acts as a facilitator and provides support, guidance, and further questioning if necessary.

Independent Work:
1. Introduction (Phase 1) – Students introduced to internet, World Wide Web through Web of Connections Activity Packet
2. Cultural Context (Phase 2) – Students’ knowledge of social media is connected with concept of social networking.
3. Classroom Science (Phase 3) – Students introduced to the concept of how the human body systems work as a network of interdependent systems working together with numerous connections in order to maintain Homeostasis.
4. Integration Work (Phase 4) - Students design and create Web of Connections using body systems and networking design theme

**Homework:**

Complete any unfinished work within the modules!
Web of Connections

With the arrival of the internet, people have the ability to acquire information and knowledge once deemed inaccessible. Having access to the internet, individuals can search for information and find it within seconds through the use of search engines. The internet has opened the door to numerous types of social media websites providing new, simple, and easy ways for individuals to remain in contact with one another. Most Americans use the internet daily as it has become an essential aspect of their lives. Have you ever stopped and asked yourself what is the internet? How does it work? What does it consist of?

What is the internet?


What is the internet? The internet is actually very simple when you step back and look at the big picture. In short, the internet is a network, or group of connections, that joins billions of computers together and allows them to communicate with one another. Imagine that you could take a flat map of the world and mark the location of every individual computer on it with a single dot. Then draw a line from one computer to another close by it and from there another line to the next computer. Repeat this until all of the dots are joined with lines between them. Now backup far away from the map. You will see that all of the lines showing these connections would look like an immense spider web. This is how the phrase the World Wide Web was coined. It simply resembles a huge spider web shaped network that shows connections from every computer to every other. By looking closely at this web structure, you can see how there is now a path between any two computers on the entire map of the whole world. You may need to zigzag through the maze of connections, but the path will be there nonetheless.

According to estimates, more than 1.5 billion people currently use the internet each year. Each internet connected computer is joined to the World Wide Web by either a wired or a wireless method. Each computer is using basically the same method to communicate and search for information making the internet very efficient to use.

In addition to all of the home computers using the internet, you also have smart phones, tablets, cash registers, parking meters, intersection cameras, and any
other devices with an internet connection. Can you imagine how quickly this becomes a complex mess? It is truly a monumental task to keep it all straight and organized.

Think about all the ways you use the internet and list them below:

**The Internet and Social Media**

Social Media has provided numerous opportunities for individuals to become members of social networks. Social networks provide individuals opportunity to make connections with others who may have the same interests, keep in contact with personal acquaintances, and provide occupational means to interact with individuals of related professions. With improvements in technology and the increase use of Smartphones and Tablets the popularity of social media apps has increased rapidly.

Do you use any Social Media Apps? If so, which ones?

__________________________________________________________________________________________

Why have you chosen to use social media apps? What is it that you like or enjoy about them?

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________
What is the basic Structure and Function of a social network?

Let’s first examine the definition of a network:

Dictionary.com defines network as:

“any netlike combination of filaments, lines, veins, passages, or the like:”

“an association of individuals having a common interest, formed to provide mutual assistance, helpful information, or the like”

Merriam-Webster.com defines network as:

“a system of lines, wires, etc., that are connected to each other

“a group of people or organization that are closely connected and that work with each other”

After reading the definitions above and looking at the picture on the right, what conclusions can we make about social networks and their structure and function?

Knowing the definitions of a network and combining it with the conclusions you made above, create a network key to represent each symbol in the network on the right:

<table>
<thead>
<tr>
<th>Network Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person = __________________________________________</td>
</tr>
<tr>
<td>Circle = __________________________________________</td>
</tr>
<tr>
<td>Lines between Each Circle = _________________________</td>
</tr>
</tbody>
</table>
Like the internet, World Wide Web, and social networking sites, the human body is made up of a network of systems working together with numerous connections. The overall function within the network of body systems working together is to keep the internal conditions of the body at dynamic equilibrium (state of balance) despite constant changes internally and externally. No system of the body works in isolation, and the health of a person depends upon the well-being of all the interacting body systems. A disruption within one system generally has consequences for several additional body systems.

**Homeostasis Basics:**
- environment (both inside & outside of body) is constantly changing
- regulation: cells and organisms respond to these changes
- regulatory system made up of nervous & endocrine systems
  - coordinate body activities and adjust them when internal/external environment changes
- constant adjustment help maintain homeostasis (stable state)

**Four Major Themes in Maintaining Balance:**
- themes are interrelated to help your body maintain homeostasis
  1. Feedback Loops (Remember your Feedback Mechanism Flow Charts!)
    - Stimulus-Response
  2. Structure and Function of each Body System
  3. All organs found within each Body System are related to the System’s division of labor
    - Each Body System has a job to accomplish in maintaining Homeostasis within the organism; each organ has a specific job to contribute to each body system (Remember the different levels of organization; each one has structure and function)
    - By fulfilling its function and job it contributes to the overall task of keeping body in Homeostasis
  4. Interdependence of Body Systems
    - This is how the systems work together and where they connect with each other to form the body systems network.
Human Body Systems Web of Connections Project

Directions: Connect the 8 main body systems and make 10+ connections between systems used. A connection shows how the two systems interact to maintain homeostasis. Each connection must be a written explanation with details (be specific) how the two body systems work together. Each connection should be written upon each line between corresponding body systems.
## Standard 4: Living Environment
### Key Idea 1:
Living things are both similar to and different from each other and from non-living things.

### Performance Indicator 1.2
Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

<table>
<thead>
<tr>
<th>Major Understanding</th>
<th>Performance Objectives</th>
<th>Suggested Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.2a</strong> Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.</td>
<td>• Explain how organization is necessary to maintain efficiency with increasing levels of complexity.</td>
<td>• Sequence the levels of biological organization. • Identify and define each level of biological organization. • Explain why organization is needed in living systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vocabulary/Visuals</th>
<th>Suggested Activities</th>
<th>Conceptual Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levels of organization</td>
<td>• Construct a chart of the level of biological organization. • Compare the relationships of organization and complexity to these of other systems (such as economics, factories, etc.)</td>
<td>• How are living things organized from simple to complex?</td>
</tr>
<tr>
<td>Biological complexity</td>
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<tr>
<td>Structure</td>
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<td>Functions</td>
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<td>Organelles</td>
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<td>Cells</td>
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<td>Macromolecules</td>
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<tr>
<td>Tissues</td>
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<td></td>
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<tr>
<td>Organs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organ systems</td>
<td></td>
<td></td>
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<tr>
<td>Organisms</td>
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</tbody>
</table>

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Humans are complex organisms. They require multiple systems for digestion, respiration, reproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

### Vocabulary/Visuals
- Complex organisms
- Digestion
- Respiration
- Reproduction
- Circulation
- Excretion
- Movement
- Coordination
- Immunity

### Suggested Activities
- Study and label visuals of the human body systems.
- Observe videos on how the human body functions.

### Conceptual Questions
- How is the human body organized to maintain life?

---

### Standard 4: Living Environment

**Key Idea 1:**
Living things are both similar to and different from each other and from non-living things.

**Performance Indicator 1.2**
Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

#### Major Understanding

1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

#### Performance Objectives
- Explain why negative feedback is important.
- Explain how components of the human body system operate to maintain stability in the organism.
- Describe how negative feedback is used to regulate hormone levels.
- Diagram a negative feedback loop – Include drawings of glands/organs and explanations of steps.
- Demonstrate how equilibrium is maintained through feedback mechanism.

#### Suggested Assessment

#### Vocabulary/Visuals
- Study and label visuals of the human body systems.

#### Suggested Activities
- Observe videos on how the human body functions.

#### Conceptual Questions
- How is the human body organized to maintain life?
Feedback Mechanism
Positive Feedback
Negative Feedback
Pancreas
Hormones
Stimuli

- Identify and explain various negative feedback loops.
- Investigate a feedback system that controls the output of pancreatic hormones insulin and glucagon.
- Create a diagram or graph to show the relationship between blood sugar levels and hormone levels.
- Draw a model of negative feedback in the endocrine system.
- Investigate stages of child birth as a positive feedback.

- How do biological systems achieve homeostasis through feedback mechanisms?

**Standard 4:**

**Living Environment**

**Key Idea 1:**
Living things are both similar to and different from each other and from non-living things.

**Performance Indicator 1.2**
Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

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</tr>
</thead>
<tbody>
<tr>
<td><strong>1.2d</strong></td>
<td>- Describe how diseases disrupt homeostasis. &lt;br&gt;- Demonstrate how the body reacts to disturbance in stability.</td>
<td>- Explain how diseases affect the homeostatic in humans. &lt;br&gt;- Describe how diseases or injury may disrupt the functioning of body systems. &lt;br&gt;- Describe how the human body responds to a disease state.</td>
</tr>
</tbody>
</table>

**Vocabulary/Visuals**

**Suggested Activities**

**Conceptual Questions**
<table>
<thead>
<tr>
<th>Disease</th>
<th>Pathogen</th>
<th>Virus</th>
<th>Bacteria</th>
<th>Fungus</th>
<th>Parasite</th>
<th>Antibiotic</th>
<th>Toxin</th>
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</table>

- Research how specific diseases affect the functions of body systems.
- How do diseases disrupt homeostasis?

**Standard 4:** Living Environment

**Key Idea 1:** Living things are both similar to and different from each other and from non-living things.

**Performance Indicator 1.2** Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).

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<tbody>
<tr>
<td>1.2e The organs and the systems of the body help to provide all the cells with their basic needs. The cells of the body are different kinds and are grouped in ways that enhance how they function together.</td>
<td>Explain how body systems function to support the organism at the cellular level.</td>
<td>Identify the major organ systems and their parts in the human body.</td>
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<td>Show how various systems address cells with specific needs.</td>
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<td></td>
<td>Describe how tissues function in organ systems.</td>
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<td></td>
<td>Identify and describe the cellular needs of various organ systems.</td>
</tr>
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<tr>
<th>Vocabulary/Visuals</th>
<th>Suggested Activities</th>
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</thead>
<tbody>
<tr>
<td>Cells Tissue Organ Organ systems Homeostasis</td>
<td>Trace the passage of materials through various organ systems. Study how organ system work together to support homeostasis. Study the tissue specialization in various organ systems.</td>
<td>How do systems function to support each other at the microscopic and macroscopic levels.</td>
</tr>
</tbody>
</table>
References


