Dancing Molecules:
A Study in Dance and Chemistry Integration

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This curriculum unit is recommended for:
6,7 and 8th grade Dance

Keywords: Dance, Arts Integration, Medicinal Chemistry, Pathway, Time, Weight, Space, Flow, Movement Qualities, Choreography, Choreographic Devices, Dance Phrase, Intermolecular Forces, Element, Molecule, Compound, ADME, Drug Discovery Process.

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: This unit focuses on the integration of medicinal chemistry into the dance curriculum. Movement fosters retention of new material and is a perfect medium for kinesthetic learning. Students will learn about concepts related to medicinal chemistry and use dance to explain, and create a presentation about, what they have learned. They will participate in various activities that expand their knowledge of both dance and chemistry. As a culminating activity in this unit, students will investigate a particular kind of drug that they are likely to encounter in everyday life. These drugs include NSAIDs, bronchodilators, epinephrine, and antihistamines. They will utilize dance as a form of communication to express the effects of the specific drug in the body.

I plan to teach this unit during the coming year to (62) students in (8th grade dance class).

Introduction

In many states and school systems around the country, programs for the arts are being reduced or eliminated in the public school setting. The basis for this is to create more time for the standard curriculum and in turn, hopefully increase test scores. To keep the artistic discipline alive, we must prove our value and worth to the public education system. I am always trying to find new ways to integrate other concepts into the dance classroom, for the benefit of my students. It is for this reason that I wanted to study Chemical Interactions in the Body in this year's Charlotte Teachers Institute Seminar.

Dance, like many other art forms, is accessible to all students. No prior knowledge or participation is needed to excel in a public education dance class. Studies show that Arts Education allows students to reach higher analytical thinking skills, reasoning and self awareness.[1] The arts automatically allow for differentiation and student expression – making it a great place for student learning and curriculum integration. Studies show students who are involved in school arts classes retain information better, learn how to collaborate with others, think creatively and respond effectively.[2] In studies where the arts is focused on *integration,* these programs show an upward trend in test scores and curriculum retention in the subjects where the arts were integrated.[1] Movement fosters retention of new material.

For this unit I chose chemistry topics that lend themselves to being interpreted and integrated into the dance curriculum. These topics include: the basics of intermolecular forces; the differences between an element, molecule and compound; drug discovery process; the ADME process and how a drug "effects" a symptom – specifically NSAIDs, bronchodilators, epinephrine, and antihistamines. Don't worry dance teachers! I will show you how these topics can easily fit into the dance curriculum and what corresponding dance standards will be accomplished through various activities relating to chemical interactions- just stay with me! Before we get started I must give you a warning. As we move through the unit it may appear that the dance concepts are "hidden." Especially in the later lessons much of the dancing takes place in student centered groups. This means that students are making the dance choices instead of the teacher leading the movement in these activities making the dancing harder to see on paper.

Rationale

Medicinal drugs are a very common item. Especially when you think of over the counter medications. They can be found just about anywhere! In a grocery store, neighborhood pharmacy, gas stations, airports, even some vending machines. Over the counter drugs are simple and easy right? You can self-diagnose, grab a box from off the counter, read the directions and the next thing you know drugs have entered your body. Many people take medicinal drugs when they are sick, to treat an ailment, weekly or even daily. There is however, a kind of mystery about drugs for most of the population who do not have a background in chemistry, advertising, or the pharmaceutical industry. There are many concepts related to drugs that many people don't even think to question. Some of the concepts that come to mind include safety, dosage, side effects, animal testing, and complications with existing conditions just to name a few. When I first read about the description of this seminar Chemical Interaction in the Body it briefly talked

about medicinal chemistry and how drugs work in the body. Reading the description provoked questions like: What are drugs actually made up of? What do they do when they enter the body? How do chemists or researchers create drugs? Are all drugs safe? Do drugs have the same effect on all people? How do some drugs have drastic side effects and are still available to the public? What about common everyday drugs, how are they different from prescription drugs? In my personal opinion, the public at large (including me!) is ignorant to how drugs work both in the body and on a business/ pharmaceutical level. We just see a drug as a "fix" to a problem. I have a headache = ibuprofen makes it stop. I have an ear infection = I need to go to the doctor so they can prescribe me an antibiotic to get rid of it. This unit attempts to give basic insight on how drugs work and will help to answer many of the questions stated above.

Part of the Dance Curriculum standards in North Carolina is about creating and promoting a healthy lifestyle. This makes the unit I am creating relevant to my students in their everyday life. It is important to understand what you are putting in your body and why. The topic of medicinal drugs is something that students will be in contact with throughout the rest of their life. The unit also has strong ties to the dance curriculum as well as the 8th grade science curriculum to make it applicable to them now.

By creating an interdisciplinary unit students are more likely to retain knowledge of both content areas. You might be asking yourself as you are reading this: but why dance and chemistry? What is the link between these two subject areas? So let's break it down a bit! Dance is based on movement and communicating ideas through movement. Medicinal chemistry (for the content in this unit) is based on the movement of drugs through the body. We can see movement as a common theme and will be utilizing the communication and storytelling aspect of dance to help us explain how drugs move through the body. Kinesthetically embodying these science ideas will help the students learn and create lasting knowledge. Presenting these ideas in a more "fun" or "different" way may result in an increase of student involvement and interest in the subject matter. The content is something the students can "take with them." Knowledge about medicinal chemistry will help students in their everyday life outside of the classroom, for years to come.

School/Student Demographics

Day	Total Number of Students	ESL students**	Gender	Exceptional Students	Students with previous dance experience
A	28	4 Languages: spanish, arabic	11 Male 17 Female	3	25
B*	34	1 - portuguese	10 Male 24 Female	8	20

* B day has three students who are at the 6th grade academic level, but participating in the 8th grade elective classes due to their learning needs/ schedule for core classes. **Since I have many students who need ESL services I will utilize google translate to communicate effectively with these students.

Unit Goals

- Students will utilize combinations of time, space, weight and flow when dancing ● Students will understand and utilize movement qualities: pendular, sustained, suspension, collapse, vibratory, percussive.
- Students will create a dance sequence that communicates meaning
- Students will use reflection and discussion to revise choreography
- Students will understand how to use dance as a form of communication and/ or portrayal of topics.
- Students will increase their knowledge of intermolecular forces.
- Students will understand the drug discovery process and be able to identify each phase. ● Students will embody the drug discovery process with teacher guidance. ● Students will understand the ADME process and be able to create a whole- class dynamic representation of the process with teacher guidance.
- Students will research and understand how one of the following drug types "effects" the body: NSAID, bronchodilators, epinephrine, antihistamines.
    - From their research in groups, students will create a dance modeling the symptom and the drug that relieves this symptom.
    - This dance will have set criteria and serve as the culminating activity for this unit

Refer to Appendix I – Teaching Standards for more details on learning objectives that are specific to the North Carolina Teaching Standards.

Content Research

I have broken this section into two parts: dance content and chemistry content. To keep things tidy, I have given each concept a number in the section below. There are 2 main dance concepts: movement qualities, choreographic elements/ vocabulary. There are 5 main chemistry concepts: intermolecular forces, element/molecule/compound, drug discovery process, ADME process and drug "effects." You will see the bulk of the content research is descriptions of chemistry content you need to know. The reason for this is that most dance teachers (like myself) have limited experience or knowledge on chemistry curricula, therefore extra description is necessary. Most of the dance concepts listed are basic and beginner dance concepts. I am confident that my dance teacher audience will have working knowledge of these concepts. In a later section I will explain how to integrate the dance and chemistry concepts, but for now we are just outlining the things we need to know!

Dance Concepts

1. Movement Qualities - the different types of energy that categorize movements. There are 6

movement qualities.

● Pendular movements are characterized by a swinging quality that is light and flowing ● Sustained movements utilize the same amount of energy at a continuous rate ● Suspended movements show an off balance suspension before catching your fall ● Collapse is a quick and sudden movement that lets go of all the energy in the body or part of the body
● Vibratory movements show quick, repeated energy that often use small body parts ● Percussive movements are sharp and quickly halted, often forceful and punctuated. (3)

2. Choreographic Elements/ Vocabulary - elements that students should be familiar with and add into their dance phrases to add more dimensions. This is vocabulary and concepts that students should know before creating a dance phrase. Vocabulary words are in **bold**.

- **Time** is when the dancer is moving. Time can refer to the tempo or speed of a movement or phrase. Tempo can be slow or fast. Time can also be characterized by measure, how many beats in a measure, or overall time of a piece.
- **Rhythm** is also related to time as it is the pattern of beats.
- **Space** is where the dancer is moving. Space concepts can include positive and negative space, directions, pathways, levels and dimension.
    - **Positive Space** is defined as the space you occupy while the **negative spac**e is the space around you.
    - **Directions** include sideways, forward, backward, circular, diagonal, arc, up and down.
    - **Pathways** are the route you take to get from one place to another doing various movements.
    - **Levels** include low, middle and high.
    - **Dimension** is talking about the size of a movement so how large to how small a movement is or becomes.
- **Weight** can vary from heavy to light.
- **Flow** of movements can be bound or free, direct or indirect.
- All movements are either locomotor or non locomotor. **Locomotor** means to move from place to place while **non locomotor** is a movement that stays in one place.[3]

Chemistry Concepts

1. Intermolecular Forces – how molecules interact with one another.

Hydrogen Bonding – water contains two hydrogen atoms and one oxygen. The positive side of one water molecule is attracted to the negative side of another, making them cling together. In the **solid state** these molecules are very close but still have space which form a crystal lattice structure (the reason ice floats). The molecules are in fixed positions when they are ice, but they still vibrate. In the **liquid state** these molecules are weaker and are able to move around one another. In the **gaseous state** (water vapor) the molecules are not bound together and move very quickly.[4] See image: Hydrogen Bonding Image [5]

2. Element/ Molecule/ Compound - what are the differences between these three categories and how does it relate to the next concept: the drug discovery process.

- Element - substance that consists of only one type of atom. Examples: all elements in the periodic table.
- Molecule - when two or more atoms from the same element join together. Examples: molecular hydrogen - H_2, molecular oxygen - O_2
- Compound - when two different elements combine. Examples: Water - H_2O, Hydrogen Peroxide - H_2O_2, Salt - NaCl. Drugs are made from molecular compounds.[6] All drugs are created from molecular compounds. This is a great segway or precursor to the drug discovery process, building student's understanding and bridging gaps between the concepts.

3. Drug Discovery Process – how do researchers find a new drug?

- Stage I – Drug Discovery – researchers identify a protein, an enzyme or receptor, that they want to target (one they think will help a certain disease) test millions of molecular compounds looking for the ones that connects to that specific protein. The most promising molecules they find are called "leads"

- Stage II – Pre-clinical Research – researchers conduct animal testing on their lead molecules to determine if this drug is safe and effective before putting the drug in humans. They research the best methods for administration, drug half life, and side effects that may be related to the drug.

- Stage 3 III – Clinical Trials
    - Phase I: 20 – 100 volunteers in this stage. Researchers are collecting samples and recording data on the drugs efficacy. They are also testing if it is safe and the side effects.
        - According to FDA.gov 70% of drugs pass this stage.
    - Phase II: 100 – 200 patients. In this stage the patients have the disease that the drug is trying to target. There may be a placebo or control group. The trial is double blind so that the results are not skewed. This stage is looking for efficacy and what dosing is required.
        - According to FDA.gov 33% of drugs pass this stage.
    - Phase III: 1,000 – 2,000 patients. In this stage the patients have the disease that the drug is trying to target. Still looking for efficacy and dosage. In this stage they will test to see how the drug works in different ages, ethnicities and volunteers with other health risk.
        - According to FDA.gov 25% -30% move on to stage IV.[7]
- NDA approval
    - Phase IV: Several thousand patients. At this point the researchers submit a New Drug Application for the FDA to review. The application includes safety updates,

data showing safe and effectiveness, proposed labeling, drug abuse information, patent information, all data from clinical trials, directions for use etc. The drug must continue to be monitored for safety.[8]

4.ADME Process **–** Pharmacokinetics – movement of drugs within the body.

ADME – Absorption, Distribution, Metabolism, Excretion.
Absorption – going from the point of administration into the blood. Absorption increases the concentration of the drug in the body. The two main points of administration are through an IV or taken orally. An IV goes straight to the blood stream whereas an orally delivered drug is taken by mouth but is not absorbed until it gets to the small intestines. The drug then crosses the membrane to go into the bloodstream. Orally delivered drugs immediately go to the Hepatic Portal System which goes through the liver (see metabolism below).
Distribution – transport to and from the target. A drug is transported through the blood. This process can increase or maintain the concentration of the drug through the body. **Metabolism** – one removal process, the chemical modification of a drug. The liver is the organ that is responsible for the metabolism process. Enzymes in the liver cause chemical reactions to modify the drug. 1st pass effect – drugs initially get administered by orally and arrive in the liver through the Hepatic Portal System before it gets to the Circulatory System. Metabolism decreases the concentration of the drug in the body.
Excretion – another removal process. The blood is filtered by the kidneys to remove waste. The waste is stored as urine in the bladder until it is excreted. Decreases the concentration of the drug in the body.[9]

5. Drug "Effects" **–** what happens to the symptom you were having when you take certain drugs.

NSAID – Acronym for Non- Steroidal Anti-Inflammatory Drug is a type of drug used to reduce pain, relieve fever and has anti-inflammatory effects to reduce swelling and redness. Can fight headaches, sprains, reduce fever, body aches and cramps. NSAIDs reduce the production of prostaglandins which are chemicals that promote inflammation, pain and fever. Prostaglandins can also have positive effects like protecting the lining of the stomach and intestines from acid, activating blood platelets to promote blood clotting and helps the kidney function normally. Prostaglandins that are released hit nerve endings which send pain signals through the spine to the brain. When you take an NSAID like ibuprofen it blocks the prostaglandin by taking its spot on the enzyme. When you take an NSAID like aspirin it changes the chemical makeup of the COX enzyme to stop the prostaglandins. With aspirin the cell is irreversibly altered and the body must make new copies of the enzyme to take its place which can take several days.[10]

Bronchodilators – Asthma is caused by narrowing and swelling of the airways and excess of mucus may contribute to asthma. During an asthma attack the degree of constriction in the airways is even higher and people are likely to breathe heavier during the attack. This causes the symptoms of: coughing, wheezing, chest tightness and difficulty breathing. Common asthma triggers include: house dust mites, pollen, mold, cigarette smoke, animal fur or dander, pollution and cold weather. Other triggers include: lower respiratory infections, overeating, anxiety,

psychological stress, exercise and laughter. Bronchodilators relax and smooth muscles of the airways and dilates them to ease airflow.[11]

Epinephrine/ Adrenalin – Treats anaphylaxis, an allergic response to exposure of an allergen. Anaphylaxis is when the heart is unable to pump enough blood through the body due to this allergic reaction. This weakens the heart muscle and shrinks the veins so less blood can get through. Epinephrine goes straight into the bloodstream (when injected to the leg tissue) and increases the blood flow throughout the body.[12]

Antihistamines – Antihistamines are used to control the symptoms of allergies. Histamine is a substance produced by the body, it is stored in mast cells in many tissues of the body. When the body is exposed to an allergen, a histamine is released in response. Histamine binds to H-1 receptors, which causes a chain reaction – releasing other chemicals that add to the allergic response like inflammation, itching, sneezing, runny nose, swelling and also increased blood flow. Antihistamines work by blocking the histamine receptors, which in turn decreases the reactions (itching, sneezing etc). [13]

Instructional Implementation and Teaching Strategies

It is time to form connections between dance and chemistry. This section explains how you will be implementing activities and outlines activities in a descriptive format. Refer back to this information as needed when planning your lessons. Are you ready? Let's fuse dance and chemistry together!

1. Intermolecular Forces – how molecules interact with one another.

Hydrogen Bonding - Students will embody the three states of water. Each student will be labeled a hydrogen or oxygen and will be grouped together to form water molecules. They will change their movement and reaction to other molecules around them based on if they in a solid, liquid or gaseous state. The movement will be based on dance component of movement qualities. So before beginning this activity we will discuss as a class the process of hydrogen bonding and what movement quality fits best with each state of matter. This way we are attaching a specific movement quality to each stage. This will be a guided practice activity where the teacher will guide the students to create the correct groupings, movements and structure to show each of the three states of water.

2. Element/ Molecule/ Compound - what are the differences between these three categories and how does it relate to the next concept: the drug discovery process.

Students will embody the differences between an element, molecule and molecular compound. First explain/ go over the differences between an element, molecule and molecular compound and explain how this looks in terms of dancing.

- Element - substance that consists of only one type of atom. Examples: all elements in the periodic table. Dancing - atoms dancing alone.
- Molecule - when two or more atoms from the same element join together. Examples:

molecular hydrogen - H_2, molecular oxygen - O_2. Dancing - two atoms from the same element dancing together.

- Compound - when two different elements combine. Examples: Water - H_2O, Hydrogen Peroxide - H_2O_2, Salt - NaCl. Drugs are made from molecular compounds. All drugs are created from molecular compounds. Dancing - multiple elements dancing together.

Next split the class into two groups with a given criteria (example socks vs. no socks, pants vs. shorts. Utilize a criteria that is visible to all students). Splitting groups by a given criteria ends the problem of students picking their best friend to work with or always counting by numbers. Explain that one group is hydrogen, one group is oxygen. For compounds they have the option of creating water (two hydrogen and one oxygen) or hydrogen peroxide (two hydrogen and two oxygen). Instruct students that they will be given movement criteria and will be told to move as an element, molecule or compound. This criteria will dictate how the students will move, who they will move with, or if they will be dancing alone thus linking the chemistry and dance components. You can choose your own criteria as needed for your classroom.
Example criteria:

- Percussive, Element (explanation: students will dance anywhere in the room using percussive movement, alone).
- Sustained, Molecule
- Vibratory, Compound
- Low level, Element
- Backwards direction, curved pathway, Molecule
- Fast tempo, Compound
- Slow tempo, Element

3. Drug Discovery Process – how do researchers find a new drug?

Stage I – Drug Discovery – the class will be split into two groups: molecules and proteins. Each student will be given a specific movement quality on a sheet of paper. Movement qualities are: pendular, sustained, suspension, collapse, vibratory, percussive. The papers will all have different movement qualities on them with the exception of the target protein. One student in the protein group will be the target protein. That student will have the movement quality: “vibratory” on their paper since vibratory is the movement quality most similar to the way molecules interact or talk to one another. There will be 4-5 students in the molecules group who also have vibratory. After passing out a paper to all students, students will be instructed to look at their paper and to complete their dance move, moving around the room to try to find a match. After a few minutes the target protein will find it’s match of 4-5 different molecules. This will demonstrate a small scale of Phase I in drug discovery, since only a small number of students found a match.

Stage II – Pre – clinical Research – Following Phase I, all students who did not find a match will sit down. This leaves us with the 4 – 5 other students which resemble the molecules who show promise and become “leads”. In this phase I will come up with a “fun”scenario of what happened in the Pre-clinical Research that lead to all molecules except 1 to be disqualified. For example maybe one molecule proved to be unsafe when tested on rats, another had an adverse side effect

of drowsiness for over 24 hours etc etc.

Stage III – Clinical Trials – Now we are testing that one molecule that has been transformed into a drug. The student who was the chosen molecule will stay as that molecule. All other students will be added to the scenario as people participating in clinical trials.

- Phase I: 20 – 100 volunteers in this stage. 3 students will be added to this stage of the clinical trial, they will resemble 10 volunteers each.
- Phase II: 100 – 200 patients. In this stage the patients have the disease that the drug is trying to target. 10 students will be involved in this stage of the clinical trial, each will resemble 10 patients.
- Phase III: 1,000 – 2,000 patients. In this stage the patients have the disease that the drug is trying to target. All students in the class will be involved in this clinical trial each student resembling 50-100 patients each.
- Phase IV: We will discuss this stage of clinical trials and how even though the drug has now gotten approval, ongoing monitoring is necessary to ensure the drug remains safe and effective over time.

4.ADME Process – Pharmacokinetics – movement of drugs within the body.

ADME is an acronym for: Absorption, Distribution, Metabolism, Excretion.In the dance room we will construct a layout of the body from head to toe. We will do this with large, colored rolls of paper to outline specific parts – head, torso, limbs, blood stream, small intestines, liver, kidneys, bladder. In small groups students will practice the ADME process as a drug goes through the body. They will decide whether they are administered by IV or oral drug. They will, as a group, move through the body as if they are a drug. The group will have to decide which movement quality fits best/ and how the movement quality changes as the drug goes through the body. For example when the drug reaches the liver for the first pass effect I picture the drug as percussive since the liver is trying to break it down. Some students from the group will exit the body as they are excreted or metabolized to show drug concentration.

5. Drug “Effects” – what happens to the symptom you were having when you take certain drugs.

In small groups students will view a BlendSpace about one of the four topics: NSAIDs, Bronchodilators, antihistamines and epinephrine/ adrenalin. A BlendSpace is an online learning platform where I have loaded in specific video’s, readings, and vocabulary for the student’s to view. This allows the students to learn specific information that will help them in their project. It also ensures students are on task.

After completing the BlendSpace activity student will figure out a way to present the information they learned using dance. Think of it as a type of pantomime or acting out something but with dance. Each student will need to be a narrator at some point during the presentation to ensure that the audience understands what is happening as other students “dance out” the symptoms and how the drug relieves these symptoms. It will be important to make sure that one student is not the narrator the whole time however, to ensure that each student takes part in the dancing as well.

Students will need to utilize the movement qualities: pendular, sustained, suspension, collapse, vibratory, percussive. Students will make choreographic decisions in terms of time, space, weight and flow. Students will use the process of reflection and revision to enhance their dance phrase/ presentations.
Classroom Lessons and Activities

These lessons are mostly short activities, you could do more than one in a day or spread them out among many days as needed. For the purposes of my classroom I plan to implement these lessons at the tail end of each class period for 7 consecutive class periods. This will provide more consistency and continuity to promote student learning. I have italicized the type of activity,then provided an explanation followed by the estimated time that I think the activity will take.

Lesson 1 – Introduction to Movement Qualities

Journal – What do you think the term "Movement Qualities" means, is, or could be? Students are required to write a minimum of 5 sentences for all journal activities. (5 minutes)

Improvisation – Lead students on a structured improvisation through all 6 movement qualities. Be sure to participate along with the students so you are showing them the types of things you want to see. Verbally give the description of each movement quality and encourage students to move around the room as that movement quality. Encourage students to try the quality as whole body vs. a specific body part. This will increase their exploration. Instead of using just arms or legs try using only the head or elbow etc. (5 minutes) * For a reminder of the descriptions of the 6 movement qualities, refer to the "Dance Concepts" section on page 5 of this unit.

Lesson 2 – Review of Movement Qualities
Journal – Watch the video and write about the movement qualities you see. Minimum of 5 sentences. Video: tinyurl.com/1hummingbird [14] (10 minutes)

Warm up – Have students complete a standard warm up that they already know or a warm up that is teacher lead. Have each student pick a different movement quality. Instruct the students to modify the whole warm up to fit that movement quality. For example is the warm up includes jumping jacks the jumping jacks will look different with the quality of sustained vs. percussive. Halfway through the warm up have students switch to a new movement quality. (5 minutes)

Lesson 3 – Hydrogen Bonding

Question & Discussion - What do you already know about the 3 states of matter? What do you already know about Hydrogen Bonding? Review any material that students do not already have knowledge of. (5 minutes) *See "Chemistry Concepts" on page 6 if you need a refresher!

Video - Watch the video to understand more about how the water molecules interact with one another during the 3 states. tinyurl.com/1hydrogenbonding [15] (3 minutes)

Discuss – From what you see what movement quality would work best for each state? Decide as a class what movement quality we will use. (3 minutes)

Guided Practice – Students will be placed in groups of 3 to create a water molecule (2 students will be hydrogen 1 will be oxygen). Together they will create a shape for their molecule that resembles a water molecule. We will practice going through the 3 states as these water molecules. Using the movement qualities we selected during the discussion, students will embody the 3 states. (6 minutes)

Lesson 4 – Elements, Molecules and Compounds

Journal – Explain what you know about elements, molecules and compounds. Students are required to write a minimum of 5 sentences for all journal activities (5 minutes)

Discussion – Ask 3 volunteers to share their thoughts on elements, molecules and compounds. Following this, explain any information that the students may have left out about elements, molecules and compounds. (5 minutes)

Guided Practice – Students will embody the movements of atoms as they are grouped as elements, molecules and compounds. Utilize the instructions on page 8 and 9 of this unit to implement this activity. (10 minutes)

Lesson 5 – Drug Discovery Process

Timeline and Discussion – On a projector show students the Drug Discovery and Development Timeline in Figure 1.[16] Discuss the drug discovery process with students. (15 minutes) *See "Chemistry Concepts" on page 7 if needed.

Journal – Following the discussion students will need to write down 5 things they remember about the drug discovery process. This will serve as their journal topic for today. (5 minutes)

Guided Practice – Students will embody all steps of the Drug Discovery Process. Please utilize the instructions on pages 7 and 8 of this unit to implement this activity. (20 minutes)

Lesson 6 – ADME Process

Materials needed – Different colored butcher paper rolls

Overview – Give a lecture style overview of the ADME process *See "Chemistry Concepts" on page 7 if needed. (5 minutes)

Set Up – Unroll the butcher paper to create a very large human body in the dance room (utilize the whole room if possible). Use different colors to signify different parts of the body. Be sure to

include the general body outline (head, limbs etc), kidney, liver. Delegate tasks and have students help set up. (5 minutes)

Guided Practice – Break students up into groups of 5 or 6 students. Students will travel through the body as if they are a drug, they will showcase the ADME process in the body. Instruct students to utilize the movement qualities we have learned in previous lessons as they travel through the body. Movement qualities: pendular, sustained, suspension, collapse, vibratory, percussive. Lead the first group of students through the body so that the students understand what is expected of them. Explain to students that they will all enter the body as one drug/ pill/ IV injection. Once they enter the body and start the ADME process they will split up during different phases to show the processes of Absorption, Distribution, Metabolism and Excretion. (10 minutes)

Discuss – How did you decide what movement quality to do during different parts of the ADME process? Why? How did the movement quality you chose help you show a specific part of the process? (5 minutes)

Lesson 7 – Drug "Effects"

Blendspace – Break students into groups of 4 or 5 students. Give each group one of the 4 topics: NSAIDs, Bronchodilators, antihistamines and epinephrine/ adrenalin (repeat topics with additional groups if necessary). Instruct students to go to the blendspace link about their topic and complete all activities on the blendspace. The last page of the blendspace will give students the following instructions for their project which includes the dance requirements. Upon completion of the project, have students perform their dance for the class. (1 hour-1.5 hours)

Blendspace Activities:

- NSAID - http://tinyurl.com/NSAIDdance
- Bronchodilators - http://tinyurl.com/asthmadance
- Epinephrine - http://tinyurl.com/epipendance
- Antihistamine - http://tinyurl.com/allergydance

Presentation Requirements for the Blendspace:

- Presentation must show and explain how your group's drug works in the body ● Must utilize dance and narration to communicate how the drug works in the body ● Must utilize all movement qualities: pendular, sustained, suspension, collapse, vibratory, percussive
- Time - utilize fast and slow tempo
- Space - utilize low, medium and high levels
- Space - utilize different pathways
- Weight - utilize heavy and light
- Flow - utilize bound and free

Assessment

You can adapt the lessons and activities utilized in this unit to whatever assessment method

works for you. I have outlined how I plan to assess students during given activities. However, feel free to make changes to allow the unit to better fit your students and your classroom. I have italicised the activities you saw in the lessons above for consistency.

Journals – In my classroom journals are counted as a formal grade. We complete a journal during each class period and students are expected to keep up and maintain a quality journal. They are required to have at least 5 sentences for each journal topic. As long as they have 5 sentences and their journal is written about the given topic, they receive full credit for that journal.

Participation Points – During each class period students are assessed on their participation. This includes *Question & Discussion, Improvisation,* and *Guided Practice* activities. Students can receive up to 5 points each day for participation. I will take off points if students are not actively engaged during class. This is considered an informal grade.

Embedded Assessment - While this form of assessment does not result in an actual grade for the student it will help you understand what students know and do not know. Consistently during each class you should be asking yourself the following: Do the students understand the content? Are the students demonstrating their understanding of the content? Are the students dancing in a way that demonstrates their understanding of the content? If at any time during the duration of these lessons your answer is "no" you must find a way to cover a topic again. This could be as simple as stopping the class and verbally reviewing the content before continuing. Maybe you need to backtrack to the last activity and discuss it again. The goal of embedded assessment is to always ensure students are demonstrating their understanding, and ready to move forward.

Blendspace - Since this is a culminating activity this will be counted as a formal grade. Utilize the rubric in Appendix 2 to grade this presentation.

Appendix I - Teaching Standards

Listed below is each lesson and the standards that correspond to that lesson.

Lesson 1 - Introduction to Movement Qualities

- 8.DM.1.2 Apply combinations of time, space, weight, and flow in dance.
- 8.DM.1.3 Execute technical skills in dance.

Lesson 2 - Review of Movement Qualities

- 8.DM.1.2 Apply combinations of time, space, weight, and flow in dance.
- 8.DM.1.3 Execute technical skills in dance.

Lesson 3 - Hydrogen Bonding

- 8.C.1.2Exemplify connections between dance and concepts in other curricular areas. ● 8.P.1.3 Compare physical changes such as size, shape and state to chemical changes that are the result of a chemical reaction to include changes in temperature, color, formation of a gas or precipitate.

Lesson 4 - Elements/ Molecules/ Compounds

- 8.C.1.2Exemplify connections between dance and concepts in other curricular areas. ● 8.P.1.3 Compare physical changes such as size, shape and state to chemical changes that are the result of a chemical reaction to include changes in temperature, color, formation of a gas or precipitate.

Lesson 5 - Drug Discovery Process

- 8.C.1.2Exemplify connections between dance and concepts in other curricular areas.

Lesson 6 - ADME

- 8.C.1.2Exemplify connections between dance and concepts in other curricular areas. ● 8.DM.1.2 Apply combinations of time, space, weight, and flow in dance. ● 8.CP.1.2 Create dances that fulfill aesthetic criteria including: beginning, development of an idea, resolution, and end; use of variety in the elements of dance; artistic form; and communication of the intent of the choreographer.

Lesson 7 - BlendSpace

- 8.C.1.2Exemplify connections between dance and concepts in other curricular areas. ● 8.DM.1.2 Apply combinations of time, space, weight, and flow in dance. ● 8.CP.2.3 Integrate self-assessment, teacher feedback, and peer feedback in the process of refining dance performance.
- 8.CP.1.2 Create dances that fulfill aesthetic criteria including: beginning, development of an idea, resolution, and end; use of variety in the elements of dance; artistic form; and communication of the intent of the choreographer.
- 8.CP.1.3 Organize dance sequences into simple dances that communicate ideas, experiences, feeling, images, or stories.
- 8.L.5.2 Explain the relationship among a healthy diet, exercise, and the general health of the body

Appendix 2: Blendspace Rubric

Points - Criteria	0 - No Evidence	1 - Developing	2 - Accomplished	3 - Distinguished
Utilizes dance to communicate meaning.	None.	Dance is a small portion of the overall performance. Less than 50%.	Dance is utilized in over 50% of the performance.	Dance is integrated throughout the entire performance to help communicate meaning.
Utilizes narration to communicate meaning.	None.	Minimal use of narration.	Use of narration is apparent but lack clarity and effectiveness.	Use of narration is clear and effective to communicate meaning.

Utilizes movement qualities.	None.	Uses 1-2 movement qualities.	Uses 3-4 movement qualities.	Use of all 6 movement qualities is apparent in final performance.
Utilizes fast and slow tempo.	None.	Tempo changes are unclear/ not overly apparent.	Tempo changes are present, clear and apparent.	Uses a variety of *clear* tempo changes.
Space - Levels	None.	One level is used.	Two levels are used.	All three levels are used and clearly seen in final performance.
Space - Pathways	None.	Uses one pathway for a majority of the performance	Uses a few different pathways but they are not clear.	Uses a variety of pathways that are clearly seen in final performance.
Weight	None.	Utilizes one weight for a majority of the performance	Uses different weights, but they are not clear.	Clear use of heavy and light weight throughout the final performance.
Flow	None.	Utilizes one flow for the majority of the performance.	Uses different types of flow, but they are not clear.	Clear use of bound and free flow throughout the final performance.
Group Member	Did not participate.	Minimal participation as a productive group member.	Varied participation as a productive group member.	Participated fully as a productive member, had an equal part in shaping the performance.
Audience Etiquette	Did not utilize.	Had over 3 “breaks” in audience etiquette.	Had between 1-3 “breaks” in audience etiquette.	Showed all positive audience etiquette traits with 0 “breaks in audience etiquette.

Name: _____ Group: _____ Score: _____/ 30 point

Resources

List of materials needed for classroom use:

Chromebooks or other electronic device to access the internet This is for the culminating activity using the online blendspace module.

Butcher paper rolls in different colors

Used during the ADME process activity

Projector
Used for videos and examples

Slips of Paper (3x3 squares or similar)
Used during Drug Discovery Process Activity
Student Resources

Hydrogen bonding video: tinyurl.com/1hydrogenbonding
Students will watch this video in class

Example movement qualities video:
tinyurl.com/1hummingbird Students will watch this video in class

Blendspace Activities

- NSAID - http://tinyurl.com/NSAIDdance
- Bronchodilators - http://tinyurl.com/asthmadance
- Epinephrine - http://tinyurl.com/epipendance
- Antihistamine - http://tinyurl.com/allergydance

Students will utilize the different blendspaces in their culminating group activity.

http://kidshealth.org/en/kids/kidmedic.html
Website geared towards kids with basic medicinal information.

http://www.scholastic.com/browse/article.jsp?id=3757743
Website geared towards kids with basic medicinal information.
Endnotes

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1. Walker and Welsky, *Achievement Data,* Key Findings.
2. Swartz, *Integrating Arts,* Art is not extra, it's integral.
3. Kassing, *Discovering Dance,* 44.
4. Weingroff, *It's Just a Phase*
5. Atoms & Molecules, *Hydrogen Bond*
6. *The Difference Between*
7. Commissioner, *Drug Development Process*
8. Commissioner, Drug Discovery Process
9. Cheprasov, *ADME*

10. Gbemudu, *NSAIDs*
11. Artour, *Asthma*
12. Rakhimov, *How does the EpiPen Work*
13. MADG, *Antihistamines*
14. SYTYCD video
15. Hydrogen bond video
16. Kloda, *Drug Discovery Timeline*

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Schwartz, Katrina. "How Integrating Arts Into Other Subjects Makes Learning Come Alive." MindShift. https://ww2.kqed.org/mindshift/2015/01/13/how-integrating-arts-into other-subjects-makes-learning-come-alive/. Positive outcomes of integrating arts and core subjects.

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