

IMPROVING TEACHER QUALITY (ITQ)
Arts and Science Integration

Theatre and Life Science

GRADE 5

**ITQ ARTS AND SCIENCE INTEGRATION
GRADE 5
THEATRE and LIFE SCIENCE**

**Photosynthesis, Let's Get into This!
Investigation 3: Sugar and Cells, Part 1
LESSON #1**

CONTENT STANDARDS

Theatre Grade Three

2.3 Collaborate as an actor, director, scriptwriter, or technical artist in creating formal or informal theatrical performances.

5.1 Use theatrical skills to dramatize events and concepts from other curriculum areas, such as reenacting the signing of the Declaration of Independence in history-social science.

Science Grade Three

LS2f Students know plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.

ESSENTIAL QUESTIONS (*Questions students might ask about the topic*)

- How can I use theatre to understand photosynthesis?
- What is improvisation?
- What is photosynthesis?
- What do plants need to make their food?

OBJECTIVES & STUDENT OUTCOMES (*Students will be able to....*)

- demonstrate cooperative learning skills.
- use theatre games to demonstrate their understanding of photosynthesis.

ASSESSMENT (*Various strategies to evaluate effectiveness of instruction and student learning*)

- **Feedback for Teacher**
 - Student participation in Photosynthesis Machine
 - Student responses
 - Video
 - Feedback
- **Feedback for Student**
 - Teacher and Peer Feedback
 - Participation in Photosynthesis Machine Student
 - Video

WORDS TO KNOW

Theatre Grade 5

- **actor:** a person, male or female, who performs a role in a play or an entertainment.
- **character:** the personality or part an actor recreates.
- **director:** the person who oversees the entire process of staging a production.
- **gesture:** an expressive movement of the body or limbs.
- **posture:** a position the body can assume in sitting, standing, kneeling or lying down that gives clues to a frame of mind or attitude toward someone or something.

Physical Science Grade 5

- **carbon dioxide:** a waste gas produced during cellular respiration. Plants use carbon dioxide during photosynthesis to make food.
- **cellular respiration:** the process by which energy for life is released from food in cells.
- **chlorophyll:** a molecule that absorbs red and blue light and reflects green light.
- **oxygen:** a waste gas produced by plants during photosynthesis, which is used by all plants and

- animals during cellular respiration.
- **photosynthesis:** the process by which green plants make sugar from carbon dioxide and water in the presence of light.
- **sugar:** the nutrient that cells use for energy.
- **transport:** to move or carry

MATERIALS

- Photosynthesis Chart (included)
- Photosynthesis Character Name Tags (included)
- Photosynthesis in Action! Script (included)
- Photosynthesis in Action! Stage Map (included)
- Science notebooks (one/student)

RESOURCES

- *SDUSD Core Learnings*
- *FOSS Kit 5th Grade, "Sugar and Cells," Investigations 3, Part 1*
- *FOSS Science Resources Book Grade 5*
- *Unscripted Learning, Using Improv Activities Across the K-8 Curriculum, Carrie Lobman and Matthew Lundquist*
- DOGO News: <http://www.dogonews.com/2010/11/22/video-of-the-week-jam-to-the-photosynthesis-rap>

PREPARATION

- Review investigation 3, part 1 from *FOSS Science Kit Grade 5*.
- Print and cut out the Photosynthesis nametags.
- Make 20 copies of Photosynthesis in Action! Script.
- Lead students in an actor's warm up.

WARM UP (*Engage students, access prior learning, review, hook or activity to focus the student for learning*)

(10 minutes)

- Explain to students that they are going to take a part in a theatre game that challenges students to use their bodies and voices in a collaborative activity.
- Tell students they are going to make a human food-making machine.
- Explain to students that one person at time will be added to the machine adding their movement and sound to the overall machine.
- Call on one student to come to the front of the room.
- Instruct that student to make machine like noise and movement, such as bending at the waist and make a repetitive sound like "bonk".
- Tell students you will be calling on more students to come up and physically connect to the machine and add a new sound and movement.
- Explain to students that the movement and sound they add to the human machine should be consistent with the rhythm of the first sound and movement.
- Remind students they are to make a machine that makes some kind of food.
- Tell students they do not need to physically connect but should be close, so it looks like they are all a part of the same machine.
- Call on students one at a time until ten or more students are part of the human machine.
- Instruct the students making the human machine to speed up, slow down, get louder, or quieter.
- Signal the students in the acting space (stage) to freeze.
- Have students who are watching or the audience to applaud for the performers.
- Repeat the game until every one has had a chance to be part of a human food-making machine.
- Direct students to return to their seats.

MODELING (*Presentation of new material, demonstration of the process, direct instruction*)

(20 minutes)

- **Say:**
 - *Ask students what they do when they get hungry? [I go to the kitchen and open the refrigerator and take out some food to eat. I go out to eat with my .]*
 - *But if you were a plant you couldn't go to the refrigerator or go to a local restaurant. Plants have to get their food some other way.*
- **Ask:**
 - *How does a plant get its food? [Plants make food through **photosynthesis**.]*
 - *What do you know about **photosynthesis**? [Plants use carbon dioxide, water and light to make food.]*
- Explain to students they are going to use the theatre game they just practiced to create a human **Photosynthesis** machine while learning about **photosynthesis**.
- Write on the board or chart paper the word **Photosynthesis**.
- Write the definition for **photosynthesis**.
- Project on the board the **Photosynthesis** Chart.
- **Say:**
 - *So let's take a look at this **Photosynthesis** Chart and have a look at how **photosynthesis** works.*
- Write on the board or chart paper underneath the word **Photosynthesis** the following: Sun, Carbon Dioxide, Oxygen, Water, Chlorophyll, Sugar, and Roots
- **Say:**
 - *The words I just wrote down are the main components needed by plants to have **photosynthesis** occur. They are also the parts of the machine you will be creating. One or more students will be assigned to each of these parts. But before we do that let's first make sure we understand how **photosynthesis** works. A good actor always studies who their character is and for you to understand your character you need to understand how **photosynthesis** works. To help us understand how **photosynthesis** works we are going read a script called "Photosynthesis in Action!"*
- Explain to students you are going to call on them to come up to the acting area to read the script.
- Project on the board the **Photosynthesis** Machine Stage Map.
- Explain to students you will be the **director**.
- **Ask:**
 - *What is the role of a theater **director**? [The person who oversees the entire process of staging a production.]*
- Explain to students the role of a theater **director**.
- Tell students the stage map that is projected is to help the **director** know where to place the actors on stage as well as to help the **actors** remember where they need to stand once they have been placed.
- Explain to the students the place on stage they are being assigned is also the place they need to be when they create the human **Photosynthesis** Machine.
 - Call on three students to represent 2 **carbon dioxide** molecules each. Place the students in the acting area according to the **Photosynthesis** Machine Stage Map.
 - Call on another four students to come up to the front of the room, two students to represent 3 water molecules each and two students to represent the plant's roots. Place the four students in the acting area according to the Stage Map.
 - Call on two more students to come up to the room to represent the "Sun" and place them in the acting area according to the stage map with name tags with the word "Sun" written on them.
 - NOTE: If a step stool is available for both students playing the "Sun" have them stand on it to add levels.
 - Select another three students, one to be "Sugar Molecule" and two to be "Chlorophyll" then place them according to the stage map with their name tags.
 - Call on another six students to come up to be "Oxygen Molecules" and place them on in the acting area with their name tags.
 - Finally, call on two more students who will serve to represent the "**Photosynthesis**" process.
- Distribute scripts to the actors on stage.
- Project a copy of the script on the projector.
- Direct students to read their designated parts as the rest follow along.

- Say:
 - So now that we have a basic idea of how **photosynthesis** works, let's create a human **Photosynthesis Machine!**

GUIDED PRACTICE (*Application of knowledge, problem solving, corrective feedback*)

(15 minutes)

- Collect the scripts read from the students on stage.
- Explain to students the same group of actors will be used to create the human **Photosynthesis Machine**.
- Tell the other half of the class they will also be given the opportunity create their version of human **Photosynthesis Machine**.
 - Option: If preferred, the other half of the class can be used to create the human **Photosynthesis Machine**.
 - Distribute a name tag with "2 Carbon Dioxide Molecules" written on it to the three students playing 2 carbon dioxide molecules each.
 - Instruct these three students to stand in their position for now. Later these students will create a movement to show how they are part of the **photosynthesis** process.
 - Distribute to two students playing "3 Water Molecules #1 & 2" their name tags.
 - Distribute to the two students playing Root #1 & 2 their name tags.
 - Instruct these four students to sit in their position for now. Later these students will create a movement to show how they are part of the **photosynthesis** process.
 - Distribute to the two students playing "Sun" #1 & 2 their name tags.
 - Distribute to the student playing "Sugar Molecule" their name tag.
 - Distribute to the two students playing "Chlorophyll" #1 & 2 their name tags.
 - Distribute to the six students playing "Oxygen Molecules" # 1 – 6 their name tags.
 - Finally, Distribute to the two students playing "Photosynthesis" process their name tags.
- Explain to the student actors on stage that on their name tags there is a short phrase they need to repeat aloud as they are doing their movement.
- Direct the student actors to say their phrase, one group at a time, i.e., First the Sun, then the carbon dioxide, etc.
- Signal the student actors to stop.
- Instruct students to create a movement and use the following guide questions to help students.
- Ask:
 - *Sun, what movement could you do to show the audience you are sending your light to the plant?*
 - *Carbon Dioxide, what movement could you do to show that you are in the air around us and going into the leaf?*
 - *Roots, Where are you located on the plant? [At the bottom under the soil.]*
 - *What movement can you do, roots, to show us, the audience, you're absorbing water and transporting it up to the leaf?*
 - *Water, what kind of movement can you do to show you are water moving up into the leaf of the plant? Remember, you're being transported from the roots up to the leaf.*
 - *Chlorophyll, what movement can you do to show the audience how you are capturing the energy from sunlight to create a chemical reaction which will help you create sugar? Think of a movement, chlorophyll, that shows chemical reaction.*
 - *Sugar, what kind of movement can you come up with that shows you are being changed into sugar?*
 - *Oxygen, think of a movement that shows the audience that you are leaving the leaf and going into the surrounding air.*
 - *Now for you Photosynthesis, create a movement that you believe can best represent the photosynthesis process?*
- Once all the student actors have created a movement then have them practice their phrase, which is written on their name tag.
- Allow enough time for students to practice, then signal the students to freeze.
- Explain to the students you are going to call "Lights!" and once you call out "Lights" they are to begin their movement along with their phrase. When you call out "Scene!" that is their cue to stop.

- Call "Lights!"
- Instruct the students to speed up, slow down, get louder or quieter.
- After changing speed and volume call out "Scene!"
- Instruct students to return to their seats.
- Explain to the students that the other half of the class will recreate this machine in the next lesson as a review.

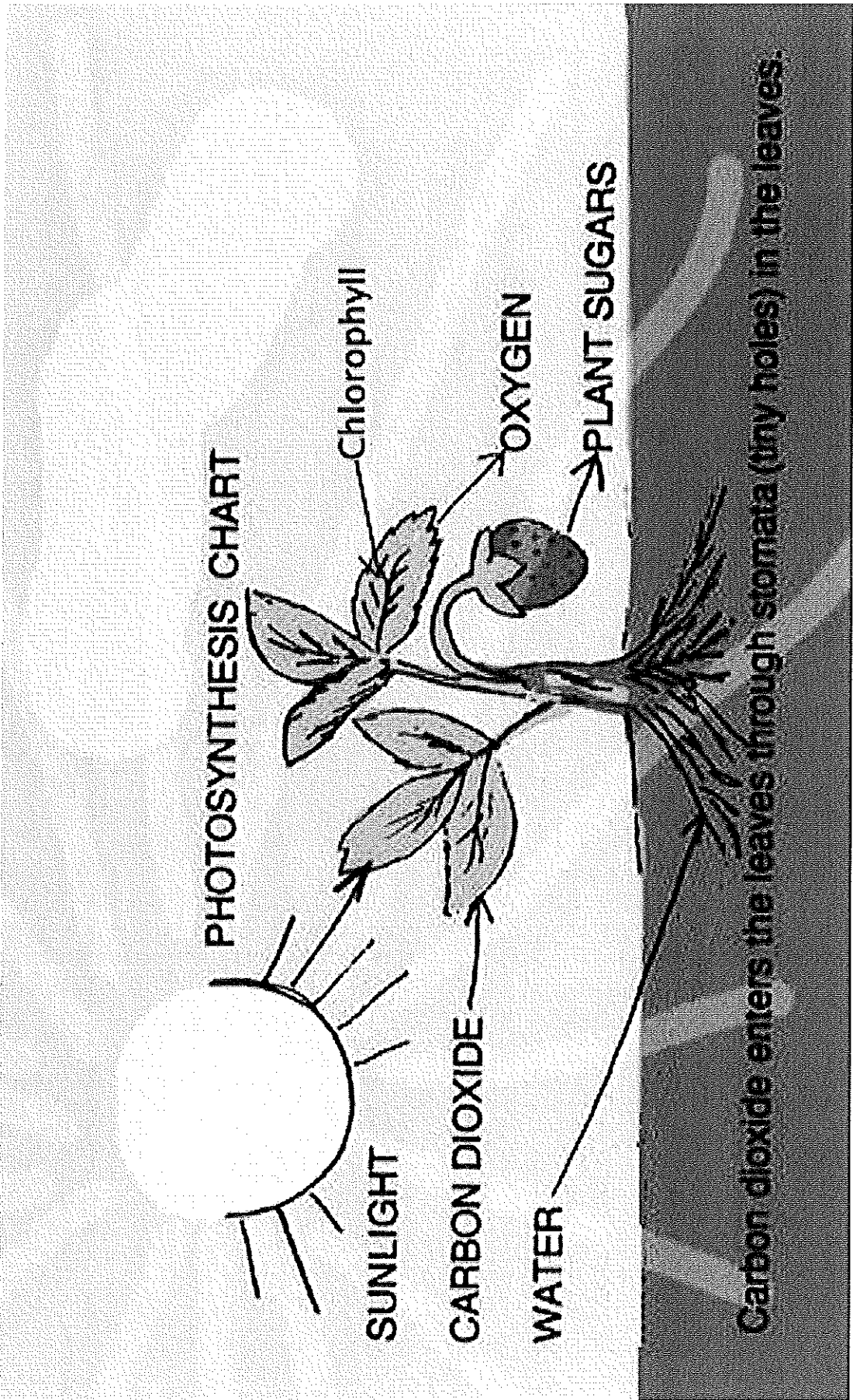
DEBRIEF & REFLECT (*Identify problems encountered, ask and answer questions, discuss solutions and learning that took place. Did students meet outcomes?*)

(5 minutes)

- Ask:
 - *What is the process called when plants make their food?*
 - *What three things do plants need to make sugar?*
 - *How does photosynthesis benefit us?*
 - *What is a director?*
- *Have students respond to the following prompt in their science notebooks:*
 - *How did theatre help you understand the photosynthesis process?*

EXTENSION (*Expectations created by the teacher that encourage students to participate in further research, make connections, and apply understanding and skills previously learned to personal experiences.*)

- Videotape the student's as they act like the human **Photosynthesis Machine** and play it back for the class to watch.
- Have students practice their Photosynthesis Machine and scripts 5 to 10 minutes a day to review.



Carbon dioxide enters the leaves through stomata (tiny holes) in the leaves.

Photosynthesis Name Tags

SUN #1

Say: Energy filled sunlight!

SUN #2

Say: Energy filled sunlight!

2

**CARBON DIOXIDE
MOLECULES #1**

Say: Plants need CO₂ so into the leaf I go!

2

**CARBON DIOXIDE
MOLECULES #2**

Say: Plants need CO₂ so into the leaf I go!

2

**CARBON DIOXIDE
MOLECULES #3**

Say: Plants need CO₂ so into the leaf I go!

ROOTS #1

Say: Under the ground transporting water to the leaf!

ROOTS #2

Say: Under the ground transporting water to the leaf!

3

**WATER
MOLECULES #1**

Say: I'm H₂O so up to the leaf I go!

**3
WATER
MOLECULES #2**

Say: I'm H₂O so up to the leaf I go!

CHLOROPHYLL #1

Say: Chemical reaction! That's what's going to happen in green plants!.

CHLOROPHYLL #2

Say: Chemical reaction! That's what's going to happen in green plants!.

**SUGAR
MOLECULE**

Say: Sugar, sugar! You are my sunshine made glucose!

**OXYGEN
MOLECULES #1**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**OXYGEN
MOLECULES #2**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**OXYGEN
MOLECULES #3**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**OXYGEN
MOLECULES #4**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**OXYGEN
MOLECULES #5**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**OXYGEN
MOLECULES #6**

Say: Oxygen! It's a gas by-product of Photosynthesis!

**PHOTOSYNTHESIS
#1**

Say: Photosynthesis, it's a food making process!

**PHOTOSYNTHESIS
#2**

Say: Photosynthesis, it's a food making process!

Photosynthesis in Action!

Setting: Inside a leaf.

Time: A sunny day.

Characters:

Photosynthesis #1

Photosynthesis #2

Carbon Dioxide Molecules #1, 2 & 3

Root #1 & 2

Sun #1 & 2

Chlorophyll #1 & 2

Water Molecule #1 & 2

Sugar Molecule

Oxygen Molecule #1, 2, 3, 4, 5 & 6

Photosynthesis #1

Here's basically how the **photosynthesis** process goes.

Photosynthesis #2

First, plants need to collect the raw materials needed for **photosynthesis**.

Photosynthesis #1

There are two common substances that plants use: water and **carbon dioxide**.

Carbon Dioxide (ALL)

(Carbon Dioxide #1, 2 & 3 enter from their starting position to their spot on stage.)

Carbon dioxide is a common gas in the air all around us and the plant absorbs CO₂ through small holes under its leaves called stomas.

Root #1 & 2

(Root #1 & 2 enter from their starting position to their spot on stage.)

While that's happening the roots of the plant absorb the water needed for **photosynthesis**.

Water Molecule #1 & 2

(Water Molecule #1 & 2 enter from their starting position to their spot on stage.)

Once we get absorbed by the plant's roots, we then are **transported** to the plant's leaves, where it is also used.

Photosynthesis #2

Leaves are nature's food factory. Leaves are where plants carry on most of their **photosynthesis**.

Photosynthesis #1

Once plants have water and **carbon dioxide**, leaves have the raw materials needed for **photosynthesis**.

Sun #1

(Sun #1 & 2 enter from their starting position to their spot on stage.)

However, something else is needed before the process can actually start. Does anybody have any idea what that "something" could be? Right! That "something" is sunlight.

Sun #2

Light from the sun is what provides the energy for **photosynthesis**. If you ever look closely at leaves you'll see how well suited they are to capture the sun's energy.

Photosynthesis #2

But how do the leaves capture the sunlight? Well, that's where **chlorophyll** steps in.

Chlorophyll #1

(Chlorophyll #1 & 2 enter from their starting position to their spot on stage.)

Chlorophyll molecules in leaves absorb red and blue light but reflect green light, which is why plants look green to us.

Chlorophyll #2

Once sunlight falls on **chlorophyll**, light energy is absorbed and a series of complex chemical reactions begins.

Carbon Dioxide (ALL)

These reactions change some of the **carbon dioxide** molecules plants take into carbon and **oxygen** atoms. *(Exit)*

Water Molecule #1

The same thing happens to some of the water molecules plants absorb.

Water Molecule #2

They are broken apart into hydrogen and **oxygen** atoms. *(Both Water Molecule #1 & 2 Exit.)*

Photosynthesis #1

Some of the carbon, hydrogen, and **oxygen** atoms are then joined together to make glucose, a kind of **sugar**.

Sugar Molecule

(Enters from their starting position to their spot on stage.)

Glucose contains stored energy, which came from the sun. Plants do different things with the glucose produced during **photosynthesis**. Plants use some of the glucose right away as food to provide the energy they need to carry on life. When I am needed somewhere else in the plant I move through the phloem to get to there.

Photosynthesis #2

Plants can also change some of the **sugar** they make into starch and store it for use later.

Photosynthesis #1

Whenever we eat potatoes, yams, and similar foods, we are eating food which plants stored in their roots as starch to meet the plant's future energy needs.

Oxygen Molecule #1 & 2

(Oxygen Molecule #1 - 6 enter from their starting position to their spot on stage.)

Photosynthesis provides far more than just food alone. You may not believe this, but without **photosynthesis**, we couldn't breath.

Oxygen Molecule #3 & 4

And that's because the world's **oxygen** supply comes from plants! It is a by-product of **photosynthesis**.

Oxygen Molecule #5 & 6

Remember how earlier we learned that during **photosynthesis** plants use light energy to change water molecules into hydrogen and **oxygen** atoms?

Oxygen Molecule #1 & 2

Well, plants use some of these **oxygen** atoms to make their food and then release the remaining **oxygen** into the air around us.

Oxygen Molecule #3 & 4

We breathe this **oxygen**.

Oxygen Molecule ALL

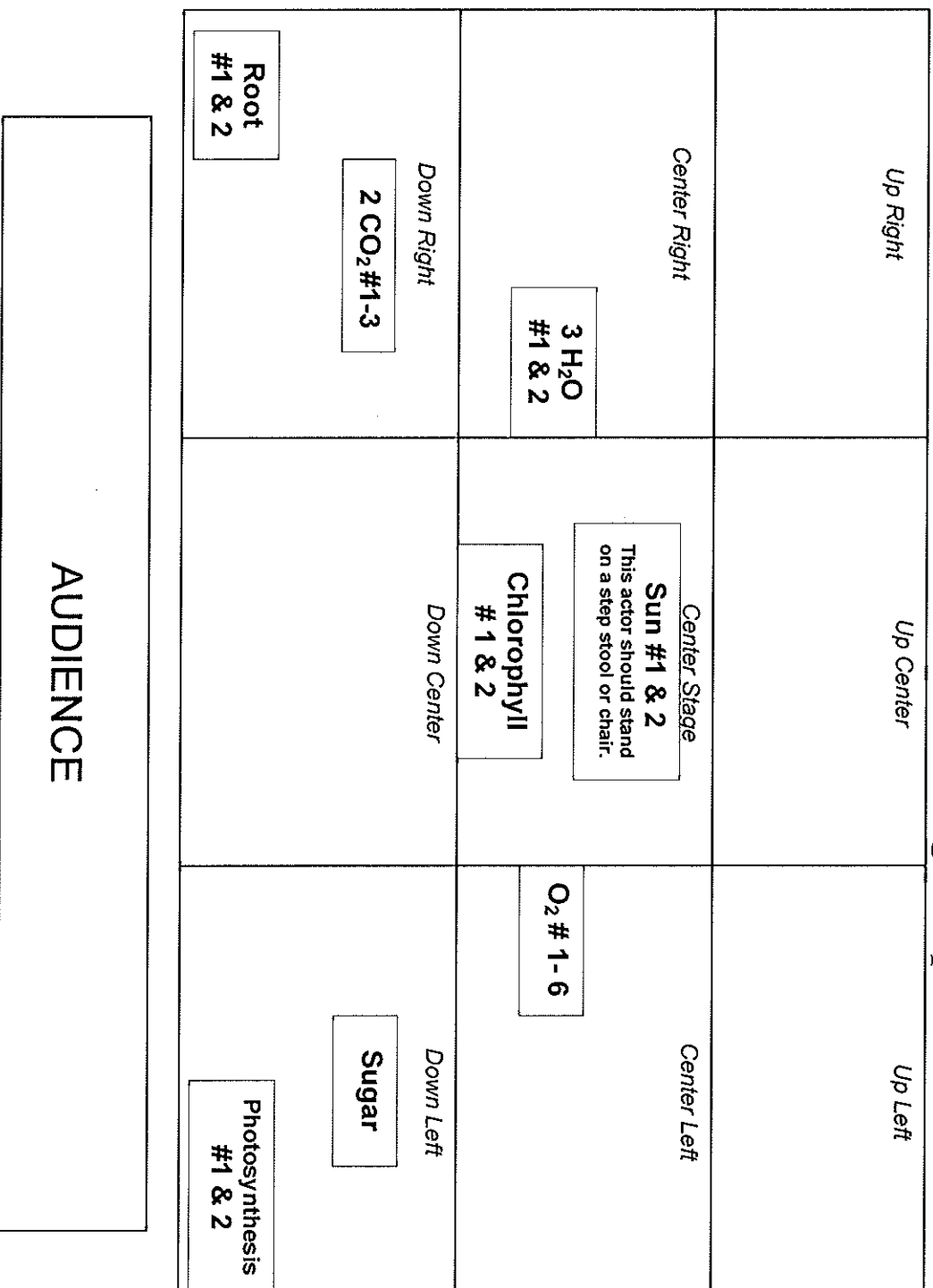
The **oxygen photosynthesis** produces.

Photosynthesis #2

As do all the many other critters, both big and small, that share the planet with us.

(All the actors move to their spots on stage and bow then return to their starting positions according to the Photosynthesis in Action! Stage Map.)

Photosynthesis in Action! Stage Map



**ITQ ARTS AND SCIENCE INTEGRATION
GRADE 5
THEATRE and LIFE SCIENCE**

**Sugar: Let's Break it Down!
Investigation 3: Sugar and Cells, Part 2
LESSON #2**

CONTENT STANDARDS

Theatre Grade Three

5.1 Use theatrical skills to dramatize events and concepts from other curriculum areas, such as reenacting the signing of the Declaration of Independence in history-social science.

Science Grade Three

LS2f Students know plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.

LS2g Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).

ESSENTIAL QUESTIONS (*Questions students might ask about the topic*)

- How can I use theatre to understand cellular respiration?
- What happens to sugar during cellular respiration?

OBJECTIVES & STUDENT OUTCOMES (*Students will be able to.....*)

- demonstrate cooperative learning skills.
- use theatre games to demonstrate their understanding of photosynthesis and cellular respiration.

ASSESSMENT (*Various strategies to evaluate effectiveness of instruction and student learning*)

- **Feedback for Teacher**
 - Student participation in Photosynthesis Machine
 - Student participation of Cellular Respiration Machine
 - Student responses
 - Video
 - Feedback
- **Feedback for Student**
 - Teacher and Peer Feedback
 - Participation in Photosynthesis Machine Student
 - Student participation of Cellular Respiration Machine
 - Video

WORDS TO KNOW

Theatre Grade 5

- **actor:** a person, male or female, who performs a role in a play or an entertainment.
- **blocking:** the planning and working out of the movements of actors on stage.
- **character:** the personality or part an actor recreates.
- **director:** the person who oversees the entire process of staging a production.
- **gesture:** an expressive movement of the body or limbs.
- **posture:** a position the body can assume in sitting, standing, kneeling or lying down that gives clues to a frame of mind or attitude toward someone or something.
- **script:** the written text of a play.

Physical Science Grade 5

- **carbon dioxide:** a waste gas produced during cellular respiration. Plants use carbon dioxide during photosynthesis to make food.
- **cellular respiration:** the process by which energy for life is released from food in cells.

- **chlorophyll:** a molecule that absorbs red and blue light and reflects green light.
- **oxygen:** a waste gas produced by plants during photosynthesis, which is used by all plants and animals during cellular respiration.
- **photosynthesis:** the process by which green plants make sugar from carbon dioxide and water in the presence of light.
- **sugar:** the nutrient that cells use for energy.
- **transport:** to move or carry

MATERIALS

- Photosynthesis Chart (included in lesson #1)
- Photosynthesis Machine Stage Map (included in lesson #1)
- Photosynthesis Character Name Tags (included in lesson #1)
- Cellular Respiration Scripts (included)
- Cellular Respiration Stage Map (included)
- Science Notebook (one/student)

RESOURCES

- *SDUSD Core Learnings*
- *FOSS Kit 5th Grade, "Sugar and Cells," Investigations 3, Part 1*
- *FOSS Science Resources Book Grade 5*
- *Unscripted Learning, Using Improv Activities Across the K-8 Curriculum*, Carrie Lobman and Matthew Lundquist
- DOGO News: <http://www.dogonews.com/2010/11/22/video-of-the-week-jam-to-the-photosynthesis-rap>

PREPARATION

- Review investigation 3, part 1 from *FOSS Science Kit Grade 5*.
- Review reading from *FOSS Science Resources Book Grade 5* "Photosynthesis"
- Make enough copies of the Cellular Respiration Scripts for the whole class.
- Lead students in an actor's warm up.

WARM UP *(Engage students, access prior learning, review, hook or activity to focus the student for learning)*

(10 minutes)

- Say:
 - *The other day we read a script and used a theatre game to create a human **Photosynthesis Machine** with only half the class. As a review, we are going to have the other half of the class come up to create their version of the **Photosynthesis Machine**.*
- Follow the same process as was done in lesson 1.
 - Call on three students to come up to the room to represent 2 **carbon dioxide** molecules each and place them in the acting area according to the **Photosynthesis Machine Stage Map** and hand them a nametag with "2 **Carbon Dioxide Molecules**" written on it.
 - Instruct these three students to stand in their position for now but later they will be creating a movement to show how they are part of the **photosynthesis** process.
 - Call on another four students to come up to the front of the room, two to represent 3 water molecules each and two to represent the plants roots and place them in the acting area according to the Stage Map.
 - Hand two of them a nametag with "3 Water Molecules" written on it and hand the other two tags with the word "Root" written on it.
 - Instruct these four to sit in their position for now but later they will be creating a movement to show how they are part of the **photosynthesis** process.
 - Call on two more students to come up to the room to represent the "Sun" and place them in the acting area according to the stage map with name tags with the word "Sun" written on them.
 - Select another three students, one to be "**Sugar Molecule**" and two to be "**Chlorophyll**" then place them according to the stage map with their nametags.

- Call on another six students to come up to be “Oxygen Molecules” and place them on in the acting area with their nametags.
- Finally, call on two more students who will serve to represent the “Photosynthesis” process.
- Remind the student actors on stage that on their nametags there is a short phrase they need to repeat aloud as they doing their movement.
- Direct the student actors to say their phrase group at a time, i.e., First the Sun, then the carbon dioxide, etc.
- Signal the student actors to stop.
- Instruct students to create a movement
- If needed, use the following guide questions to help students.
- Ask:
 - *Sun, what movement could you do to show the audience you are sending your light to the plant?*
 - **Carbon Dioxide**, *what movement could you do to show that you are in the air around us and going into the leaf?*
 - *Roots, Where are you located on the plant? [At the bottom under the soil.]*
 - *What movement can you do, roots, to show us, the audience, you’re absorbing water and transporting water up to the leaf?*
 - *Water, what kind of movement can you do to show you are water moving up into the leaf of the plant? Remember, you’re being **transported** from the roots up to the leaf.*
 - **Chlorophyll**, *what movement can you do to show the audience how you are capturing the energy from the sunlight to create a chemical reaction which will help you create **sugar**? Think of a movement, **chlorophyll**, that shows a chemical reaction.*
 - **Sugar**, *what kind of movement can you come up with that shows you being creating into **sugar**?*
 - **Oxygen**, *can you think of a movement that shows the audience that you are leaving the leaf and going into the surrounding air.*
 - *Now for you **Photosynthesis**, can you create a movement that you believe can best represent the **photosynthesis** process?*
- Once all the student actors have created a movement give the signal for students to freeze.
- Explain to the students you are going to call “Lights!” and once you call out “Lights” they are to begin their movement along with their phrase and when you call out “Scene!” that is their cue to stop.
- Call “Lights!”
- Instruct the students to speed up, slow down, get louder or quieter.
- After changing speed and volume call out “Scene!”
- Instruct students to return to their seats.
- Ask:
 - *Now that we’ve reviewed **photosynthesis** through theatre, what is photosynthesis? [The process by which green plants make sugar from carbon dioxide and water in the presence of light.]*

MODELING (Presentation of new material, demonstration of the process, direct instruction)

(20 minutes)

- Instruct the group of students who where in **Photosynthesis** Machine to stay in their spots in the acting area.
- Explain to students they are now going to use the **Photosynthesis** Machine to discuss cellular respiration.
- Ask:
 - *Once a plant makes sugar, what does it do with it? [It breaks the **sugar** down for energy.]*
 - *What is called when a plant breaks down **sugar**? [**Cellular Respiration**.]*
- Say:
 - *Let’s take a closer look at how **cellular respiration** works using our **Photosynthesis** Machine here.*
 - *We have two students here who represent the roots of the plant.*
- Ask:
 - *Are the roots needed during **cellular respiration**? [No]*
 - *How about the **chlorophyll**? [No]*
- Say:

- *We are going to ask for the actors playing the part of the roots, chlorophyll, and photosynthesis to please go back to their seats.*
- *Now, the sun is not directly part of the cellular respiration equation either so we are going to ask those actors to also have a seat.*
- Discuss with students the process of **cellular respiration** using the student actors as models.
- Say:
 - *Let's take a look at what we have here up on stage.*
 - *Here in the middle we have one **sugar** molecule.*
 - *In order for a plant cell to break down the **sugar** molecule so it can release the needed energy, it needs something else.*
 - *Let's take a look at who else is up here on stage. We have two actors who have nametags that say "3 Water Molecules".*
- Ask:
 - *How many water molecules does that make? [6 water molecules.]*
- Say:
 - *There are 6 water molecules.*
 - *So the sugar molecule reacts with 6 water molecules and when that happens energy is released.*
 - *Wait! We don't have anybody up here to represent energy.*
- Call on one student to come up to the front of the class and place them according to the **Cellular Respiration Stage Map**.
- Say:
 - *But that's not all that happens.*
 - *Besides energy being released, there are by products created during the **cellular respiration** process.*
 - *Let's go again to the actors on stage and see what we have.*
 - *There are three students with nametags that say "2 Carbon Dioxide Molecules".*
- Ask:
 - *How many **carbon dioxide** molecules does that make? [6 carbon dioxide molecules.]*
- Say:
 - *So we have 6 **carbon dioxide** molecules. But that's not all, we also have here six students with nametags that say "Oxygen molecule".*
 - *That means that during the **cellular respiration** process when water and **sugar** interact, besides releasing energy to use for it's every day activities, it also produces 6 **carbon dioxide** molecules and 6 **oxygen** molecules.*
- Explain to the students on stage they are going to quickly create a **Cellular Respiration Machine**.
- Instruct the students on stage to come up with a movement that best fits what they represent in the cellular respiration process.
- Explain they will also need to create a simple phrase to go with their movement, i.e., Sugar: Being broken down to release my energy!, Water: Breaking down!, Energy: Energy for the plant!
- Direct students to begin their machine and speed it up and slow it down to make it interesting.
- Instruct students to "freeze".

GUIDED PRACTICE (*Application of knowledge, problem solving, corrective feedback*)

(15 minutes)

- Explain to students now that they have gone over the basic process of **cellular respiration** they are now going to create and rehearse a theatrical performance using simple scripts.
- Tell the students on stage they are going to model for the class what they will be doing in their group.
- Tell the students you will be the **director** and they will be your **actors** and that together they will be working collaboratively to create this performance.
- Explain to students when theatre professionals work on a theatrical performance, collaboration is very important.
- Say:
 - *Even though the **director's** job is to oversee the entire process of staging a production they are not doing it alone. The **director** needs to work with **actors**, lighting designers, costumers and whole crew of people. Because it takes several people to produce a show it requires that they all*

work well with each other. That means they may NOT get their way, but instead work towards a common goal. So, keep in mind as you are working with your fellow actors on your performance that you ALL work towards the same goal. Your goal is to create a performance to show the audience what you have learned about cellular respiration.

- Hand out the **Cellular Respiration Scripts** to the actors on stage.
- Explain to the students today they are going to read through the **script** and that in the next lesson one group is going to add more movement to this script while another will use the Photosynthesis in Action! Script.
- Explain to the students they will also explore the **actors** voice on ways they can say their lines.
- Direct the **actor** playing the "2 CO₂" furthest upstage to stand on a step stool (if one is available) or a chair so the audience can see him/her.
- Direct the students playing **Oxygen**, CO₂, and Water to turn their backs to the audience.
- Call on the two students who were playing the part of **Photosynthesis** during the warm up to come up to the front of the class.
- Explain to these two students they now are going to play the part of **Cellular Respiration**.
- Direct one student to stand down stage left and the other to stand down stage right.
- Explain to students, for this read through, having them stand with their back to the audience is how the audience will know they are not onstage.
- Say:
 - *When actors work together with a director on planning their movements on stage this is called **blocking**. **Blocking** means the planning and working out of the movements of actors on stage. During your rehearsal, when you are working on **blocking**, you will plan when each actor enters. We will talk more about that in the next lesson.*
- Tell the students you are going to give them a signal to begin reading the script and you will read the stage directions, which are the sentences inside the parenthesis.
- Begin reading, start with the title, then the Setting, the Time and the At Rise, part of the script.
- As the students continue to read the script, the teacher reads all the stage directions.
- Tell students after they have read through the script they are going to read it again.
 - Option: After the first read through, call on students from the other days **Photosynthesis Machine** to come and read.
- Explain to students the second time they read through the script to add **posture** and **gestures** to go with what they are saying.
- Read through the script a second time.
- After the students read through the script a second time, collect the scripts and direct students to return to their seats.

DEBRIEF & REFLECT (*Identify problems encountered, ask and answer questions, discuss solutions and learning that took place. Did students meet outcomes?*)

(5 minutes)

- Ask:
 - *What is the process called when sugar is broken down?*
 - *What is blocking?*
 - *What is a director's job?*
- *Have students respond to the following prompt in their science notebooks:*
 - *How did theatre help you understand cellular respiration?*

EXTENSION (*Expectations created by the teacher that encourage students to participate in further research, make connections, and apply understanding and skills previously learned to personal experiences.*)

- Have students rehearse 5 minutes a day the Cellular Respiration Script with their group to help memorize lines.

Cellular Respiration Script

Setting: Inside a plant cell

Time: Present

Characters:

Sugar Molecule	Oxygen Molecule #4	2 CO₂ Molecules #3
Energy	Oxygen Molecule #5	3 H₂O Molecules #1
Oxygen Molecule #1	Oxygen Molecule #6	3 H₂O Molecules #2
Oxygen Molecule #2	2 CO₂ Molecules #1	Cellular Respiration
Oxygen Molecule #3	2 CO₂ Molecules #2	Cellular Respiration

At rise: Sugar molecule is standing center stage facing the audience. Energy is kneeling directly behind Sugar. Cellular Respiration #1 and #2 are standing, one down stage right and the other down stage left.
Note: For placement of actors playing the parts of oxygen and CO₂ see Cellular Respiration Stage Map.
Casting Note: If needed, instead of having one student represent 2 CO₂ you can have one student for each CO₂.

Cellular Respiration 1 & 2

Cellular respiration, the process of breaking down sugar!

Sugar Molecule

I am a sugar molecule. Freshly created by the process of photosynthesis. In order for me to release my energy I need to be broken down by 6 oxygen molecules.

Oxygen Molecules

(All Oxygen Molecules enter and stand around the Sugar Molecule.)

We are oxygen molecules that can interact with you Sugar.

Sugar and Oxygen

Together we react...

Sugar

And I get broken down.

Sugar and Oxygen

A by product of us interacting is...

(Sugar slowly gets down on knees and trades places with Energy who was kneeling behind Sugar)

CO₂ Molecules

(All CO₂ Molecules enter and speak in chorus)

Six Carbon Dioxide molecules...

H₂O Molecules

(All H₂O Molecules enter and speak in chorus)
And six water molecules.

CO₂ and H₂O

(Speaking in chorus)

When we are produced and sugar is broken down energy is released.

Energy

I am used to fuel cellular activities. *(Pause)* I am energy!

Cellular Respiration 1 & 2

Cellular Respiration breaks down sugar to release energy so that cells can do what they do.

(All the actors turn putting their backs to the audience signaling the end of the scene.)

Cellular Respiration Stage Map

<p><i>Up Right Stage</i></p>	<p><i>Up Center Stage</i></p> <p style="text-align: center;">2 CO₂</p> <p style="text-align: center;">This actor should stand on a step stool or chair.</p>	<p><i>Up Left Stage</i></p>
<p><i>Right Stage</i></p> <p style="text-align: center;">2 CO₂</p>	<p><i>Center Stage</i></p> <p style="text-align: center;"> O₂ O₂ O₂ O₂ O₂ O₂ Energy Sugar </p>	<p><i>Left Stage</i></p> <p style="text-align: center;">2 CO₂</p>
<p><i>Down Right Stage</i></p> <p style="text-align: center;">Cellular Respiration</p>	<p><i>Down Center Stage</i></p> <p style="text-align: center;">3 H₂O 3 H₂O</p>	<p><i>Down Left Stage</i></p> <p style="text-align: center;">Cellular Respiration</p>

AUDIENCE

**ITQ ARTS AND SCIENCE INTEGRATION
GRADE 5
THEATRE and LIFE SCIENCE**

**The Sugar's the Thing!
Investigation 3: Sugar and Cells, Part 1 & 2
LESSON #3**

CONTENT STANDARDS

Theatre Grade Three

2.3 Collaborate as an actor, director, scriptwriter, or technical artist in creating formal or informal theatrical performances.

5.1 Use theatrical skills to dramatize events and concepts from other curriculum areas, such as reenacting the signing of the Declaration of Independence in history-social science.

Science Grade Three

LS2f Students know plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.

LS2g Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).

ESSENTIAL QUESTIONS (*Questions students might ask about the topic*)

- How can I use theatre to understand cellular respiration?
- What is blocking?
- How does an actor use their voice to convey emotion?
- What is photosynthesis?
- What do plants need to make their food?
- What happens to sugar during cellular respiration?

OBJECTIVES & STUDENT OUTCOMES (*Students will be able to.....*)

- demonstrate cooperative learning skills.
- add blocking to a script they will be performing.
- use theatre to demonstrate their understanding of cellular respiration.

ASSESSMENT (*Various strategies to evaluate effectiveness of instruction and student learning*)

- **Feedback for Teacher**
 - Student performance of Cellular Respiration script
 - Student performance of Photosynthesis in Action! script
 - Student responses
 - Video
 - Feedback
- **Feedback for Student**
 - Teacher and Peer Feedback
 - Performance of Cellular Respiration script
 - Performance of Photosynthesis in Action! script
 - Video

WORDS TO KNOW

Theatre Grade 5

- **Actor:** A person, male or female, who performs a role in a play or an entertainment.
- **Blocking:** The planning and working out of the movements of actors on stage.
- **Center Stage:** The center of the acting area.
- **Character:** The personality or part an actor recreates.
- **Director:** The person who oversees the entire process of staging a production.

- **Downstage:** The stage area toward the audience.
- **Gesture:** An expressive movement of the body or limbs.
- **Posture:** A position the body can assume in sitting, standing, kneeling or lying down that gives clues to a frame of mind or attitude toward someone or something.
- **Script:** The written text of a play.
- **Stage Left:** The left side of the stage from the perspective of the actor facing the audience.
- **Stage Right:** The right side of the stage from the perspective of the actor facing the audience.

Physical Science Grade 5

- **Carbon Dioxide:** A waste gas produced during cellular respiration. Plants use carbon dioxide during photosynthesis to make food.
- **Cellular Respiration:** The process by which energy for life is released from food in cells.
- **Chlorophyll:** A molecule that absorbs red and blue light and reflects green light.
- **Oxygen:** A waste gas produced by plants during photosynthesis, which is used by all plants and animals during cellular respiration.
- **Photosynthesis:** The process by which green plants make sugar from carbon dioxide and water in the presence of light.
- **Sugar:** The nutrient that cells use for energy.
- **Transport:** To move or carry

MATERIALS

- Chemical equation signs (included)
- Photosynthesis in Action! Script (included in lesson #1)
- Photosynthesis Machine Stage Map (included in lesson #1)
- Cellular Respiration Scripts (included in lesson #2)
- Cellular Respiration Stage Map (included in lesson #2)
- Science notebooks (one/student)

RESOURCES

- *SDUSD Core Learnings*
- *FOSS Kit 5th Grade, "Sugar and Cells," Investigations 3, Part 2*
- *FOSS Science Resources Book Grade 5*
- *Unscripted Learning, Using Improv Activities Across the K-8 Curriculum, Carrie Lobman and Matthew Lundquist*

PREPARATION

- Review investigation 3, part 2 from *FOSS Science Kit Grade 5*.
- Review reading from *FOSS Science Resources Book Grade 5* "Cellular Respiration"
- Make two copies of sign #1 – 3 and one copy of signs # 4 – 7.
- Make four 8 x 11 signs with a large addition sign on them.
- Lead students in a short actor's warm up.

WARM UP *(Engage students, access prior learning, review, hook or activity to focus the student for learning)*

(10 minutes)

- Direct the students to stand in a circle or if there is no enough room in the front of the class have the students stand behind their seats.
- Explain to students they are going to practice adding expression to their voice.
- Tell the students for this exercise the only words they will be allowed to use are the numbers 1 – 10.
- Instruct students to count from 1 – 10 using a neutral or emotionless voice.
- After students have finished explain to the students you are going to offer an emotion for them to express while they are counting 1 – 10.
- Below are some suggested emotions to call out:
 - Boredom
 - Excitement
 - Love

- Puzzlement
- Happiness
- Anger
- Fright
- Sadness
- Surprise
- Amusement
- It is not necessary to use all the emotions listed.
- Explain to students they will all start counting at the same time but do not have to finish at the same time.
- Tell students to really explore saying the numbers with the different emotions.
- Instruct students to take their seats.

MODELING (*Presentation of new material, demonstration of the process, direct instruction*)

(20 minutes)

- Project on the board the **Photosynthesis in Action! Stage Map** with the starting positions for the actors.
- Remind students they have already learned about **blocking** earlier in the school year when they worked on the **script** about the water cycle and wrote their stage blocking in their script.
- Explain to the students they are going apply what they learned from that lesson to this one.
- Explain to the students the stage map being projected is similar to the ones they had seen the other day in the previous lessons, however in this map it has the starting positions for all the **actors** along with the nine different stage areas.
 - Briefly review with students the different stage areas and how **actors** write stage directions in their **script**. i.e., "Cross **center stage**" is written XCS, "cross **center left stage**" is written XCLS.
 - Point out to the students the X's on the stage map.
 - Explain to the students they represent where they will be sitting on stage at the start of the play.
- Say:
 - *The other day I told you how actors work together with a director on planning their movements on stage and this is called **blocking**. **Blocking** means the planning and working out of the movements of actors on stage. Today you will be working on adding simple **blocking** to your script. But, before we do that we are going to look closely at both the **Cellular Respiration** process and compare it with the **Photosynthesis** process. After we have done that then you will work in your groups to add the simple **blocking**.*
- Call on the students who read the **Photosynthesis in Action! Script** from the previous lesson.
- Direct the students to stand in a semi-circle as far **upstage** as possible as marked on the **Photosynthesis in Action! Stage Map**.
- Explain to the students you are starting them in this position so they will understand where they will be entering from as they enter the acting area.
- Place students in their acting spots on stage according to the stage map.
- Instruct the students on stage to stay in these spots.
- Remove the **Photosynthesis in Action! Stage Map** and project on the board the **Cellular Respiration Stage Map** with the starting positions for the actors.
- Call on the students who read the **Cellular Respiration Script** from the previous lesson to come up to a different part of the room.
 - Make sure both groups can see each other as they will need to be able to see each other to compare both the **cellular respiration** and **photosynthesis** process.
 - If one group is in front of the class, perhaps the other group may need to be in the back.
 - If room is needed, push table and chairs away to clear as much space as possible.
- Explain to this group of students where the audience will be and where **upstage** is so they have a point of reference as you use the stage map.
- Direct the students to stand in a semi-circle as far **upstage** as possible as marked on the **Cellular Respiration Stage Map**.
- Explain to this group of students, just like the other group, you are starting them in this position so they will understand where they will be entering from as they enter the acting area.
- Place students in their acting spots on stage according to the stage map.

- Distribute the chemical equation signs to the appropriate actors, i.e., $C_6H_{12}O_6$ sign goes to **Sugar**, $6 O_2$ sign goes to **Oxygen**, etc.
 - For the roles that have more than one actor have just one actor hold the sign.
 - In between the characters, i.e., **Carbon Dioxide** and **Water**, **Sugar** and **Oxygen**, have a student hold an addition sign. Place a student with an arrow pointing to sugar and oxygen to complete the equation. (See photosynthesis Stage Map)
 - Arrange another group of students to show the chemical formula for cellular respiration, i.e., **Sugar plus oxygen** arrow pointing to **water plus energy**. (See Cellular Respiration Stage Map)
- Explain to the students each group now represents a chemical equation, one for **photosynthesis** and the other for **cellular respiration**.
- Instruct students to look at the other group and the chemical equations being displayed.
- Ask:
 - *What do you notice about the chemical equations being shown on both sides?* [Both sides have similar equations.]
 - *Which ones look the same?* [$C_6H_{12}O_6$, $6 O_2$, $6CO_2$, $6 H_2O$]
 - *Which ones are different?* [Light and **Chlorophyll**, energy]
 - *With photosynthesis where does the equation start?* [**Carbon dioxide and water.**]
 - *Where does the equation begin for **cellular respiration**?* [**Sugar and oxygen.**]
- Distribute scripts to the actors.

GUIDED PRACTICE (*Application of knowledge, problem solving, corrective feedback*)

(15 minutes)

- Explain to the two groups they are now going to read through their scripts with their group.
- Tell students during this rehearsal time they need to practice starting from their beginning positions so they can practice entering and exiting.
- Assign one of the actors in each group as the **director**.
- Remind students that actors must work collaboratively in order to create a performance, which is exactly what they need to do.
- Direct students to also add posture and gestures they believe would go with the character they are playing.
- Have cast begin rehearsing their play.
- Walk around and side coach as needed and to ensure students are on task.
- Direct both groups to return to their seats.
- If time permits, call on one of the groups to come up to the front of the class and perform their script.
- Explain to the students you are looking to see if they remember their **blocking** as well as the **gestures, posture** and expression you instructed them to add to their lines.

DEBRIEF & REFLECT (*Identify problems encountered, ask and answer questions, discuss solutions and learning that took place. Did students meet outcomes?*)

(5 minutes)

- Ask:
 - *Who can describe the **photosynthesis** process?*
 - *Who can describe the **cellular respiration** process?*
 - *What do actors do to remember **blocking**?*
 - *What are the nine different stage areas?*
- *Have students respond to the following prompt in their science notebooks:*
 - *How did rehearsing the scripts help you understand cellular respiration and photosynthesis?*

EXTENSION (*Expectations created by the teacher that encourage students to participate in further research, make connections, and apply understanding and skills previously learned to personal experiences.*)

- Have students rehearse 5 minutes a day both scripts with their group to help memorize lines and blocking.
- Perform for other classes the scripts about Cellular Respiration and Photosynthesis in Action!

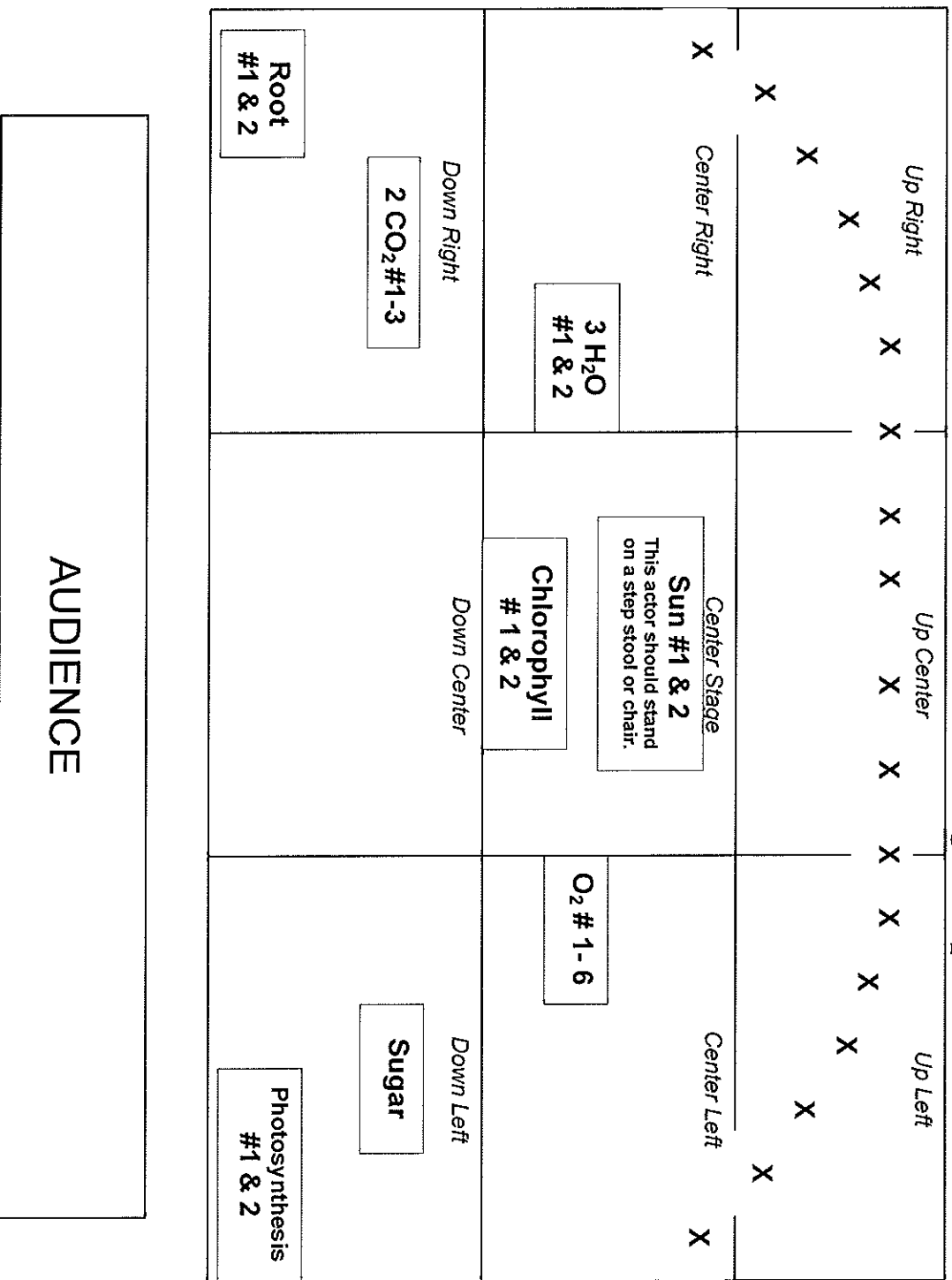
Cellular Respiration Stage Map

Up Right Stage	Up Center Stage	Up Left Stage
<p>X</p> <p>X X X X X X X X X X</p>		<p>X</p>
<p>Right Stage</p>	<p>Center Stage</p>	<p>Left Stage</p>
<p>Down Right Stage</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Sugar</div>	<p>Down Center Stage</p>	<p>Down Left Stage</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Energy</div>
<p>Cellular Respiration # 1 & 2</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">O₂ # 1-6</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">2 CO₂ #1-3</div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">3 H₂O # 1& 2</div>

AUDIENCE

X = Starting positions for all the actors except Cellular Respiration #1 & 2.
Actors move to their spots on stage just before their lines are to be spoken.

Photosynthesis in Action! Stage Map



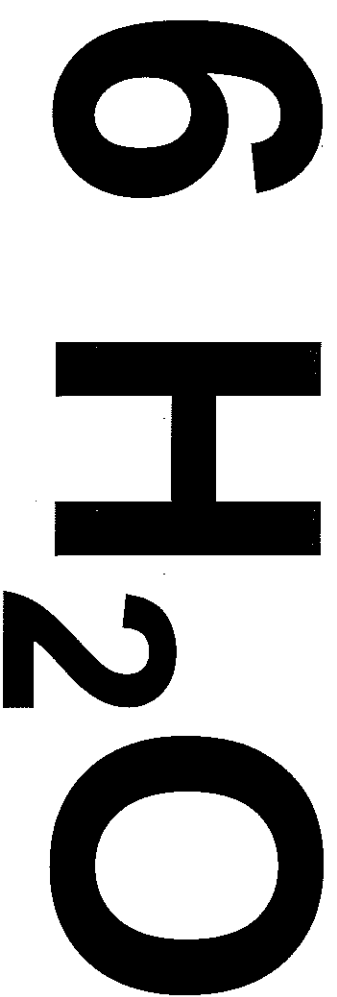
X = Starting positions for all the actors except Photosynthesis #1 & 2.
Actors move to their spots on stage just before their lines are to be spoken.

Sign #1

6 CO₂

Molecules

Sign #2



Molecules

Sign #3

6 O₂

Molecules

Sign #4

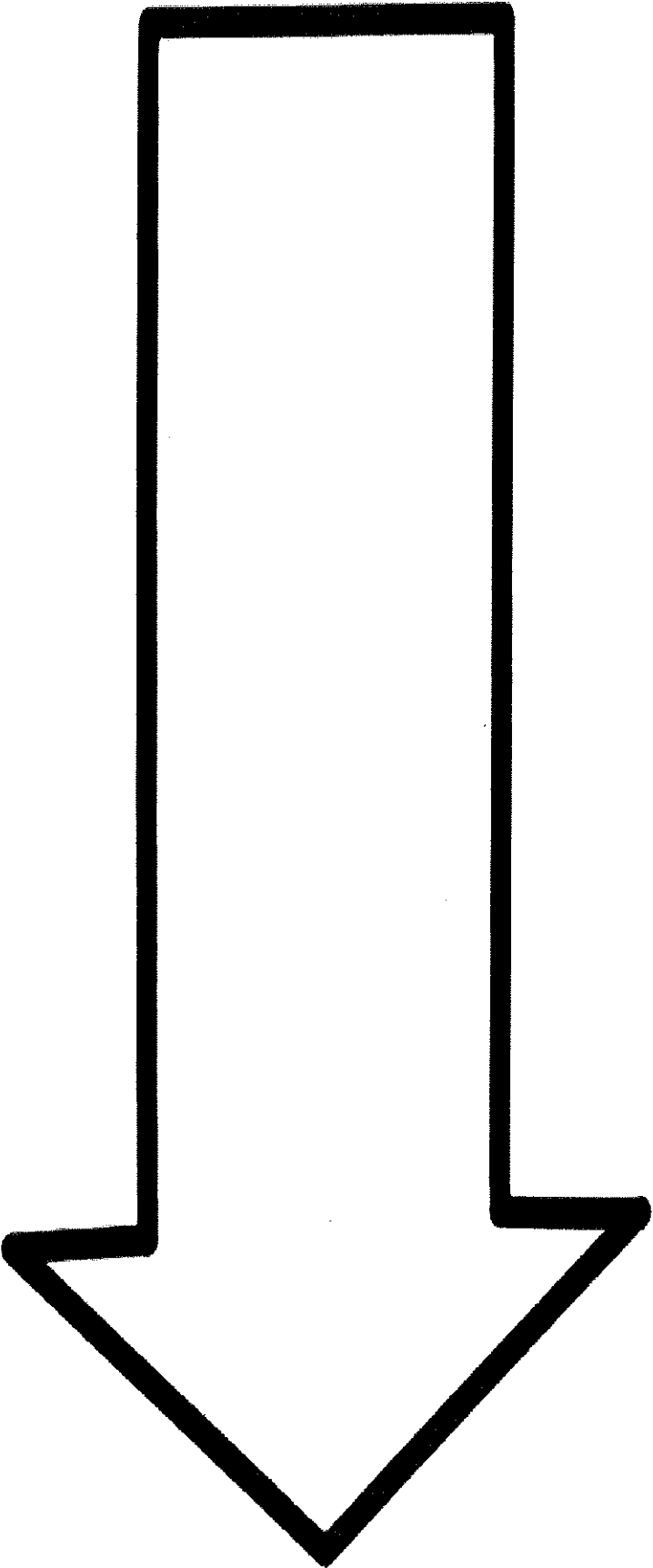
C₆H₁₂O₆
Sugar or
Glucose

Sign #5

Light

Chlorophyll

Sign #6



Sign #7

Energy