

Resource Guide for Chemistry Classes

South Cross Bayou Water Reclamation Facility

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Chemistry Resource Overview

Choice! The following resources were designed to allow for teacher choice. Choice for teachers allows for customizing *what* students are expected to learn and differentiating *how* students are expected to demonstrate learning. By choosing the critical learning focus and the methods of demonstrating mastery, teachers design appropriate boundaries for students.

A tour of South Cross Bayou Wastewater Treatment Facility provides opportunities for your students to learn a tremendous amount of relevant information aligned to the Florida Standards for Chemistry. The Florida Standards have been provided and specific Learning Targets have been written to guide the learning expectations and outcomes. Teachers should review the [Florida Standards and Learning Targets](#) provided and choose which Learning Targets will be the critical focus for students.

A wide variety of Activity Options were developed to meet the needs and learning styles of diverse students. Activity Options have been grouped into three different point values based on the amount of student work associated with the activity. Teachers should review the [Activity Options](#) for the chosen Learning Targets and select a total of eleven Activity Options that are a good fit for their classroom and learners. (*Note: Students will only be expected to complete two of these eleven Activity Options*). To create a customized 20-50-80 Menu for their class, teachers should copy the eleven chosen Activity Options and paste them into the appropriate boxes of the template for the [20-50-80 Menu](#). This ensures that students will only see the eleven Activity Options that are predetermined by the teacher.

By establishing these boundaries, teachers can infuse *student* choice as well. Many teachers observe that if students have both choice and voice then there is an increase in motivation and desire to learn.

Students will preview the [20-50-80 Menu](#) before the SCB tour and predetermine *two* learning activities that best fit their interest, comfort and learning style. Students have many combinations to choose from to earn the necessary 100 points. Scaffolded supports for learning, as well as transparency of expectations, are provided through the descriptions on the [20-50-80 Menu](#), [Product Criteria Cards](#) and [All-Purpose Product Rubric](#) (or [SCB Resume Rubric](#)). The desired effect of students knowing *how* they will use the information from the SCB tour is an increase in motivation and desire to learn.

Chemistry Standards & Learning Targets



Pinellas County Schools Mission Statement/ Florida Standards

- Learning Targets

PCS Mission: Educate and prepare each student for college, career, and life.

- Identify and describe various careers available in wastewater treatment.
- Determine required education, training, and skills necessary for a career in wastewater treatment.



SC.912.L.17.15 Discuss the effects of technology on environmental quality. (Honors Chemistry Only)

- List and describe the ways in which South Cross Bayou uses technology to turn human "waste" into beneficial and useful products. Describe the impacts these practices have on the environment.

L.17.5

SC.912.L.17.19 Describe how different natural resources are produced and how their rates of use and renewal limit availability. (Honors Chemistry Only)

- Discuss the sustainability of water as a renewable natural resource.
- List and describe the steps used by South Cross Bayou Waste Reclamation facility to treat wastewater in order to produce reusable water.

L.17.19

L.17.19

SC.912.N.1.2 Describe and explain what characterizes science and its methods.

SC.912.N.3.5 Describe the function of models in science, and identify the wide range of models used in science.

- Discuss how each of the following characteristics of science are specifically present within SCB's processes to treat wastewater: use of models, adherence to ethical practices, identification and systematic testing of key variables, adaptability, and development of innovative technology and techniques that allow for improvements in quality of life.

N.1.2; N.3.5

SC.912.P.8.1 Differentiate among the four states of matter.

- Describe how the evaporator induces a change in the state of matter of the nitrogen gas in the pelletizer.
- Identify the various states of matter at each station at SCB. Differentiate between the different states in terms of energy, particle motion, and phase transitions.

P.8.1

P.8.1

SC.912.P.8.2 Differentiate between physical and chemical properties and physical and chemical changes of matter.

- Describe the physical properties of water that are measured and/or observed throughout the wastewater treatment process.
- Describe the chemical properties of water that are monitored throughout the wastewater treatment process.
- Identify the physical changes of matter that occur throughout South Cross Bayou wastewater treatment facility.
- Identify the chemical changes of matter that occur throughout South Cross Bayou wastewater treatment facility.
- Describe the physical changes occurring at the following stations: headworks, teacups, grit snails, primary clarifier tanks, dewatering centrifuges, and pelletizer.
- Describe the chemical changes occurring at the following stations: anoxic tanks, aeration tanks, mixing facility, denitrification, chlorine contact tank, UV system, outflow cascade, and digesters.

P.8.2

SC.912.P.8.7 Interpret formula representations of molecules and compounds in terms of composition and structure.

- Interpret formula representations of various molecules discussed during this tour: methane, carbon dioxide, chlorine, nitrate, nitrite, nitrogen gas, oxygen, sulfur dioxide.

P.8.7

SC.912.P.8.8 Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions.

- Identify and describe the type of reaction occurring in outflow cascade.
- Identify and describe the type of reaction occurring in the chlorine contact tank.
- Identify and describe the type of reaction occurring in denitrification.
- Identify and describe the type of reaction occurring in the anoxic and aeration tanks.
- Identify and describe the type of reaction occurring in mixing facility.

P.8.8

P.8.8

SC.912.P.10.1 Differentiate among the various forms of energy and recognize that they can be transformed from one form to others.

- Identify the forms of energy present in the UV system and describe the transfer of energy occurring in this system.
- Identify the forms of energy present in the digesters and describe the transfer of energy occurring in this system.

P.10.1

SC.912.P.10.18 Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications.

- Describe the ultraviolet light used in the UV system in terms of wavelength, frequency, and energy.

P.10.18

SC.912.P.12.12 Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction.

- Explain how a change in concentration can affect flocculation in the mixing facility.
- Explain how temperature can affect flocculation in the mixing facility.

P.12.12

Chemistry Teacher Guide for 20-50-80 Menu



Learning Targets

Relevant [9-12 Science Standards for Chemistry](#) are provided and specific [Learning Targets](#) have been developed. Teachers choose the [Learning Targets](#) and associated [Activity Options](#) that are a desired critical focus for their students.

Student Materials Needed for Activity Options

lined paper	glue/tape	markers	colored pencils	white paper
scissors	coat hanger (for mobile)		smartphone or tablet with video recording	

Special Notes

Since the [Activity Options](#) have either a 20, 50 or 80 point value, the [All-Purpose Product Rubric](#) must be customized by the students. When using the [All-Purpose Product Rubrics](#) have students circle the correct point value for the product (20, 50 or 80) and record the correct partial point values at the top of the full and half credit columns. Use the tables below for partial point values:

Full	Half	No
4	2	0
4	2	0
4	2	0
4	2	0
4	2	0
20 Points Possible		

Full	Half	No
10	5	0
10	5	0
10	5	0
10	5	0
10	5	0
50 Points Possible		

Full	Half	No
16	8	0
16	8	0
16	8	0
16	8	0
16	8	0
80 Points Possible		

Time Frame

Allow one or two 50 minute class periods prior to your SCB visit to have students preview resources and predetermine two activities from the [20-50-80 Menu](#).

Allow two or three 50 minute class periods after your SCB visit to have students complete their two chosen activities from the [20-50-80 Menu](#).

Additional Forms

[All-Purpose Product Rubrics](#) (two per student)

[SCB Resume Rubric](#) (for SCB Career Resume)

[Product Criteria Cards](#)



Chemistry Teacher Guide for Activity Options

Teachers, below is the master list of suggested in-class activities for students to demonstrate mastery on the [Learning Targets](#). You will narrow down three 20 point options, four 50 point options and three 80 point options and place the eleven options on the [20-50-80 Menu template](#). Prior to the SCB tour, students will choose two activities (with a sum of 100 points) from the options you provide. Back in the classroom after the SCB tour, students will complete both activities they have selected.

20 Points Options *Teachers, place <u>three</u> options on the 20-50-80 Menu .	
L.17.19	Develop a 5 page children's book for second graders that explains and illustrates an answer to the question "Will we run out of water?" Think about how in ideal circumstances water can be considered a renewable natural resource. Be sure to include at least three factors that determine if water is truly available for use
P.8.8	Design two WANTED signs, in the style of the Wild West Fugitive WANTED signs. One sign should be for aerobic respiration while the other sign is for anaerobic respiration. On each WANTED sign, include the fugitives' names (reactants), aliases/AKA (molecular formulas), last seen with (the type of bacteria), the alleged crime (describe the products that are made), their occupation (categorize the type of chemical reaction), and their last known location (the tank they are housed in). On the back of each sign identify a clever place you think it should be posted for public viewing. Each WANTED sign should incorporate all the components listed above into the fugitive WANTED theme.
P.8.1	Write an internal email to the SCB staff about a safety concern occurring in the pelletizer: the pellets are heating up too quickly and undergoing spontaneous combustion. Educate the staff on the use of liquid nitrogen to solve this problem. Be sure to include in your email how SCB is using a phase change to solve this problem.
P.8.7	Create a mobile for the following molecules discussed during the facility tour: methane, carbon dioxide, chlorine, nitrate, nitrite, nitrogen gas, oxygen, sulfur dioxide. For each molecule, be sure to write out and describe the structural formula, empirical formula and chemical formula.

50 Points Options *Teachers, place <u>four</u> options on the 20-50-80 Menu .	
N.1.2	You are assistant to the education outreach coordinator at SCB. You have been tasked with recruiting science minded students for an internship at SCB. The regional science fair will be the perfect opportunity to recruit. Design a display board or a brochure that communicates how SCB embodies scientific practices and methods. Include how SCB does the following: use of models, adherence to ethical practices, identification and systematic testing of key variables, adaptability, and development of innovative technology and techniques that allow for improvements in quality of life.
N.3.5	
L.17.19	Develop a learning game of hopscotch (there are many ideas on-line to give you ideas). On index cards, summarize each step of the wastewater treatment process. When you write the rules, you must incorporate interactions where players read your descriptions of the wastewater treatment steps. When you design the layout of the hopscotch squares, purposefully mirror the steps used by SCB for wastewater treatment.

P.8.1	A group of first grade students will be touring SCB. Design signs for the following areas of the facility: Influent pump station, headworks, teacups, grit snail & dumpster, primary clarifier tanks, anoxic tanks, aeration tanks, mixing facility, secondary clarifier tanks, denitrification tanks, chlorine contact tank, UV system, outflow cascade, digesters, dewatering centrifuges, and pelletizer. Each sign should focus on the examples that can be found of each applicable state of matter. Cater your sign to first graders by including by including interesting imagery, graphics, use of color, and visual interest.
P.8.8	Often heard from the mouths of chemistry students is the dreaded question, "Why do I need to know this?" Create a PowerPoint presentation that a chemistry teacher could use to show real world connection between types of chemical reactions and a student's everyday life. In this PowerPoint presentation, identify a location at SCB facility that a chemical reaction is occurring, describe the purpose of the reaction in terms of water treatment, provide the balanced chemical reaction, characterize the type of chemical reaction (synthesis, single replacement, dissociation etc.), and explain your reasoning for choosing that reaction type.
P.10.18	Unfortunately, a fake news story was reported and went viral on social media. This fake news report indicated that local waterways contain radioactive water. Uninformed local residents are requesting an immediate shut down of the UV system at SCB, incorrectly stating that the UV radiation used to disinfect the treated wastewater prior to release in Joe's Creek is to blame for the supposed radioactive waterways. City officials have asked you, the Facilities Manager at SCB, to be an expert speaker at a town hall meeting to calm fears and provide facts. Write and record a 3 minute speech for the town hall meeting. In your speech: introduce yourself (including your profession), state that the news story was fake, provide the purpose of the UV System, describe what UV light is in terms of wavelength, frequency and energy by making a comparison to visible light, and remind the residents that local waterways are not radioactive. Conclude with one tip to help determine if a news story on social media is factual.
PCS Mission	Create a resume for a specific career at SCB. Use a professional template when creating your resume. Be factually accurate when writing the resume. For instance, professional/technical skills, school programs, length of time to complete degree, certifications, state licensure and previous work experience from actual work places. This activity will be graded using the SCB Resume Rubric instead of the All-Purpose Product Rubric.

80 Points Options *Teachers, place <u>three</u> options on the 20-50-80 Menu .	
P.8.2	<p>Develop a learning game of four corners. Remember that a learning game focuses on concepts, but can still involve score keeping somehow. You must have 25 SCB scenario cards that describe a property (physical or chemical) being measured, observed or monitored or describe a change (physical or chemical) occurring in specific steps of the wastewater treatment process. When you write the rules, you must incorporate interactions where players read your scenario cards and others choose from the four corners: physical change, physical property, chemical change, and chemical property. You must provide either a separate answer key to your scenario cards or write the answer on the back of each scenario card.</p> <p>Your 25 SCB scenario cards should: Describe the physical properties of water that are measured and/or observed throughout the wastewater treatment process; Describe the chemical properties of water that are monitored throughout the wastewater treatment process; Identify the physical changes of matter that occur throughout South Cross Bayou wastewater treatment facility; Identify the chemical changes of matter that occur throughout South Cross Bayou wastewater treatment facility; Describe the physical changes occurring at the following stations: headworks, teacups, grit snails, primary clarifier tanks, dewatering centrifuges, and pelletizer; Describe the chemical changes occurring at the following stations: anoxic tanks, aeration tanks, mixing facility, denitrification, chlorine contact tank, UV system, outflow cascade, and digesters.</p>

<p>P.10.1</p>	<p>Imagine that you are the SCB tour guide who is preparing for a visit of eager Fourth Grade students who have just finished learning all about the forms of energy, that energy is not created or destroyed, and that energy can be transformed from one form to another form. The Fourth Grade teacher has requested that the tour discuss the wastewater treatment process and emphasize the identification of energy forms and transformations. The teacher has already prepared his/her students by announcing that the digester and the UV system will model multiple energy forms and transformations that students learned during class time. As a SCB tour guide, you already have a wastewater treatment process script so all you need to do is script out 10 minutes worth of additional energy form and transformation information. In your script of energy form and transformation information, be sure to label which portion of the tour that this extra information will be added to. Be sure to practice speaking out the words in your energy form and transformation script so that you know that it is 10 minutes of additional information and that it sounds like something a tour guide at SCB would say to a group of Fourth Grade students learning about energy forms and transformations at SCB. In other words, the information should not seem like textbook information. It should all be directly referencing a process occurring as the wastewater is treated.</p>
<p>P.12.12</p>	<p>Write a training manual for the position of chemist at SCB. Begin by describing the general duties of a chemist at SCB. Discuss the importance of the chemist in ensuring the removal of unwanted solids from the wastewater. Because the water treatment processes at SCB are time-sensitive, the chemist must ensure ideal conditions for chemical reactions to occur at proper rates. Provide relevant information about the mixing facility, and explain how a change of either concentration or temperature might affect flocculation (formation of the precipitant) at the mixing facility.</p>
<p>PCS Mission</p>	<p>Write and present to the class Three Facts & A Fib for each of three different careers that are present at SCB. You may use resources provided by SCB to help you identify careers and give you general information, but your 9 facts and 3 fibs must be information that was not included in the SCB resources. Conduct independent research on the three careers when writing your facts and fibs.</p>
<p>PCS Mission</p>	<p>You are an employee at SCB and have been asked to speak at a local high school for the Great American Teach-In. Prepare a presentation that describes your role within the treatment facility. Share with class about a situation (power outage to the city due to storms, infiltration/inflow of stormwater due to leaking pipes, sensor failure in the monitoring of water parameters, etc) when you had to problem solve a major crisis.</p>
<p>PCS Mission</p>	<p>Create a WebQuest to explore new resource recovery practices being used throughout the world that are currently <i>not being used</i> at SCB. Consider that resource recovery is an innovative sustainable practice that helps offset the environmental and economic costs of wastewater treatment. Design a WebQuest that has participants researching and answering guided questions about relevant details.</p>

All-Purpose Product Rubric **Product:** _____ **20, 50, or 80 Point Option** **Name:** _____

Aspect	Full Credit <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">Points</div>	Half Credit <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">Points</div>	No Credit <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">0 Points</div>	Peer Feedback	Self Evaluation
Content: Is the content of the product well chosen?	Content chosen represents the best choice for the product. Graphics are well chosen and related to content.	Information or graphics are related to content, but are not the best choice for the product.	Information or graphics presented do not appear to be related to topic or task.		
Completeness: Is everything included in the product?	All information needed is included. Product meets the product criteria and the criteria of the task as stated.	Some important information is missing. Product meets the product criteria and the criteria of the task as stated.	Most important information is missing. The product does not meet the task or does not meet the product criteria.		
Creativity: Is the product original?	Presentation of information is from a new perspective. Graphics are original. Product has elements of fun and interest.	Presentation of information is from a new perspective. Graphics are not original. Product includes an element of fun and interest.	There is no evidence of new thoughts or perspective in the product.		
Correctness: Is all of the information included correct?	All information presented in the product is correct and accurate.	N/A	Any portion of the information presented in the product is incorrect.		
Communication: Is the information in the product well communicated?	All information is neat and easy to read. Product is in appropriate format and shows significant effort. Oral presentations are easy to understand and presented with fluency.	Most of the product is neat and easy to read. Product is in appropriate format and shows significant effort. Oral presentations are easy to understand, with some fluency.	The product is not neat and easy to read or the product is not in the appropriate format. It does not show significant effort. Oral presentation was not fluent or easy to understand.		
Total Grade					

SCB Resume Rubric

Career: _____

50 Point Option

Name: _____

Aspect	Full Credit	Half Credit	No Credit	Peer Feedback	Self Evaluation
<p>Format: Does this have the appearance of a professional job resume?</p>	<p>Resume is computer generated, has balanced margins, is visually appealing, highlights strengths & information, appropriate font style and size used with variety. 10 Points</p>	<p>Resume is computer generated, has balanced margins, highlights strengths & information, no variation in font style and/or size. 5 points</p>	<p>Resume is handwritten, format detracts from strengths & information, font distracts from readability. 0 Points</p>		
<p>Job-Specific Information: How well does your information describe your skillset?</p>	<p>Action phrases are used to describe duties and skills, information demonstrates ability to perform the job, and professional terminology is used when describing skills. 16 Points</p>	<p>3 duties/skills lack action phrases, some information demonstrates ability to perform the job, and some professional terminology is used when describing skills. 8 Points</p>	<p>5-6 duties/skills lack action phrases and information does not clearly demonstrate ability to perform the job. 0 Points</p>		
<p>Resume Content: How rich in detail is your resume?</p>	<p>Heading, objective, skills, experience, certification and education covered in detail. Extra information given to enhance resume. 14 Points</p>	<p>Heading, objective, skills, experience, certification and education covered with little detail. Minimal information given to enhance resume. 7 Points</p>	<p>Missing one or more: heading, objective, skills, experience, certification or education. No extra information given to enhance resume. 0 Points</p>		
<p>Spelling & Grammar: How well do you display your ability for written communication?</p>	<p>No spelling or grammar errors. 10 Points</p>	<p>3 spelling or grammar errors. 5 Points</p>	<p>5-6 spelling or grammar errors. 0 Points</p>		
Total Grade					

Name: _____

Date: _____

Chemistry 20-50-80 Menu

Student Directions: Choose two activities from the menu below. **The activities must total 100 points.** Place a checkmark next to each box to show which activities you will complete. All activities must be completed by _____.

20 Points	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	

50 Points	
<input type="checkbox"/>	

80 Points	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	

Students, attach the Product Criteria Cards for your two activities in the spaces below.

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Chemistry Product Criteria Cards

Student Directions: The cards below convey additional criteria for various products. Cut out the two applicable product criteria cards and attach each to your 20-50-80 Menu.

<p style="text-align: center;">Children's Book</p> <ul style="list-style-type: none"> • Has a cover with book's title and student's name as author • Has 5+ pages • Each page has an illustration along with the content/story • Neatly written or typed 	<p style="text-align: center;">Mobile</p> <ul style="list-style-type: none"> • At least 10 pieces of related information • Includes color and pictures • 3+ layers of hanging material • Is balanced when hanging 	<p style="text-align: center;">Sign</p> <ul style="list-style-type: none"> • Is the <u>size</u> of standard poster • Includes at least five pieces of important information • Has a clear and concise message that is easy to recognize • Contains both words and images • Name and location of where to post is on the back
<p style="text-align: center;">Email</p> <ul style="list-style-type: none"> • Is typed and printed • Contains appropriate "To" "From" and "Subject" • Contains appropriate greeting and closing • Describes the message in two paragraphs (be sure to cover the who, what, where, when, why & how) • All actionable items are emphasized and include who is responsible and when the action should take place 	<p style="text-align: center;">Comic Strip</p> <ul style="list-style-type: none"> • 8.5" x 11" or larger • On white paper • 6+ cells • Contains meaningful dialogue • Imagery is in color 	<p style="text-align: center;">Town Hall Speech</p> <ul style="list-style-type: none"> • Was videotaped or audio recorded • Script was written and provided to teacher • Begins with introduction and explains your credentials or authority to speak on the subject • Provides appropriate background knowledge and detail for the type of audience • States the purpose for speaking • Has a clear wrap-up that restates the purpose of the speech • Voice was loud and easy to understand

<p style="text-align: center;">Tour Script</p> <ul style="list-style-type: none"> • Adheres to the required time length when read • Language is appropriate for target audience • Is engaging and interesting • Refers to actual locations at SCB as if you were actually on-site • Contains all required content • Can be neatly handwritten or typed 	<p style="text-align: center;">PowerPoint Presentation</p> <ul style="list-style-type: none"> • At least 10 informational slides and one title slide with student's name • No more than 10 words per slide • Slides must have color and no more than two graphics • Use legible font and sizes that are large enough to read from the back of a large room • Animation is optional and must not distract from information being presented • Contains all required content 	<p style="text-align: center;">Training Manual</p> <ul style="list-style-type: none"> • 5+ pages • Has a cover that states the job/position and company • Contains contact information • Connects the mission/vision/purpose of the company to the mission/vision/purpose of the position • Contains concise step by step descriptions of job duties • Identifies what to look for if things go wrong • Explains impact of when things go wrong • Explains troubleshooting to fix or avoid problems • Has images or diagrams • Has descriptive section headings
<p style="text-align: center;">Learning Game</p> <ul style="list-style-type: none"> • Game will allow all class members to participate • Must provide written rules that are easy to understand • Must provide answer key • Must be preapproved by teacher before being scheduled for play • Must provide all needed materials to play the game 	<p style="text-align: center;">WebQuest</p> <ul style="list-style-type: none"> • Must quest through at least 5 government websites • Websites should be linked in the document • Submit to teacher by PowerPoint • At least 3 questions for each website • The links and questions should be included as slides • Answers should be put in the notes section for each slide • Must address the topic 	<p style="text-align: center;">Presentation: Great American Teach-In</p> <ul style="list-style-type: none"> • Take on the role of the SCB employee • Cover at least 5 important facts about the job of the employee • Should be 3-5 minutes in length • Script must be approved by teacher before information is presented • Must have props or some form of costume • Allow for questions at the end of presentation
<p style="text-align: center;">Three Facts & A Fib</p> <ul style="list-style-type: none"> • Can be typed, written or on PPT • Contains exactly four statements: three true statements and one false statement • False statement should not be obvious • Paragraph should be included that explains why the fib is false 	<p style="text-align: center;">SCB Career Resume</p> <ul style="list-style-type: none"> • See <u>SCB Resume Rubric</u> for product criteria. 	<p style="text-align: center;">Display Board or Brochure</p> <ul style="list-style-type: none"> • Uses either a cardboard trifold board (of any size) or a standard sheet of paper folded to create three columns • Clear and visible overall title and section headings • Uses graphics, charts, images etc (can be hand drawn or printed) • Neat and legible • Thoroughly meets the content

