Resource Guide for Physics Classes
South Cross Bayou Water Reclamation Facility

Teacher Resources

- Resource Overview
- Standards & Learning Targets
- Teacher Guide for 20-50-80 Menu
- Teacher Guide for Activity Options

Student Resources

- All-Purpose Product Rubric
- SCB Resume Rubric
- 20-50-80 Menu
- Product Criteria Cards
Physics 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 Physics. 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.
## Physics Standards & Learning Targets

### Pinellas County Schools Mission Statement/ Florida Standards

<table>
<thead>
<tr>
<th>Learning Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS Mission: Educate and prepare each student for college, career, and life.</td>
</tr>
<tr>
<td>- Identify and describe various careers available in wastewater treatment.</td>
</tr>
<tr>
<td>- Determine required education, training, and skills necessary for a career in wastewater treatment.</td>
</tr>
</tbody>
</table>

**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 |

**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.10.3** Compare and contrast work and power qualitatively and quantitatively.

- Identify and describe examples of work occurring throughout SCB facility.
- Identify and describe examples of power occurring throughout SCB facility.
- Compare and contrast work and power throughout SCB

| P.10.3 |

**SC.912.P.10.4** Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter.
**SC.912.P.10.5** Relate temperature to the average molecular kinetic energy.

- Relate temperature to the average molecular kinetic energy in the digesters when sludge initially undergoes continuous thermal circulation.
- Relate temperature to the average molecular kinetic energy in the dryer drum during the processing of the biosolids.
- Relate temperature to the average molecular kinetic energy in the pellet storage silos when nitrogen gas is added to cool the pellets.

**SC.912.P.12.2** Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.

- Analyze the motion of wastewater as it travels through the influent pump station.
- Analyze the motion of wastewater inside the teacups.
- Analyze the motion of the sand, grit, and solid material inside the teacups.
- Analyze the motion of the gritty material in the Grit Snails.
- Analyze the motion of the wastewater after aluminum sulfate (Alum) is added in the mixing facility.
- Analyze the motion of the wastewater after NALMET is added in the mixing facility.
- Analyze the motion of the vacuum arm that rotates in the bottom of the secondary clarifier tanks.
- Analyze the motion of the arm that rotates on the top of the secondary clarifier tanks.
- Analyze the motion of the wastewater through the baffles in the chlorine contact tank.
- Analyze the motion of the water as it travels through cascade outflow.
- Analyze the motion of the digested sludge as it travels through dewatering centrifuges.

**SC.912.P.12.3** Interpret and apply Newton’s three laws of motion.

- Provide examples of Newton’s laws of motion occurring throughout the SCB facility.

**SC.912.P.12.4** Describe how the gravitational force between two objects depends on their masses and the distance between them.

- Describe the impact to gravitational force if there is an increase in biosolid mass within the Tea Cups.
- Describe the impact to gravitational force if there is a decrease in sludge mass within the Primary Clarifier Tanks.
Physics Teacher Guide for 20-50-80 Menu

Learning Targets

Relevant 9-12 Science Standards for Physics 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

<table>
<thead>
<tr>
<th>lined paper</th>
<th>glue/tape</th>
<th>markers</th>
<th>colored pencils</th>
<th>white paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>scissors</td>
<td></td>
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</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Full</th>
<th>Half</th>
<th>No</th>
</tr>
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<table>
<thead>
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<table>
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</table>

<table>
<thead>
<tr>
<th>Full</th>
<th>Half</th>
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</thead>
<tbody>
<tr>
<td>20 Points Possible</td>
<td>50 Points Possible</td>
<td>80 Points Possible</td>
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</tbody>
</table>

50 Points Possible

<table>
<thead>
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<tbody>
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80 Points Possible

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<thead>
<tr>
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<td>16</td>
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</tbody>
</table>

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
Physics 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 **three** options on the **20-50-80 Menu**.

<table>
<thead>
<tr>
<th>Option</th>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.8.1</td>
<td>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.</td>
</tr>
<tr>
<td>P.10.3</td>
<td>Create an interactive map of SCB wastewater facility. Select 5 locations on the map where you can describe the work and power occurring. For each chosen location on the map create a flap. Under the flap provide an explanation of the work and power occurring at that location.</td>
</tr>
<tr>
<td>P.10.5</td>
<td>Write and illustrate a comic strip to depict the relationship between temperature and average molecular kinetic energy in the digesters when sludge initially undergoes continuous thermal circulation.</td>
</tr>
<tr>
<td>P.10.5</td>
<td>Write and illustrate a comic strip to depict the relationship between temperature and average molecular kinetic energy in the dryer drum during the processing of the biosolids.</td>
</tr>
<tr>
<td>P.10.5</td>
<td>Write and illustrate a comic strip to depict the relationship between temperature and average molecular kinetic energy in the pellet storage silos when nitrogen gas is added to cool the pellets.</td>
</tr>
</tbody>
</table>

### 50 Points Options

*Teachers, place **four** options on the **20-50-80 Menu**.

<table>
<thead>
<tr>
<th>Option</th>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.1.2</td>
<td>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 <strong>how</strong> 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.</td>
</tr>
<tr>
<td>N.3.5</td>
<td>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 &amp; 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.</td>
</tr>
</tbody>
</table>

P.8.1
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.

Create an interactive map of SCB water reclamation facility. For every location on the map where heat is transferred create a flap. Under the flap provide an explanation of how heat at this location is transferred by convection, conduction, and/or radiation and the role of this heat transfer in the water treatment or fertilizer pelletizer process.

Write and present to the class Three Facts & A Fib for changes to gravitational force on objects throughout SCB. Present a total of 6 facts and 2 fibs. Construct each fact or fib as an if/then statement.

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.
<p>| PCS Mission | Create a model to demonstrate the motion of matter within SCB. For each model be sure to demonstrate aspects of motion, including position, velocity, and acceleration (with respect to a frame of reference) as functions of time. Make a video recording of your model as you demonstrate motion and describe each aspect of motion for your chosen object. Choose one of the following for your model: wastewater traveling through the influent pump station; wastewater inside the teacups; sand, grit, and solid materials inside the teacups; gritty material in the grit snails; wastewater after aluminum sulfate (Alum) is added in the mixing facility; wastewater after NALMET is added in the mixing facility; vacuum arm that rotates in the bottom of the secondary clarifier tanks; arm that rotates on the top of the secondary clarifier tanks, wastewater through the baffles in the chlorine contact tank; treated water as it travels through cascade outflow; or digested sludge as it travels through dewatering centrifuges. |
|PCS Mission | Write and present to the class Three Facts &amp; 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. |
|PCS Mission | 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. |
|PCS Mission | Create a WebQuest to explore new resource recovery practices being used throughout the world that are currently <em>not being used</em> 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>
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Full Credit</th>
<th>Half Credit</th>
<th>No Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content:</strong></td>
<td>Content chosen represents the best choice for the product. Graphics are well chosen and related to content.</td>
<td>Information or graphics are related to content, but are not the best choice for the product.</td>
<td>Information or graphics presented do not appear to be related to topic or task.</td>
</tr>
<tr>
<td><strong>Completeness:</strong></td>
<td>All information needed is included. Product meets the product criteria and the criteria of the task as stated.</td>
<td>Some important information is missing. Product meets the product criteria and the criteria of the task as stated.</td>
<td>Most important information is missing. The product does not meet the task or does not meet the product criteria.</td>
</tr>
<tr>
<td><strong>Creativity:</strong></td>
<td>Presentation of information is from a new perspective. Graphics are original. Product has elements of fun and interest.</td>
<td>Presentation of information is from a new perspective. Graphics are not original. Product includes an element of fun and interest.</td>
<td>There is no evidence of new thoughts or perspective in the product.</td>
</tr>
<tr>
<td><strong>Correctness:</strong></td>
<td>All information presented in the product is correct and accurate.</td>
<td>N/A</td>
<td>Any portion of the information presented in the product is incorrect.</td>
</tr>
<tr>
<td><strong>Communication:</strong></td>
<td>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.</td>
<td>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.</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Total Grade**
### SCB Resume Rubric

<table>
<thead>
<tr>
<th>Career: ___________________</th>
<th>50 Point Option</th>
<th>Name: ________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format:</strong> Does this have the appearance of a professional job resume?</td>
<td><strong>Full Credit</strong></td>
<td><strong>Half Credit</strong></td>
</tr>
<tr>
<td>Resume is computer generated, has balanced margins, is visually appealing, highlights strengths &amp; information, appropriate font style and size used with variety.</td>
<td>Resume is computer generated, has balanced margins, highlights strengths &amp; information, no variation in font style and/or size. <strong>10 Points</strong></td>
<td>Resume is computer generated, has balanced margins, highlights strengths &amp; information, no variation in font style and/or size. <strong>5 points</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Job-Specific Information:</strong> How well does your information describe your skillset?</th>
<th><strong>Full Credit</strong></th>
<th><strong>Half Credit</strong></th>
<th><strong>No Credit</strong></th>
<th>Peer Feedback</th>
<th>Self Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action phrases are used to describe duties and skills, information demonstrates ability to perform the job, and professional terminology is used when describing skills. <strong>16 Points</strong></td>
<td>3 duties/skills lack action phrases, some information demonstrates ability to perform the job, and some professional terminology is used when describing skills. <strong>8 Points</strong></td>
<td>5-6 duties/skills lack action phrases and information does not clearly demonstrate ability to perform the job. <strong>0 Points</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Resume Content:</strong> How rich in detail is your resume?</th>
<th><strong>Full Credit</strong></th>
<th><strong>Half Credit</strong></th>
<th><strong>No Credit</strong></th>
<th>Peer Feedback</th>
<th>Self Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heading, objective, skills, experience, certification and education covered in detail. Extra information given to enhance resume. <strong>14 Points</strong></td>
<td>Heading, objective, skills, experience, certification and education covered with little detail. Minimal information given to enhance resume. <strong>7 Points</strong></td>
<td>Missing one or more: heading, objective, skills, experience, certification or education. No extra information given to enhance resume. <strong>0 Points</strong></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Spelling &amp; Grammar:</strong> How well do you display your ability for written communication?</th>
<th><strong>Full Credit</strong></th>
<th><strong>Half Credit</strong></th>
<th><strong>No Credit</strong></th>
<th>Peer Feedback</th>
<th>Self Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No spelling or grammar errors. <strong>10 Points</strong></td>
<td>3 spelling or grammar errors. <strong>5 Points</strong></td>
<td>5-6 spelling or grammar errors. <strong>0 Points</strong></td>
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<table>
<thead>
<tr>
<th><strong>Total Grade</strong></th>
<th><strong>Full Credit</strong></th>
<th><strong>Half Credit</strong></th>
<th><strong>No Credit</strong></th>
<th>Peer Feedback</th>
<th>Self Evaluation</th>
</tr>
</thead>
</table>


Physics 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 ________________.

<table>
<thead>
<tr>
<th>20 Points</th>
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<tr>
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<th>50 Points</th>
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<th>80 Points</th>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th><strong>Demonstrate with a Model</strong></th>
<th><strong>Tour Script</strong></th>
<th><strong>Sign</strong></th>
</tr>
</thead>
</table>
| - Size is at least 8”x 8”x 12”  
- Parts of model must be labeled  
- Should be in scale when appropriate  
- Must include a title card  
- Name should be permanently written on model  
- Manipulate the pieces of the model to demonstrate the concept  
- Provide verbal explanations of what you are demonstrating  
- Provide verbal explanations of all required content  
- When demonstrating in front of class—provide time to answer class questions | - 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 | - Is the size 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 |

<table>
<thead>
<tr>
<th><strong>Email</strong></th>
<th><strong>Comic Strip</strong></th>
<th><strong>Town Hall Speech</strong></th>
</tr>
</thead>
</table>
| - 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 | - 8.5” x 11” or larger  
- On white paper  
- 6+ cells  
- Contains meaningful dialogue  
- Imagery is in color | - 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 |
<table>
<thead>
<tr>
<th>Interactive Map</th>
<th>WebQuest</th>
<th>Presentation: Great American Teach-In</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Includes a scale</td>
<td>• Must quest through at least 5 government websites</td>
<td>• Take on the role of the SCB employee</td>
</tr>
<tr>
<td>• Has two or more layers that are viewable by lifting paper</td>
<td>• Websites should be linked in the document</td>
<td>• Cover at least 5 important facts about the job of the employee</td>
</tr>
<tr>
<td>• Images are in color and are clear</td>
<td>• Submit to teacher by PowerPoint</td>
<td>• Should be 3-5 minutes in length</td>
</tr>
<tr>
<td>• Explanations are thorough and concise</td>
<td>• At least 3 questions for each website</td>
<td>• Script must be approved by teacher before information is presented</td>
</tr>
<tr>
<td>• Has a title that explains the location</td>
<td>• The links and questions should be included as slides</td>
<td>• Must have props or some form of costume</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Three Facts &amp; A Fib</th>
<th>SCB Career Resume</th>
<th>Display Board or Brochure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Can be typed, written or on PPT</td>
<td>• See SCB Resume Rubric for product criteria.</td>
<td>• Uses either a cardboard trifold board (of any size) or a standard sheet of paper folded to create three columns</td>
</tr>
<tr>
<td>• Contains exactly four statements: three true statements and one false statement</td>
<td></td>
<td>• Clear and visible overall title and section headings</td>
</tr>
<tr>
<td>• False statement should not be obvious</td>
<td></td>
<td>• Uses graphics, charts, images etc (can be hand drawn or printed)</td>
</tr>
<tr>
<td>• Paragraph should be included that explains why the fib is false</td>
<td></td>
<td>• Neat and legible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Thoroughly meets the content</td>
</tr>
</tbody>
</table>