THE BREAKDOWN – Exploring Corrosion Science

STEM²D Topics:
Science, Engineering

Target Population:
Students, ages 13–15

The Breakdown – Exploring Corrosion Science is part of the **Student Activities Series** developed by FHI 360 for Johnson & Johnson's WiSTEM²D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**ath, **M**anufacturing, and **D**esign). The series features interactive and fun, hands-on activities for youth.

Photo: A sculpture of the Greek deity Athena from the 2nd century, displaying damage from corrosion. Via the J. Paul Getty Museum, Villa Collection. https://www.getty.edu/art/collection/object/103TFZ

THE BREAKDOWN – EXPLORING CORROSION SCIENCE

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ACTIVITY DESCRIPTION

In this hands-on team-based activity, students will explore the science behind corrosion. They will discuss the factors that contribute to corrosion and how this can be avoided. They will consolidate this knowledge with a hands-on nail rust experiment.

ESTIMATED TIME

This session typically takes **60 minutes** to complete and should be conducted in **one session**.

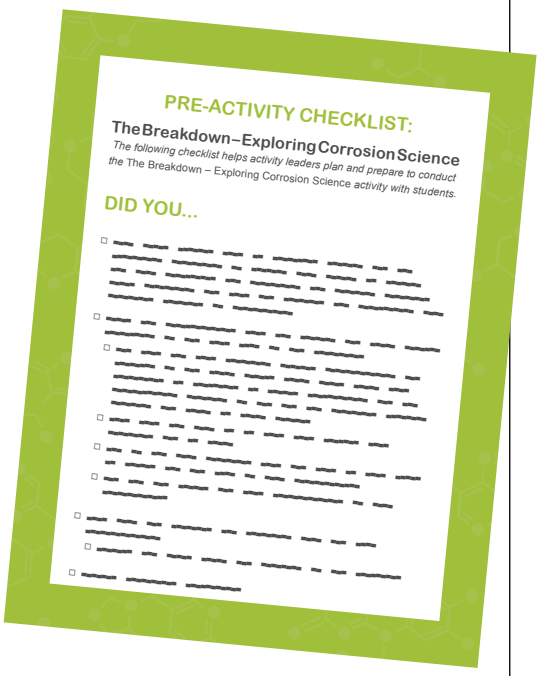
STUDENT DISCOVERIES

Students will:

- Learn the science behind corrosion.
- Identify where corrosion can occur and discuss its consequences.
- Participate in a Matching team-based activity.
- Participate in a team-based learning experience that test the rusting of iron-based nails.
- Build important STEM²D—Science, Technology, Engineering, Math, Manufacturing, and Design—skills, such as creative thinking, critical thinking, problem solving, decision making, and teamwork.
- Realize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D.

STEM²D Skills

- Collaboration
- Communication
- Creative Thinking
- Critical Thinking
- Analyzing Data
- Decision Making
- Drawing Conclusions
- Laboratory Skills
- Problem Solving
- Teamwork


PRE-ACTIVITY CHECKLIST:

The Breakdown – Exploring Corrosion Science

The following checklist helps activity leaders plan and prepare to conduct the The Breakdown – Exploring Corrosion Science activity with students.

DID YOU...

GETTING READY

Materials:

- Pre-Activity Checklist
- Tell My Story Form
- Computer with projector, speakers, and Internet access
- PowerPoint: The Breakdown – Exploring Corrosion Science
- Video: How to Clean the Eiffel Tower
- Student Handout, *1 per student*
- Pen/pencil, *1 per student*
- Corrosion Materials, 1 set of the following materials per activity leader (for demonstration) and 1 per student team
  - 3 Clear Jars with Air-tight Lid or Test Tubes and Stoppers
  - 3 Iron Nails (non-galvanized, not stainless steel)
  - 1 Silica Gel Desiccant
    - Can be found online, or in common household packaging such as shoeboxes. Also, in the science lab as Anhydrous Calcium Chloride
  - 3 Small Plastic Cups to add:
    - 30–50 mL of Tap Water*
    - 30–50 mL of Distilled Water*
    - 10–15 mL of Oil (Liquid at room temperature)

    ** Exact amount may vary depending on vessel used. Use enough water to fully immerse the nails.*
  - 1 Marker
  - 3 Labels
  - Paper Towel

Estimated Cost

Activity leaders can expect to incur less than $10.00 per group (excluding optional items) in materials costs. 3–5 students per group is recommended.

- Distilled water can be purchased from Amazon by searching for “distilled water” or by using the following link: Distilled Water
- Silica gel can be purchased from Amazon by searching for “silica gel” or by using the following link: 45 Pc 5Gram Silica Gel Pack

Activity Leader Preparation

- Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM²D.org.
- Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
- See the **STEM²D Student Activities Overview** for additional information.

STEP-BY-STEP INSTRUCTIONS: The Breakdown – Exploring Corrosion Science

1. Welcome and Introductions (5 minutes)

- Welcome the students.
- Introduce yourself by saying your name, title, and your organization/company.
- **(Today's Plan Slide)** Review the agenda. Explain that students will learn about STEM²D concepts relating to corrosion and how it affects building structure and maintenance. They will then test how exposure of nails to different conditions can affect their ability to corrode.
- They will also learn about STEM²D careers that are involved in the corrosion industry.
- Initiate an opening discussion to center students to the concepts of corrosion. Consider asking:
  - How do you think science and engineering are used every day in the workplace?
  - Where have you found rust in the past?
  - How might these STEM²D areas be used to prevent water pipes in your bathroom or kitchen from rusting?
  - Give examples of job title and careers that align with this activity and the corrosion field.

KEY WORDS

- Chemical Reaction
- Choice of Material
- Corrosion
- Corrosion Inhibitors
- Design Engineer
- Electroplating
- Environmental Factors
- Hydrated Ferric Oxide
- Corrosion Engineer
- Metal
- Oxidation Reaction
- Protective Coatings

TIPS ON STARTING CONVERSATIONS

- What area of STEM²D interests you?
- What area of STEM²D is your favorite?
- Why did you choose that area of STEM²D as your favorite?
- When you consider your future, what are you most excited about?
- What would your dream job be?
- Where do you see yourself in five to ten years?
- What does the perfect workday look like to you? Are you working with others or alone? Do you solve problems? Are you fixing or building things?

2. Warm-Up Activity (5 minutes)

- **(What's That Structure? Slide)** Initiate the lesson and topic discussion. Ask the students to look at the images on the slide and answer the following questions:
  - Can you name each of the items listed?
  - How might you group them by type?
  - What are some things they have in common?
  - What will happen over time if you expose these items to water and do not let them dry?
  - What might this outcome look like in 3, 5, and 15 years?
  - Show a slide of the same objects in a corroded state. Do these images look familiar?

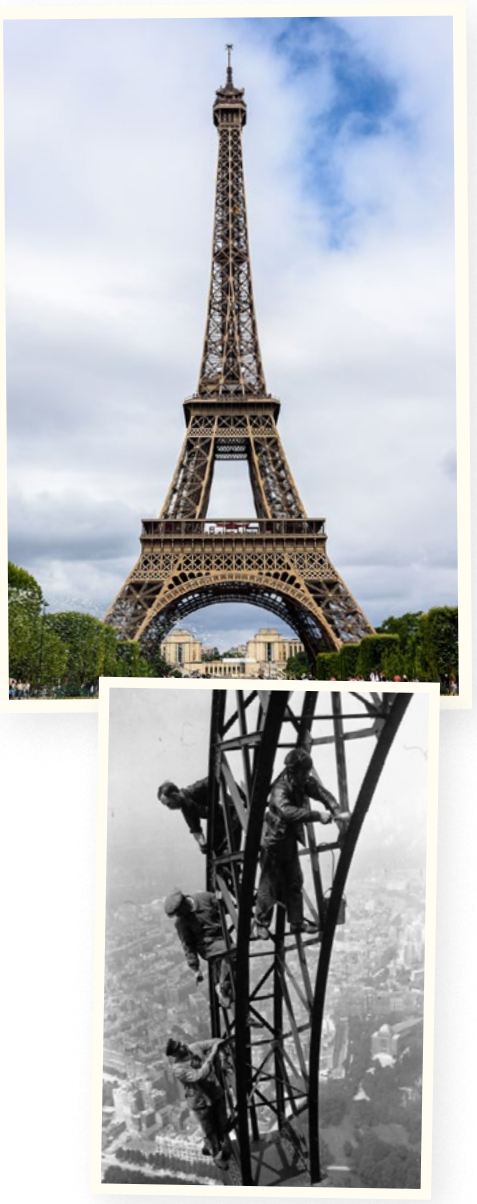
3. Content Presentation (10 minutes)

- **(Corrosion Slide)** Introduce corrosion by stating:
  - **Corrosion** is an unintentional process that breaks down materials when they are exposed to water or air.
  - Corrosion of **metals** like steel, iron, silver, copper, and brass causes them to deteriorate and become unstable over time, through **chemical reactions** known as **oxidation reactions**. For example, when exposed to air silver turns dark gray, iron rust, and copper turns green.
  - A **chemical reaction** is a process in which the structure of atoms or molecules that make up a substance is changed.
  - A **metal** is class of chemical elements that are often shiny, ductile solids that easily change their shape without breaking, and good conductors of heat. Many metals are available in nature including Iron, Steel, Aluminum, Copper, Bronze, Titanium, Brass, Zinc, and Lead.
  - The most common type of corrosion is the rusting of the iron (Fe) metal. In this oxidation reaction, iron combines with the oxygen (O_2) in the air in the presence of water (H_2O) to generate rust, a reddish-brown substance. This substance is known scientifically as **hydrated ferric oxide** ($2Fe_2O_3H_2O$) or hydrated iron (III) oxide.

1. $4Fe + 3O_2 + {}_2H_2O \rightarrow 2Fe_2O_3.H_2O$
2. Rust = $2Fe_2O_3.H_2O$

- This chemical reaction can easily be mimicked in the lab.

- **(Occurrences of Corrosion Slide)**
  - Corrosion happens naturally in our every life and can be found in bridges, buildings, pipes, nails, ships, cars, train tracks, and the structures you identified earlier.
  - Spontaneous corrosion increases when structures are openly and regularly exposed to air and water, changes in humidity, and varying concentrations of salt and other chemicals.
  - Preventing corrosion is critical in the upkeep of many structures, including, the Eiffel Tower, Statue of Liberty, and Taj Mahal.
- **(Consequences of Corrosion Slide)**
  - Introduce this slide by asking the students the following questions:
    1. What do you think are the consequences of corrosion?
    2. Have you personally seen any of the adverse effects of corrosion?
  - Once the students have shared their responses, explain that when unchecked, corrosion can cause very damaging effects and issues that are harmful to society.
  - Corrosion is an extremely costly problem around the world, with billions of dollars spent yearly to replace iron containing structures destroyed by corrosion.
  - Some of the possible impacts of corrosion include:
    1. The collapse of buildings and bridges, oil pipelines break, chemical plants leak, and bathrooms flood.
    2. Fires caused by corroded electrical circuits and switches.
    3. Blood poisoning because of corroded medical implants such as blood clot filters and artificial joints.
    4. The inability to safely dispose of toxic chemical waste that must be stored in containers for thousands of years.
- **(How to Clean the Eiffel Tower Slide)**
  - Ask the students to read the *Excite Eiffel Tower Maintenance* excerpt in their student handouts and share with each other one thing they found interesting.



TIPS FOR MAKING CONNECTIONS

Encourage students to:

- Not be afraid to ask questions if they don't understand.
- Summarize what they have learned.
- Explain their thinking process aloud.
- Explain in their own words how corrosion works.
- Outline the results from the nail being exposed to different conditions.
- Describe how they applied their critical thinking skills to the activity.

- Play the video link: https://www.nationalgeographic.com/travel/article/behind-the-scenes-eiffel-tower-paris
- Ask the students to read the '*A Day In The Life*' excerpt in their student handouts and share with each other one thing they found interesting.

4. **Learning Activity (30 minutes).** Break the group into teams and instruct the teams to sit together.
   - **(Corrosion of Iron-Based Nails Slide)** Introduce the activity using the instructions below. Indicate:
     - Today, we are going to do a team-based activity where you will take on the role of a Corrosion Engineer. Your goal is to test conditions affecting corrosion on iron-based nails.
     - The materials for the activity include glass jars, iron nails, distilled water, tap water, oil, and silica gel.
   - **(Instructions — Nail Corrosion Slide)**
     - Explain the following steps for testing the nails and encourage the students to review them in their handout:
       1. Your team will prepare 3 glass jars and label them A, B, C.
       2. Add an iron nail in each jar.
       3. Fill glass jar A halfway with tap water and then cap the lid.
       4. Fill glass jar B halfway with distilled water. Then add a layer of oil and cap the lid.
       5. To the last glass jar C, add a packet of Silica Gel desiccant and cap the lid.
       6. Leave the jars for 7–14 days then record your observations.
       7. In the meantime, you will look at 3 pre-made jars and record your observations for the changes in the nail.
     - Before giving the students the pre-made jars, ask them the following:
       1. What do you expect to happen to the nail exposed to water?
       2. What would adding the oil to the water do to the nail?

3. Silica gel is a salt that does not contain water. How might it affect the nail in Jar C?

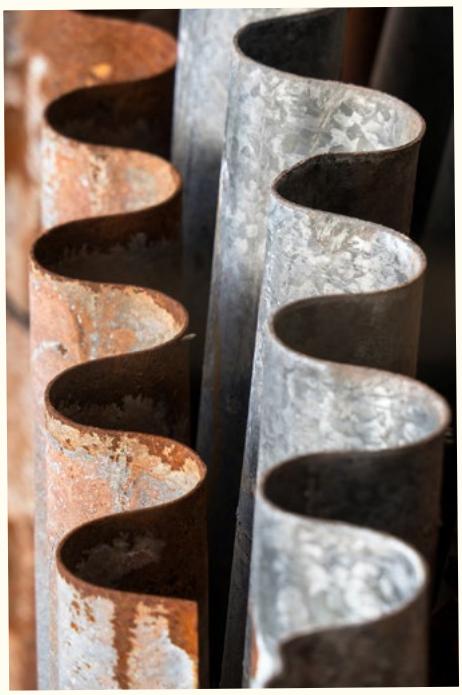
- Give the students the pre-made jars and ask them to record their observations and answer the questions in their student handout.

- **(Results Discussion Slide)**
  - Explain the three (3) expected results from the nail exposure:
    1. **Jar A (Water Only)** – The nail is highly rusted. It is exposed to water and air, so the process of corrosion will take place.
    2. **Jar B (Water + Oil)** – The nail is not rusted. The presence of oil is stopping the supply of oxygen to the nail. The water is present, but without oxygen corrosion will not take place.
    3. **Jar C (Silica Gel)** – The nail is not rusted. The salt in the silica gel is absorbing the oxygen as it enters the container. Because there is no oxygen present corrosion will not take place.
  - Ask the students the following questions:
    1. What did you think would happen to the nail? Were the results what you expected?
    2. What are some of the 'variables' in this experiment?
       a. What did adding the oil to the water do the nail? Why?
       b. Silica gel is a salt that does not contain water. How did it affect the nail in Jar C? Why?
    3. Are there any other conditions you can test to see how iron rust? What are they? Why did you choose them?
    4. How might a corrosion engineer prevent the nail from rusting?
- **(Preventative Methods and Application Slide)**
  - There are many ways to prevent corrosion. Explain briefly that some examples are:
    1. **Electroplating** — Plating the structure with other metals more resistive to rusting
    2. **Corrosion inhibitors** — Chemicals applied to the outside of a structure that may slow or prevent corrosion

TIPS ABOUT STEM²D CAREERS

Share with students that there are many different kinds of careers related to STEM²D. Possible **STEM²D** careers related to this activity:

- Corrosion Engineer
- Design Engineer
- Maintenance Engineer
- Project Engineer
- Reliability Engineer



TIPS FOR WORKING WITH STUDENTS

- Ask open-ended questions to encourage student reflection and discussion. For example:
  - What did you expect to happen to the nail in water?
  - Why might adding oil change the results of the nail in water?
  - Would you make changes to the activity design? Why?
  - What have you learned so far in this process?
- Help students stay on track with time during the group challenge.
- Move around the learning space and provide support when necessary.
- Encourage all students to participate.
- Encourage youth to take on leadership roles in their groups.
- Provide support and answer questions, as needed.
- No question is a "dumb" question. If an answer is incorrect ask how they got to that answer and offer encouragement — redirect thinking.

3. **Choice of material** — Choosing to use materials that are resistant to rusting e.g., Fiberglass or stainless steel
4. **Environmental factors** — Reducing exposure to factors that contribute to corrosion.
5. **Protective coatings** — Application of paint or other coatings to avoid exposure to elements.

- **(Preventative Methods Matching Slide)**
  - In this activity, students will match the preventative methods with their corresponding application and image.
  - Two of the methods are already matched and are:
    1. Choosing the right metal – includes stainless steel, duplex, super duplex and nickel alloy. Third image shown.
    2. Metal plating – which includes electroplating and hot dip galvanization. Fourth image shown.
  - Ask students to review the remaining three methods to match them.
  - Share the results on the next slide.
- **(STEM²D Careers in the Corrosion Industry Slide)**
  - Summarize the activity by sharing different career types in the corrosion industry. Examples include:
    1. Corrosion Engineer
    2. Design Engineer
    3. Maintenance Engineer
    4. Project Engineer
    5. Reliability Engineer
    6. Research & Development Scientist

5. Student Reflection (10 minutes)

- **(Reflection Slide)** Ask students to reflect on the activity. Have students spend a few minutes thinking about the following questions:
  - What did you learn about corrosion?

- Was there anything difficult to understand about corrosion and how detrimental it can be to buildings and other structures?
- What did you learn about working in a team?
- What would you change about the nail rusting activity if you were to do it again?
- Can you see yourself as a STEM²D professional? Why or why not?
- What is one thing you learned that you did not know coming into today?

- Thank students for joining you today and encourage them to continue exploring careers in STEM²D.

Extended Learning

Here are a few ways to extend the learning:

- Try an activity on **'How do Acids and pH Affect Corrosion'?** Add 1 cup of tap water to the first jar, 1 cup of salt water to the second, 1 cup of a carbonated lemon-lime soda to the third, 1 cup of pickle juice to the fourth container, 1 cup of orange juice to the fifth and 1 cup of white vinegar to the last container. Hypothesize what liquid will cause a nail to rust first. Submerge one iron nail in each container and set the beakers or glasses in a place they will not be disturbed. Observe the nails daily to check for rust formation. The nails in water should both form rust within three weeks, and the vinegar should rust a nail approximately one week later.
- Try an activity to **'Test and Assess a Variety of Methods for Preventing Rust'.** Wrap one nail in thin plastic film, such as 'cling film'. Paint one nail and let it dry. Coat one nail with Vaseline or other grease, or oil. Wrap a small piece of magnesium ribbon or zinc foil around a section of a nail. Wrap a small piece of copper foil around a section of a nail. Place these nails in separate test tubes and leave it for 2 weeks for results.

Key Words

- **Chemical Reaction:** A process in which the structure of atoms or molecules that make up a substance is changed.
- **Choice of Material:** Choosing to use materials that are resistant to rusting e.g., Fiberglass or stainless steel.
- **Corrosion:** An unintentional process that breaks down materials when they are exposed to water or air.
- **Corrosion inhibitors:** Chemicals applied to the outside of a structure that may slow or prevent corrosion.
- **Design Engineer:** An engineer who selects materials, develops, and monitors quality controls during production, and installs and commissions equipments.
- **Electroplating:** Plating the structure with other metals more resistive to rusting.
- **Environmental Factors:** Reducing exposure to factors that contribute to corrosion.
- **Hydrated Ferric Oxide:** A reddish-brown product that is formed when iron (Fe) metal rust. It is also known as hydrated iron (III) oxide.
- **Corrosion Engineer:** An engineer who verifies asset integrity with regular inspection, and maintenance, to ensure critical elements are functioning to prevent incidents or long downtimes.
- **Metal:** A class of chemical elements that are often shiny, ductile solids that easily change their shape without breaking, and good conductors of heat. Many metals are available in nature including Iron, Steel, Aluminum, Copper, Bronze, Titanium, Brass, Zinc, and Lead.
- **Oxidation Reaction:** A reaction that occurs when an atom, molecule, or ion loses one or more electrons and increases its oxidation state. An example is the addition of oxygen (O_2) gas to a compound.
- **Protective Coatings:** Application of paint or other coatings to avoid exposure to elements.

Resources and References

Adapted from the Johnson & Johnson WiSTEM²D Youth Programs' Race to Inspire program in partnership with JA (Junior Achievement) Singapore. Developed by FHI 360 with Yugadarshni Raja, EH&S Engineer Consumer, Malaysia and Johara Pillay, Associate Clinical Specialist Medical Device, Australia.

The following resources provide additional information or activities.

- How to Clean the Eiffel Tower – https://www.nationalgeographic.com/travel/article/behind-the-scenes-eiffel-tower-paris

Image sources (where necessary):

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"The Eiffel Tower, Paris" by Joe deSouza is licensed under CC0 1.0 / Changes: Photo was cropped.

Réfection de la peinture de la Tour Eiffel. Source: gallica.bnf.fr / Bibliothèque nationale de France https://gallica.bnf.fr/ark:/12148/btv1b90241829/#

PRE-ACTIVITY CHECKLIST:

The Breakdown – Exploring Corrosion Science

The following checklist helps activity leaders plan and prepare to conduct the The Breakdown – Exploring Corrosion Science *activity with students.*

DID YOU…

- ☐ Read **Spark WiSTEM²D**? *This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM²D.org.*
- ☐ Visit the implementation site and observe the young people? (*optional*) If so, take note of the following:
  - ☐ How does the site encourage orderly participation? For example, do the young people raise their hands when responding to questions or during discussions? How are interruptions handled? Do you see any potential problems managing the class of young people?
  - ☐ What does the site do to make each student feel important and at ease?
  - ☐ How is the room arranged? Will you need to move desks or chairs for any part of your presentation?
  - ☐ How can you engage the site representative in your presentation?
- ☐ Meet with and finalize the logistics with the site representative?
- ☐ Confirm the date, time, and location of the activity?
- ☐ Confirm the technology needs? Do you need to bring a computer and a projector to show the PowerPoint? Or, does the site have one that you can borrow? Does the site have Internet access? Can you use it during the activity to show the videos?
- ☐ Confirm the number of students attending? Knowing this will help you decide how to separate the class into teams and/or pairs, as well as the appropriate materials to purchase.
- ☐ Recruit additional volunteers?
- ☐ Prepare for the activity? Did you:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity and tailor the PowerPoint, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?

- ☐ Review the notes section of the slides in the PowerPoint for information to be shared?
- ☐ Pre-view the video? (*optional*)
- ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? If desired, include key points about your story on the *PowerPoint (see **Tell My Story Slide**).*

☐ Practice your presentation, including the hands-on, minds-on activity? Be sure to:

- ☐ Do the activity; make sure you are able to explain the concepts to students, if needed, and that you know the correct answers.

☐ Obtain the required materials? (See the **Materials** and **Estimated Materials Costs** sections.)

☐ Pre-make several jars of the 3 nail testing conditions for students to observe and record the findings.

☐ Photocopy the **Student Handouts**?

☐ Set up the site appropriately for the activity? Specifically:

- ☐ Make sure tables and chairs are arranged to accommodate the teams of students?
- ☐ Set up the computer and projector for the PowerPoint presentation? Be sure that speakers and an Internet connection are available to show the video.
- ☐ If additional volunteers are available, assign adults to specific teams.

☐ Bring a camera, if desired, to take photographs.

- ☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?

☐ **Have fun!**

TELL MY STORY FORM

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

_____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity? _____

_____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood when you had your first 'spark' or 'interest' in STEM.
- Detail your journey. Highlight what you've tried, what you learned, steps to success, etc.
- Failures or setbacks are also great to talk about, as well as difficulties and/or challenges and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why to the students.* _____

_____

What does your current position entail? *Be sure to include how you use STEM²D during a typical work day.* _____

_____

THE BREAKDOWN – EXPLORING CORROSION SCIENCE

Student Handout

Eiffel Tower Maintenance

https://www.nationalgeographic.com/travel/article/behind-the-scenes-eiffel-tower-paris

Maintaining the Eiffel Tower's signature sparkle requires monumental effort. The Eiffel Tower is built of riveted (2.5 million rivets!) wrought iron, a material that will last virtually forever if it is painted regularly. Since it was built (for the International Exhibition of Paris in 1889), the tower has been painted once every seven years.

Maintenance on the tower includes applying 50 metric tons of three graded tones of paint every 7 years to protect the 200,000 square meters of iron lattice work from rust. The darkest paint is used at the bottom and the lightest shade at the top.

"The Eiffel Tower, Paris" by Joe deSouza is licensed under CC0 1.0 / Changes: Photo was cropped.

Réfection de la peinture de la Tour Eiffel.
Source: gallica.bnf.fr / Bibliothèque nationale de France
https://gallica.bnf.fr/ark:/12148/btv1b90241829/#

Each repainting, by 25 painters working for 15 months, requires 1500 brushes, 5000 sanding disks and 1500 sets of work clothes. The 25 painters who work on the Eiffel Tower still use the traditional methods from the time when Gustave Eiffel designed it. The paint must be applied only manually, with brushes; rollers and paint guns are not allowed.

A Day In The Life of a Corrosion Engineer

Corrosion engineering involves a study of chemical kinetics, thermodynamics, electrochemistry, and materials science. Wide career scope includes material selection, develop, and monitor quality controls during fabrication, installation and commissioning of equipment. During operational life, to verify asset integrity with regular inspection, maintenance, to ensure critical elements are functioning to prevent incidents or long downtimes.

8am: Loga's day begins with a performance meeting with the operations team where progress of the various tasks, the day's plans and the technical issues faced by previous shifts are reviewed.

9:15am: Loga monitor technicians handling machine breakdowns. He makes sure that the necessary spare parts are made available for the repair job on a priority basis.

10:30 am: He talks to his interns, technicians, and supervisors about the importance of adhering to safety regulations and quality standards.

1:00pm: For a new project involving raw material storage tank, Loga discusses material selection with the design engineers. The team considers the life cycle cost of the piping system with different materials inclusive of the estimated maintenance cost and failure costs.

2:30pm: Loga and the corrosion team is looking forward to the corrosion family night fun event, where his company invites children and their family to learn about corrosion and engineering. The team discusses the activities for the event.

4:00pm: Loga reviews his schedule for the next day and closes this one on a happy note.

THE BREAKDOWN – EXPLORING CORROSION SCIENCE

Student Activity

In this team-based activity, you will take on the role of a Corrosion Engineer. Your goal is to test the corrosive effects of different chemical solutions on iron-based nails. After setting up your jars, you will be given 3 pre-made jars to observe. Record your observations in the table below and consider the questions listed.

Instructions:

Follow the steps below to test your nails:

- You will work in teams of three.
- Prepare 3 glass jars and lave them A, B, and C. Place an iron nail in each jar.
- Fill glass jar A up halfway with tap water. Cap the lid.
- Fill glass jar B up halfway with distilled water. Add a layer of oil. Cap the lid.
- Pour a packet of silica gel desiccant into glass jar C. Cap the lid.
- Leave for 7–14 days.

Record your observations here:

Glass Jar	Treatment Condition	Observations
Jar A	Tap Water (H_2O)	
Jar B	Distilled Water (H_2O) + Oil	
Jar C	Silica Gel Desiccant	

Think About It

Answer the following questions:

What did you expect would happen to the nail? Were the results what you expected? _____

What did adding the oil to the water do the nail. Why? _____

Silica gel contains a salt; how did it affect the nail in Jar C? Why? _____

Are there any other conditions you can test to see how iron rust? What are they? Why did you choose them? _____

How might a corrosion engineer prevent the nail from rusting? _____

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