STRAWBERRY SQUISH

STEM²D Topic

Science

Target Population:
Students, ages 14–18

Strawberry Squish is part of the **STEM²D 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 globally, ages 12–18.

Strawberry Squish

STEM²D Topics: Science
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ACTIVITY DESCRIPTION

In this team-based, hands-on activity, students will extract DNA from smashed strawberries and learn how DNA and genes play an important role in human development.

ESTIMATED TIME

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

STUDENT DISCOVERIES

Students will:

- Participate in a team-based learning experience.
- Build important STEM²D skills, such as collaboration, investigation, teamwork, and testing.
- Realize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D.

GETTING READY

Materials:

- Computer with projector
- PowerPoint: Strawberry Squish
- Pre-Activity Checklist
- Tell My Story Form
- Hand wipes or paper towels (for clean-up)
- Cooler with ice or a refrigerator
- Pen/pencil, *1 per student*
- Tablecloths (number will depend on tables being used)

STEM²D Skills

- Collaboration
- Communication
- Critical Thinking
- Decision Making
- Investigative and Laboratory Skills
- Problem Solving
- Scientific Inquiry
- Teamwork

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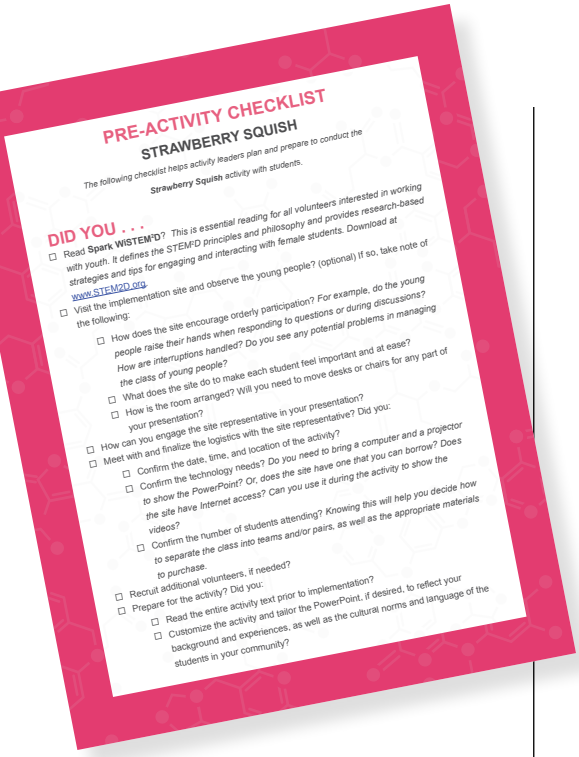
PRE-ACTIVITY CHECKLIST
STRAWBERRY SQUISH
The following checklist helps activity leaders plan and prepare to conduct the Strawberry Squish activity with students.
DID YOU . . .
☐ Read Spark WiSTEM²D? This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with female 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 in 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? Did you:
☐ 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, if needed?
☐ 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?

- Strawberry Squish Challenge materials, *1 set of the following materials per activity leader (for demonstration) and 1 per team:*
  - 5 mL (1 tsp) dish soap
  - 5 mL (1 tsp) cold rubbing alcohol (70% isopropyl alcohol kept on ice or in the refrigerator)
  - 45 mL (1.5 oz) water
  - 50-mL test tube containing ¼ tsp NaCl (table salt)
  - 1 Coffee filter
  - 1 Paper cup
  - 1 Plastic transfer pipette
  - 1 Strawberry
  - 1 Stir stick
  - 1 Test tube rack
  - 1 Ziploc™ bag (sandwich size)

Estimated Materials Cost:

Activity leaders can expect to incur less than $25.00 (excluding optional items) in materials costs when completing this activity with 20 students organized into teams of two students.

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: STRAWBERRY SQUISH

1. **Welcome and Introduction (5 minutes)**
   - Welcome the students.

Eldar Nurkovic/Shutterstock

- Introduce yourself by saying your name, title, and your organization/company.
- Share that students will be learning about STEM²D careers and will be applying STEM²D skills during the session.
- **(What is STEM²D? Slide**) Explain that **STEM²D** refers to: Science, Technology, Engineering, Math, Manufacturing, and Design.
- Ask students and other volunteers to introduce themselves and state their favorite area of STEM²D.
- **(Today's Plan Slide)** Review the agenda. Explain that today students will about DNA, genes, and proteins and will extract DNA from strawberries.

2. **Career Awareness: Science in the World of Work (10 minutes)**
   - **(Science in the World of Work Slide)** Initiate an opening discussion and brainstorming activity. Consider asking:
     - How do you think science is used every day in the workplace?
     - What kinds of careers do you think people with an interest, aptitude for, or degree in science would have?
   - **(Tell My Story Slide)** Talk about your educational and career path. Use the Tell My Story form as the basis for your remarks. Be prepared to describe your job or a typical day, and provide information about your background including:
     - When/why you developed an interest in design and engineering.
     - The classes/courses you took in secondary school.
     - Your postsecondary path, including the institution you attended and your degree. *If you switched disciplines, make sure you explain why to the students.*
     - What your current position entails. *Be sure to include how you use design and engineering and what you do on a typical work day.*
   - Weave in facts about science and engineering and STEM²D careers:
     - Tell the students that your career is only one of the many careers available in the STEM²D sectors.

Tips for Facilitators on STEM²D Careers

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

- Anthropologist/ Archeologist
- Biochemist
- Biological Scientist
- Biophysicist
- Forensic Scientist
- Geneticist
- Immunologist
- Plant Breeder
- Pharmacologist
- Science Laboratory Technician

KEY WORDS

- Chromosome
- DNA
- Extraction
- Gene
- Molecules
- mRNA
- Protein
- Soluble
- STEM2D

    - Explain that STEM²D careers are high-demand, high-growth careers and are predicted to remain in demand over the next 10 years.
    - Share a few Johnson & Johnson job titles and careers that might align with this activity.
    - Explain that STEM²D careers are high-demand, high-growth careers and are predicted to remain in demand over the next 10 years.
    - Share a few Johnson & Johnson job titles and careers.

3. **Content Presentation (15 minutes)**
    - **(DNA Slide)** Give an overview of DNA using the following text:
        - **(What is DNA? slide) DNA** stands for Deoxyribonucleic acid. This is the hereditary material in humans and almost all other organisms. Nearly every cell in a person's body has the same DNA. Most DNA is located in the cell nucleus, where it is called nuclear DNA.
        - Raise your hand if you can roll your tongue.
        - Raise your hand if you are left handed.
        - Your ability to roll your tongue or whether you are right-handed or left-handed is determined by your genes.
        - **Genes** are made up of DNA units that control the development of one or more traits. This is the basic unit by which genetic information is passed from parent to his/her offspring.
    - **(Human DNA Slide)** Explain:
        - Human DNA consists of 3 billion bases and 20,000 genes.
        - There are 4 kinds of bases: adenine, thymine, guanine, and cytosine.
        - The bases are in pairs: adenine and thymine go together and guanine and cytosine go together.
        - The sequences of these bases are biological instructions in a DNA strand. For example, the instructions for blue eyes may be: ATCGTT, while brown eyes may be ATCGCT.
    - **(What Does DNA Do? Slide)** State:
        - DNA contains instructions for development, survival, and reproduction.
        - DNA sequences, as I explained for blue eyes and brown

eyes, must be converted into messages that can be used to produce proteins.
    - **Proteins** are complex **molecules** that do most of the work in our bodies.
- **(How are DNA Sequences Used to Make Proteins? Slide)** Indicate:
    - Information is read from the DNA molecule and transcribed into an intermediary molecule called **messenger ribonucleic acid** or **mRNA.**
    - mRNA is translated into the "language" of amino acids, which are the building blocks of proteins.
    - This language tells the cell's protein-making machinery the precise order in which to link the amino acids to produce a specific protein.
    - There are 20 types of amino acids that can be placed in many different orders to form a wide variety of proteins.
- **(Protein Synthesis Slide)** Explain:
    - An easy way to remember the relationships among the nucleus, chromosomes, genes, ribosome, DNA, mRNA, RNA, and protein synthesis is to think about the steps involved in sharing a secret family recipe.
    - Let's pretend that your best friend wants your family's famous chocolate chip cookie recipe.
    - The recipe can only be found at your grandmother's house (nucleus).
    - Your grandmother has many recipes in her cookbook (chromosomes).
    - The famous chocolate chip cookie recipe is written (DNA coded sequence) on one specific recipe (gene).
    - Grandma refuses to let you take the recipe. So, you must stay at her house (DNA can't leave the nucleus) and copy the recipe for the chocolate chip cookies on a piece of paper (mRNA leaving the nucleus, same information, different format.)
    - You take the transcribed recipe (mRNA) for chocolate chip cookies to your friend's house (ribosome).

TIPS FOR MAKING CONNECTIONS

Encourage students to:

- Ask questions if they don't understand.
- Summarize what they have learned.
- Explain their thinking process aloud.
- Share what they know about DNA.

TIPS FOR WORKING WITH STUDENTS

Encourage students to ask questions to gain deeper understanding.

- Ask open-ended questions to encourage student reflection and discussion. For example:
  - What do you see in the plastic bag?
  - What other fruits do you think we could do this with?
  - What other characteristics do you see based on human genes?
- Remind students to perform the step you have modeled during the group challenge.
- Encourage all students to participate in the challenge.
- Move around the learning space and provide support when necessary.

    - Your friend reads the recipe. S/he mixes the ingredients (amino acids) in a particular order according to the directions (DNA via mRNA).
    - After baking, the cookie is done (a protein encoded by the gene).
- **(How Many Chromosomes? Slide)** State:
    - Most human cells contain 46 **chromosomes.** This is diplid, meaning 2 copies of each chromosome (23 from mother and 23 from father).
    - Strawberries are usually octoploid, which means they have 8 copies (7 chromosomes * 8 = 56 chromosomes). Because each strawberry contains so many chromosomes, it is easy to see the DNA extracted.

4. **Learning Activity: Strawberry Squish Challenge (20 minutes)**
    - **(Strawberry Squish Challenge Slide)** Share that now that students know what DNA is, they will conduct an experiment with a partner to look at DNA.
    - Explain to students that they need to closely follow your directions during the challenge in order to be safe and for the extraction to work.
    - Tell students that you will demonstrate each step, and they will copy what you have demonstrated.
    - Ask students to find a partner and distribute the materials to each pair.
    - **(Strawberry Squish Instructions Slide)** Follow the instructions outlined below in order, giving the pairs time to complete each step before moving on to the next one. The step-by-step instructions on the slides are set up to appear when you press the spacebar or right arrow.
    - FIRST, demonstrate the specific step and verbally tell the students what you are doing, THEN show the instruction on the screen. LAST, ask the students to complete the step. If you show the step on the slide before demonstrating, the students will not pay attention to your demonstration and will already be moving ahead with performing the step.
    - Start the Challenge:
        - **Step 1**: Transfer the ¼ tsp NaCl (table salt from the 50-mL test tube) into the paper cup.

- **Step 2:** Using the empty 50-mL test tube, measure 45 mL H_2O and pour in paper cup.

- Ask students: "What is H_20?" Call on a student with hand raised. *(Answer: Water.)*
- Continue the Challenge:
  - **Step 3:** Add 5-mL dish soap to paper cup.
  - **Step 4:** Use the stir stick to thoroughly mix the solution in the paper cup.
- Ask students:
  - Why are we using detergent and salt?
  - What does it do to the cell?
- Call on students with hands raised to share their thoughts. Indicate:
  - The detergent and salt solution is an extraction mixture. **Extraction** is the act or process of getting something by pulling it out.
  - The detergent and salt break open the cells and destroy the nuclei membranes within the cell.
  - They also strip away proteins that are associated with the DNA molecules.
- Complete Steps 5 to 9 of the Challenge:
  - **Step 5:** Place the strawberry in the Ziploc™ bag.
  - **Step 6:** Pour the Extraction Mixture into the Ziploc™ bag with the strawberry.
  - **Step 7:** Remove as much air as possible from the bag and mash the fruit with your fingers.
  - **Step 8:** One student should hold the coffee filter over the paper cup and while the other pours the fruit pulp mixture from the Ziploc™ bag into the filter. Be patient & try not to rip the wet filter. You don't need every last drop of liquid.
  - **Step 9:** Transfer 35 mL of the filtered liquid in the paper cup into the 50-mL test tube. Pay attention to the amount in the tube as you are transferring.
  - **Step 10:** Get the isopropyl alcohol (or rubbing alcohol) from cooler; it is being stored on ice. Slowly transfer 5 mL into your 50-mL test tube using a transfer pipette. Be sure not to mix or shake the test tube. Instead, gently squirt the

TIPS ON STARTING CONVERSATIONS

- What area of STEM²D is your favorite?
- Why did you choose that area of STEM²D as your favorite?
- What would your dream job be?
- Where do you see yourself in 5–10 years?

IPA down the side of the tube. You should now have 40 mL of liquid in your tube.

- Ask students:
  - Why are we using isopropyl alcohol?
- Call on students with hands raised to share their thoughts. Share the answer with the students:
  - DNA is not soluble in alcohol. So, alcohol separates all the components.
- Finish the Challenge:
  - **Step 11**: Look through the top layer (35–40 mL zone) of your 50-mL test tube. You should see the white "stringy gel-like" material. That is the DNA!!
  - **Step 12**: Use the stir stick to gently swirl around the outside of the tube and try to collect the DNA.
- Encourage students to recall the earlier presentation about DNA. Ask:
  - How many DNA strands are there in strawberries? *(Answer: 8.)*
  - How many DNA strands do humans have? *(Answer: 2.)*

5. **Student Reflection (10 minutes)**
   - **(Reflection Slide)** Ask students to reflect on the activity. Have them spend a few minutes thinking about the following questions:
     - What did you learn about DNA?
     - What was difficult about understanding DNA sequencing and extracting the DNA from the strawberries?
     - What more would you like to learn about DNA and genes?
     - How do you think this activity relates to a career in Science?
     - Can you see yourself as a STEM²D professional? Why or What would you need to do to make that happen?

Extended Learning

Here are a few ways to extend the learning:

- Examine the DNA from the strawberry under a microscope.
- Make genome sequencing bracelets: https://www.yourgenome.org/activities/sequence-bracelets

Key Words

- **Chromosome**: Chromosomes are made up of DNA. They carry all of the information used to help a cell grow, thrive, and reproduce.
- **DNA (Deoxyribonucleic acid)**: This is the hereditary material in humans and almost all other organisms.
- **Extraction:** The act or process of getting something by pulling it out.
- **Gene:** A unit of DNA that is usually located on a chromosome and controls the development of one or more traits. It is the basic unit by which genetic information is passed from parent to offspring.
- **Molecule:** The smallest unit of a substance that has all the properties of that substance.
- **mRNA:** Messenger RNA. It is the form of RNA that carries information from DNA in the nucleus to the ribosome sites of protein synthesis in the cell.
- **Protein:** Long chains of amino acids. There are thousands of different proteins in the human body. They perform all sorts of functions to help us survive.
- **Soluble:** Capable of being dissolved in a solvent.
- **STEM²D:** Science, Technology, Engineering, Math, Manufacturing, and Design.

Resources and References

Special thanks to Shelina Ramnarine, Postdoctoral Real-World Evidence Alliance Data Analyst, Janssen for her guidance in the development of this activity.

Activity concepts and real-life connections adapted from:

- The General Atomics Science Education Foundation: http://www.sci-ed-ga.org/biotechnolgy-recipe-analogy

The following resources provide additional information or activities:

- Your Genome: https://www.yourgenome.org/activities/
- Kiddle: https://kids.kiddle.co/DNA
- What is a Gene—KidsHealth: https://kidshealth.org/en/kids/what-is-gene.html
- Heredity for Kids—Ducksters: https://www.ducksters.com/science/biology/hereditary_patterns.php

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    - ☐ 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, if needed?
- ☐ 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?

- ☐ 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? Did you:

- ☐ Do the activity? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers?*

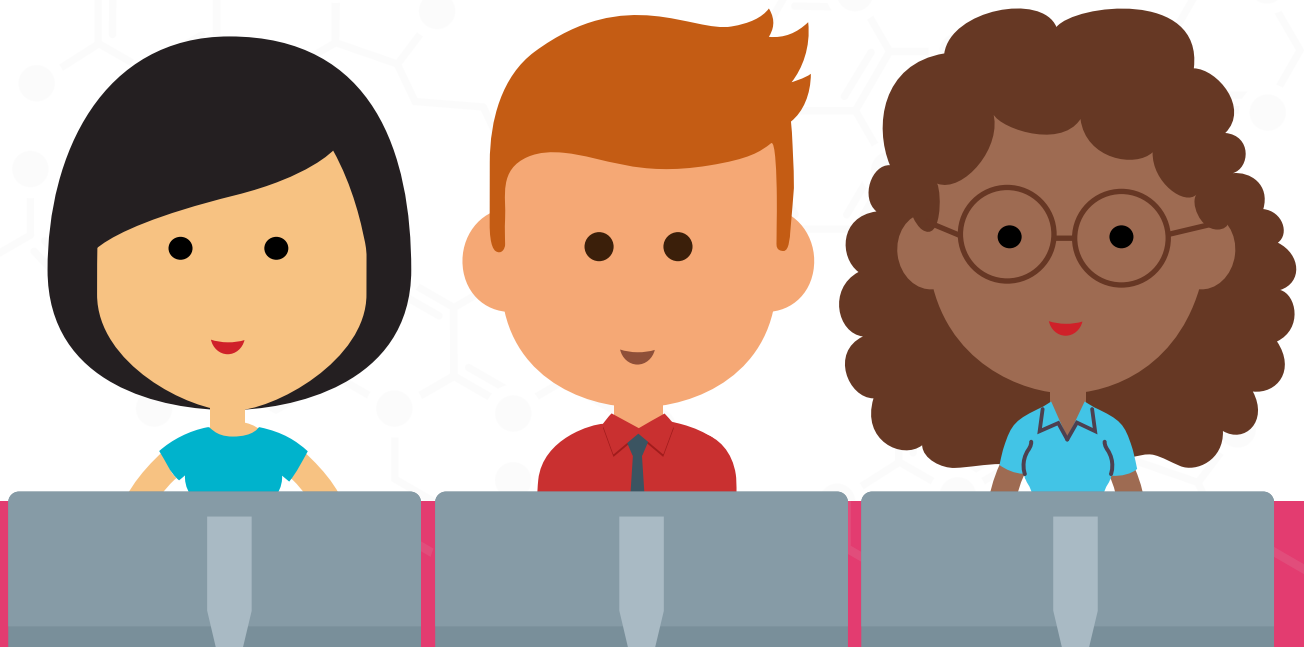
☐ Obtain the required materials? *(See the Materials and Estimated Materials Costs sections.)*

☐ Set up the site appropriately for the activity? Did you:

- ☐ Make sure tables and chairs are arranged to accommodate teams of four to five students?
- ☐ If additional volunteers are available, assign adults to specific teams?
- ☐ Set up the computer and projector for the PowerPoint presentation?
- ☐ 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 in a relevant and personal way.

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 first had your spark or interest in STEM²D.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—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.* _____

_____

What your current position entails. *Be sure to include how you use STEM²D during a typical work day.*

_____

_____

_____

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