open YOUR MIND. make YOUR MARK. color YOUR WORLD

Crayola IDEA WORKS®

the creativity exhibition

EDUCATOR GUIDE

TABLE OF CONTENTS

Welcome!

Welcome!

What to Expect on Your Field Trip

How many creative decisions are made in your classroom every day? Probably hundreds, if not thousands. Fostering a positive learning environment, one that is open to discussion and student collaboration, encourages creativity to flow throughout your school day. A field trip to *Crayola IDEAworks®: The Creativity Exhibition* builds on your daily STEAM instruction and trains your class to solve problems in fun, engaging, and memorable ways. Students of all skill levels and interests will find a way to sharpen their unique talents as they innovate, invent, and influence their way through the IDEA Workshop.

When your group enters, students will register individual wristbands with their choice of a color, icon, and initials. This ID will digitally track their progress as they practice their Design Thinking Skills in the "IDEA Workshop" and put them to the test in the "Colorverse™."

WELCOME TO THE IDEA WORKSHOP

The four sections of the **IDEA WORKSHOP**—I, D, E, and A—feature activities tied to a central Hub. Here, students answer questions to determine their own creative strengths. Scanning their wristbands triggers a video revealing stories of how Crayola has put IDEA into action to creatively solve real problems for over 100 years. Inspired by these messages, students work their way through hands-on activities in each section, honing their skills and feeling their creativity flow! Each completed activity is registered on their wristbands.

I = IDENTIFY the Problems

This is where the creative problem-solving ball gets rolling. Timed challenges highlight the importance of being able to ask questions, listen to answers, and observe in order to identify a problem. Skill-building challenges include:

- Video chatting and reacting with citizens of the Colorverse™ to find out about the problems they face. Are you an empathetic listener?
- Spotting differences by observing their surroundings through a digital, full-body challenge. Can you move quickly enough to identify all of the problems in the Colorverse or do you need to recruit help?

D = DEFINE the Details

Define emphasizes the need to narrow down priorities and clearly see what's needed in order to work toward solutions. Skill-building challenges include:

- Sorting through a series of tasks to select what's most important. How quickly can you prioritize?
- Whacking the facts in a speed challenge game! You'll need to be quick and figure out what's true, false, and just an opinion to rack up your score.

E = EXPLORE the Options

Drawing and building stations invite students to experiment with possibilities as they create their own unique prototypes and designs. Skill-building challenges include:

- Finding inspiration in real-world objects as you imagine and draw inventions for randomized challenges.
- Building, trying, and re-building structures with foam noodles and ingenuity—if at first you don't succeed, try, try again!

A = ASSESS the Solutions

Students evaluate their ideas, fix problems as they occur, and "pitch" creations to an audience. Skill-building challenges include:

- Adjusting an elaborate paint mixing machine to improve its performance and successfully create the custom color.
- Creating a fill-in-the-blank sales pitch for a randomly generated creative invention—and then seeing your pitch delivered on screen!

Students will celebrate their creative successes and the completion of their training as they are transported into the Colorverse. Then, it's time to get to work!

WELCOME TO THE COLORVERSE™

In the magical Crayola Colorverse™, students travel across the land, into space, and under the sea to use their IDEA skills and solve complex problems based in current science. As in the IDEA Workshop, they will scan their wristbands in each area for tips, encouragement, and questions to help students discover their creative strengths.

The Mars Station

Space travel is going to be a big challenge in the near future, and the Colorverse is already establishing a community on Mars. A giant projection reveals prototyping bays and a high-tech hydroponic garden inside. Students use their IDEA skills to help astronauts find ways to work and play in space.

- **Space Sportsplex:** Traditional exercises like running and weightlifting don't work in low gravity because there's much less resistance on your muscles and joints. But astronauts still need to keep their bodies in shape and have fun while doing it. Knowing that a thrown ball will fly three times farther on Mars, can you design a ball for low gravity?
- **Snacks in Space:** The challenge of producing nutritious food for astronauts is a tough one. Make sure your "Mars Garden" yields the maximum amount of food for astronauts by adjusting light, water, and oxygen. How much food can you produce with your limited resources?
- **Broadcast from Mars:** Jump in front of the greenscreen to broadcast your own "color commentary" on the day's events in space. A screen allows you to see yourself report on the daily happenings on Mars and view it with your friends back on Earth.

The SeaBase

Deep under the waves of the Colorverse Sea, a problem is brewing. Coral reefs are disappearing, and students need to help them repopulate. Using skills from the IDEA Workshop, students assess solutions to regrow the coral, bring the fish back, and inform the world about the need to care for our undersea friends.

- **Sea Soundscape:** Healthy coral reefs are a cacophony of sounds. Fish grunt, whoop, crunch, scrape, and click as they make their way around the reef. But when the coral dies, the fish move on, leaving only the sound of silence behind. Collaborate with other students to add sounds back to a damaged reef to show that you can attract new fish and help rebuild this ecosystem.
- **Restore the Reef:** When a reef is declining, we can help it recover and regrow by attaching coral fragments to the old reef with common materials like glue and cement. This time-consuming process for divers is limited by volunteers and resources. Can you speed it up and make it more fun? With a series of cogs, pulleys, knobs, and levers, figure out a way to automate transplants and stick fragments to the reef in colorful arrangements.
- **Get People Involved:** Using the Crayola Colorverse platform, students will take a selfie and select phrases to build a social media post using a randomly generated reef-themed filter. Try to score the most "likes" as you spread the word about rebuilding these underwater ecosystems.

The Land of Crayopolis

Like us, the citizens of the Colorverse have a problem with managing natural resources. They need ways to be energy efficient and reduce waste items to keep Crayopolis clean and beautiful! Students apply their IDEA skills to find new ways to design a collaborative city ecosystem, build buildings in harmony with the dynamics of nature, and turn their passion into fashion to benefit everybody.

- **Plan the Land:** Maintaining the balance between different needs in an urban landscape can be challenging and a lot of creativity is needed to ensure that all of them are met. Can you address the changing needs of a city like Crayopolis?
- **Build Together:** Work together with fellow creatives in your class to design a series of homes that can withstand our dynamic environment. Add your own ideas to your landscape as you quickly collaborate and rise to each challenge.
- **Fashion Statement:** Design a t-shirt and relate it to a cause you care about most. Scan your drawing to see yourself "wearing" your creation in a gesture-responsive mirror. What do you stand for?

WELCOME TO THE EMPOWERMENT PORTAL

Once your students have met every challenge and used their creative talents to reveal their unique strengths, they walk towards the Empowerment Portal. Here, they scan their wristbands one final time to generate a customized congratulatory message, announcing the creative strengths revealed during the visit. Encourage students to reflect on the skills and talents they discovered on their journey through *Crayola IDEAworks®: The Creativity Exhibition*.

When students create what they imagine, they are preparing for life beyond the classroom in an ever-evolving world. Keep flexing your creativity muscles to open **YOUR MIND**, make **YOUR MARK**, and color **YOUR WORLD!**

Using This Educator Guide

As a companion to your field trip experience, this Educator Guide has been developed to complement your classroom instruction and make the most of your school field trip to *Crayola IDEAworks: The Creativity Exhibition*. It contains original, assessable, STEAM-related classroom lesson plans featuring dynamic activities and assignments for students in three levels: Grades K-2, Grades 3-5, and Grades 6-8. Each level is creatively designed to be flexible. Use them to best meet the needs and capabilities of your class. You know your students better than anyone else.

Following this introduction, you will find a section containing six interdisciplinary classroom lesson plans and project-based inquiries, two for each level. The lesson plans begin with instruction pages for teachers that include answer keys and a list of the appropriate content areas and skills addressed by the activities. Rounding out the lessons are ready-to-copy Student Activity pages that center on key STEAM topics featured on your tour of *Crayola IDEAworks: The Creativity Exhibition*. Using a scaffolding approach, multiple parts of each lesson take into account a variety of differentiated instructional techniques intended to progress your students towards a stronger understanding of the content.

Grades K-2

The lesson, **Green is More Than a Color**, will demonstrate creative ways the ubiquitous markers and crayons in your classroom can be repurposed and kept out of landfills, while meeting your content standards in several areas. When markers dry up and crayons break, they can have a second life as classroom manipulatives. **How Would an Octopus Clean Your Room?** is a design challenge for students to create a biomimicry room-cleaning robot culminating in a 2D or 3D art project inspired by nature.

Grades 3-5

What Do You Need? is a primary source document analysis activity using an ad for Crayola crayons that appeared in a magazine for teachers in 1905. Students will follow up by using their IDEA skills to invent a product to solve a problem in their classroom today. In **Pick & Pitch**, students research and select two plants to grow in the first garden on Mars. Then they will pitch their classmates on why their plants should be chosen to travel in space. A final vote will determine which plants are recommended for the Mars Garden.

Grades 6-8

Fuel the Future is a lesson using historic maps to study the growth of Binney & Smith , now known as Crayola, at the site of their water-powered stone grist mill on the Bushkill Creek. Moving forward 100 years from water power to solar power today—what will power Crayola factories in the next century? Students will work as part of a team to investigate a source of renewable energy for large-scale industrial uses in the future. In **Sounds of the Reef**, your students will put their IDEA skills to work and analyze the amount of damage coral reef ecosystems in the United States have already endured. They will review the science of sound waves and how they are studied to help coral reefs, then use visual interpretations of these vibrations to create signature sound art.

After the lesson plans, you will find additional resources to use in your classroom as you see fit. **"The IDEA Design Thinking Process"** provides you with an overview of what, why, and how this creative problem-solving approach can be integrated into your daily instruction. **"Crayola Chronology"** is a timeline of the company that can be a reference for historical context and as a source for your own Crayola-inspired lesson ideas. **"Creative Fun & Games"** contains Crayola-themed puzzles you can assign for extra credit or earmark for your bus ride to and from your class visit.

We know how important it is to be able to justify field trips and document how instructional time is spent outside of your classroom. The lesson plans in this Educator Guide and the experiences your students will have on their field trip are correlated to the Next Generation Science Standards and Common Core State Standards for English Language Arts and Mathematics along with the C3 Framework for Social Studies State Standards and the National Core Arts Standards. In addition, you will find specific connections to the Pennsylvania Academic Standards to assist with planning. You can readily see how they fit into your required curriculum, making it easier than ever to connect a field trip to *Crayola IDEA works*® with your classroom instruction.

These education resources can be used before your group visit to help prepare students for the teachable moments found throughout the experience, as well as when you return to school to further explore connections between these educational themes and your classroom STEAM instruction.

We look forward to inspiring your inner creativeness each time you visit *Crayola IDEA works* with your students. As Maya Angelou tells us, "*You can't use up creativity. The more you use, the more you have.*"

Mathematics, English Language Arts, Design, Art
Measurement, Geometry, Counting/Numbers, Informational Reading, Design Process, Visual Art

Grades K-2 Lesson Plan 1

Green is More Than a Color

Teacher Instructions and Key

In the Colorverse ™ at *Crayola IDEAworks®: The Creativity Exhibition*, your students will learn about the challenges surrounding the science of city planning, including recycling technology. They will make choices in planning a "city block" to add to the landscape of Crayopolis based on changing requests and priorities. Maintaining balance among different needs in an urban landscape—including adequate greenspace—is tricky. Your students will also learn that the keys to identifying solutions to these challenges are inside each of them: creativity and innovation.

Keeping trash out of landfills by reducing, reusing, and recycling is one way to make sure that there is enough greenspace today and in the future. For this lesson plan you will demonstrate to your students some creative ways the ubiquitous markers and crayons in your classroom can be repurposed and kept out of landfills, while meeting content standards at the same time. When markers dry up and crayons break, they will have a second life as classroom manipulatives. Go Green!

This versatile lesson is designed to be set up as seven stations around your room. A student activity sheet is provided for each one. Rotations can be made in any order. The number of stations you choose will depend on the number of students in your class and the supplies you have available, which will also determine the results your students obtain. For example, some of the activities, such as sorting or making patterns, are based on the frequency of the colors or sizes in the supply at each station.

Set aside dried-up markers and collect crayons past their prime until you have saved enough for the stations. Crayon pieces can be any size and only Station 7 requires crayons with labels still on. These activities work as an excellent end-of-term or end-of-year review, which is also when most markers and crayons are at the end of their first life. You can also select one station that matches a standard your class is mastering at the moment.

Students will record the results of their explorations at each station. Additional supplies are listed below along with station-specific materials to set up during preparation. When counting and organizing materials, consider that it is up to you whether your class works as a team or individually within the rotations. If available, allow your students to use a platform such as Flipgrid or Seesaw to show their work.

Crayola Supplies

- Used Crayons (broken, any size, pieces, etc.)
- Used Markers
- Modeling Compounds (Dough, Model Magic, Air Dry Clay)
- Glue

Additional Supplies

Small bucket, basket, or box for supplies at each station, pieces of cardboard, glue dots, ruler, and balance scale

Recommended Books

- *The Crayola Shapes Book*
- *The Crayola Sorting Book*
- *The Crayola Patterns Book*
- *The Crayola Comparing Sizes Book*

Stations

For assessment, check to see that students have performed the activities on the Student Pages for the stations you assign. Remind younger students that they are not expected to know all of the content, such as all the shapes, for example. Encourage them to complete what they can.

1. Seeing Shapes

- *crayons, modeling compound, The Crayola Shapes Book*

Students compose, model, and draw two- and three-dimensional forms shapes including rectangles, squares, quadrilaterals, pentagons, hexagon, trapezoids, triangles, cubes, and right rectangular prisms. For 2D models, students will lay the pieces of crayons in the form of the shape. For 3D models, they will build shapes using crayons and modeling compound for sticks and clay balls. The Crayola Shapes Book is offered as inspiration for all and reading for those who finish early.

2. Crayon Tower Design Challenge

- *crayons*

Students use crayons as building blocks to see who can build the tallest tower. Equal-length, longer crayons stacked on top of each other in squares like Lincoln Logs work best, but any crayons will do as students must explore and assess their own stacking methods.

3. Sort It Out

- *crayons, The Crayola Sorting Book*

Students classify crayons into categories by observable and measurable attributes, then count the numbers of objects in each category and sort the categories by count. Based on the supply of crayons, categories could include wrapped vs. unwrapped, individual colors, whole vs. broken, etc. Provide a copy of The Crayola Sorting Book as inspiration for all and reading for those who finish early.

4. Marker Measurement

- *markers, ruler, The Crayola Comparing Sizes Book*

Students measure lengths and heights of classroom objects and each other using markers as a non-standard unit of measurement. Sizes of old crayons vary, so markers with caps are used because they are uniform and they can be stacked. Older students can work with standard units of measurement by repeating the activity with the ruler. Provide a copy of The Crayola Comparing Sizes Book as inspiration for all and reading for those who finish early.

5. What Does It Weigh?

- *markers, crayons, balance scale*

Students use markers as non-standard units of measurement for small objects found in the classroom. They will place the object to be measured on one side of a balance scale and add the markers to the other until the scale is even. Crayons can be added to the marker side to fine tune the balance. Check with your science lab if your classroom does not have an early elementary balance scale with platforms or buckets that can hold these items. These are the items in the student pages to be weighed at this station: hand sanitizer, pencil case, tissue box, scissors, glue stick, eraser, water bottle, and paints (watercolor). Adjust the list based on your available supplies.

6. Pick a Pattern

- *crayons, markers, The Crayola Patterns Book*

Students begin by copying simple patterns demonstrated at the station. Then they will create their own pattern using the manipulatives and recreate them by drawing on their activity sheets. For an initial pattern that students can copy, consider making a permanent example by gluing your own pattern to cardboard. Suggested patterns are in the student pages, but you may vary them based on the crayon or marker supply available. Provide a copy of The Crayola Patterns Book as inspiration for all and reading for those who finish early.

7. 3D Crayon Art

- *crayons, pieces of cardboard, glue or glue dots*

Students will use crayons as the medium to create sculptures, begun on a cardboard base and connected by glue or glue dots. Crayons with the paper wrapping stick to each other better than those with bare wax. If you have a parent volunteer, consider providing a glue gun at this station. Students can work individually or as a team to create one sculpture. They are free to create any shape or form they like and may be surprised at how well their lines and colors come together as a whole. This station may work best as a concluding activity, as the crayons will not be reusable as manipulatives. Display a "GO GREEN Crayon Art Exhibit" in your classroom. Make sticky notes available for students to leave positive reviews next to their classmates' work.

Name Date

Green is More Than a Color

Terms to Know: *height, landfill, length, recycle, reduce, reuse, sort, weight, width*

Everybody loves a colorful box of new crayons and a bright box of new markers. But what happens to the old ones? Where does a marker go when it dries out or a crayon when it is broken? Tossing them in the trash means they might end up in a landfill, polluting the Earth.

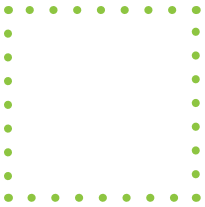
Imagine how many crayons and markers are thrown away by every class, in every school! That is a lot of crayons and markers in the garbage. The best ways to keep them out of landfills is to reduce, reuse, and recycle them. Some schools have crayon or marker recycling programs. Today, you will reuse your old markers and crayons in new ways and GO GREEN!

Your teacher will explain what to do at each station. Bring your worksheets and pencil with you as you go to each station.

1. Seeing Shapes

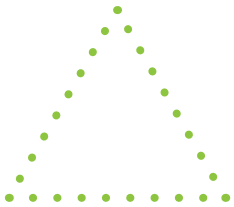
Build shapes with crayons! First, trace over the shapes you see here with a crayon. Then, use the crayon pieces to form the sides of the shapes. Connect the sides at the corners with clay. Color in each of the shapes as you make it. Take apart the shapes when you are done.

Square

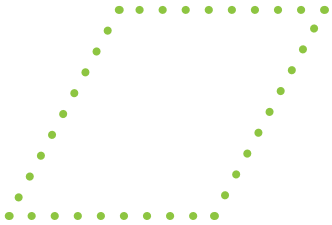


Rectangle

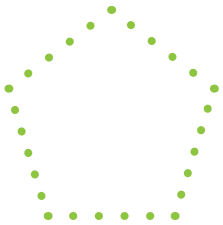
Triangle



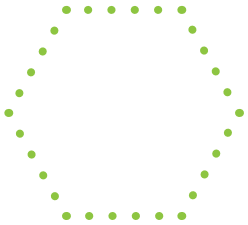
Trapezoid



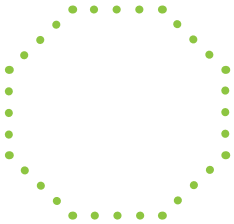
Pentgaon



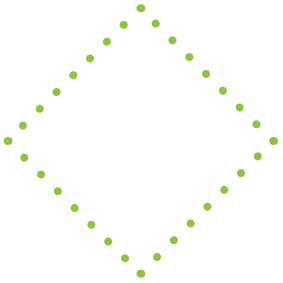
Hexagon



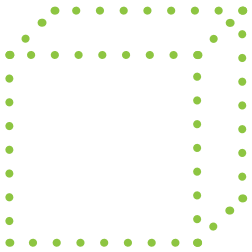
Octagon



Rhombus (Diamond)



***Challenge!* Cube**



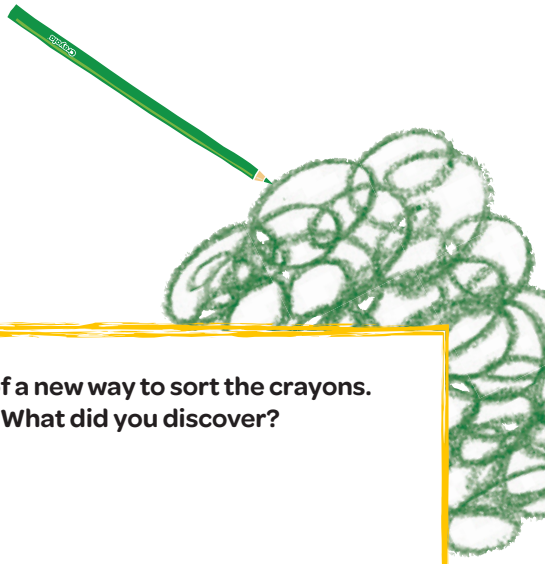
2. Tower Design Challenge

Now crayons are building blocks! Who can build the tallest tower, made only of crayons? What is the strongest way to stack them? You might have to explore and test a few ideas before you find the best way.

After the challenge, draw a picture of how the tallest tower in your group was built.

3. Sort It Out

There are many different colors, shapes, and sizes of crayons at this station. Which color appears the most? How many are smaller than your thumb? Sorting them helps you find out. Sort the crayons and record your data. You can draw or write words and numbers.



Sort the crayons that are your favorite color into one pile. How many are there?

Are there more red or blue crayons?

Are there more whole crayons or broken crayons?

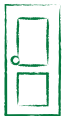
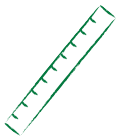
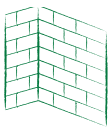
How many crayon pieces are smaller than your thumb?

Sort crayons into piles with and without their paper wrappers on. Which pile has more?

Challenge! **Think of a new way to sort the crayons. How did you do it? What did you discover?**

4. Marker Measurement

Use the markers to measure the width, length, or height of each object in the list below. First, look at which measurement to take: wide, tall, or long. Then, count how many markers it takes for that particular measurement and draw the number in the second column. You can pick something for the last one. Does your classroom have windows, pillows, or a rug you can measure?

Object	Measure	How Many Markers?	*Challenge!* Do you know how to use a ruler? Repeat your measurements to answer "how many inches?"
Chair 	← width →		
Door 	← width →		
Table 	↑ height ↓		
You 	↑ height ↓		
Friend Taller 	↑ height ↓		
Friend Shorter 	↑ height ↓		
Your Arm 	← length →		
Ruler 	← length →		
One Wall 	← length →		
Your Choice!			

5. What Does It Weigh?

How many markers does your pencil case weigh? What about a glue stick? How do you know which is heavier? Use the scale to find out how many markers and crayons equal the weight of the objects. You can pick something for the last one.

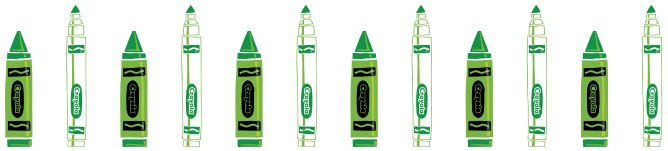
Balance the scale each time. Then count the number of markers and crayons it took to match the weight.

Object	Markers & Crayons
Hand Sanitizer 	
 Pencil Case	
 Tissue Box	
 Glue Stick	
 Scissors	
 Eraser	
 Water Bottle	
 Paints	
Your Choice!	

6. Pick a Pattern

Make these patterns with crayons and markers, then draw your patterns below.

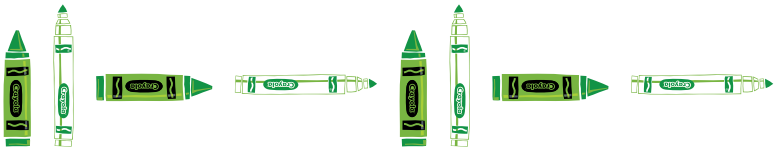
1.



2.

3.

4.



5. *Challenge!* Create your own pattern. Draw it here.

7. 3D Crayon Art

You will make art with your old crayons, but not by drawing with them! Start by gluing crayons onto a piece of cardboard. Add crayons, building up and out, into any shape or form. Your sculpture can be anything you want it to be!

Grades K-2 Lesson Plan 2

How Would an Octopus Clean Your Room?

Teacher Instructions and Key

In the Explore Zone at *Crayola IDEAworks®: The Creativity Exhibition*, your students will be asked to solve real-world problems with solutions inspired by familiar yet unrelated items. With no one correct answer, creativity is key. In this lesson plan, your students will use their design thinking skills to find solutions to the timeless task of cleaning their room, but their results must be inspired by nature.

How many of your students do you think like to clean their rooms? What would they say is the hardest part or the part they dislike the most? What if there was a robot inspired by animals to help them get the job done? Explain that finding a solution by mimicking something in nature is called "biomimicry." What can biomimicry look like for this challenge? A robot with eight arms like an octopus could help put toys away faster. A robot that lights up like a firefly can illuminate under a bed and in the back of the closet. Challenge students to think of other animals with helpful adaptations to mimic.

Working in groups, they are going to design a robot to help clean their bedrooms, inspired by a combination of body parts from three different animals. First, students will identify six jobs involved with cleaning a bedroom. Next, they will pick three of those six jobs as the problems they want to solve with their robot. They will define what they do not like about the chore and why they need help to get it done. Finally, they will look to biomimicry for solutions. A list of examples is provided, but students are free to come up with their own.

To finish the activity, groups will sketch a diagram for the robots they designed. They should label each of the three parts they chose, including from which animals it came and how it inspired the part on their robot, and describe how it will help clean a bedroom. For inspiration and encouragement while drawing their robots, provide copies of these books for your students:

- *Let's Draw Bugs and Critters with Crayola!*
- *Let's Draw Animals with Crayola!*
- *Let's Draw Robots with Crayola!*
- *Let's Draw Kooky Characters!*

Once you have seen the labeled diagrams for all groups, students will create full-color versions as either 2D or 3D art projects. Suggested materials are listed below. When all groups are finished, they can present their biomimicry room-cleaning robot to the class, which will then share ideas for improvements and vote on the most useful one.

Recommended Crayola art supplies:

- Paints: Tempera, Acrylic, Watercolor, Paint Brush Pens
- Modeling Compounds: Air Dry Clay, Modeling Clay, Model Magic
- Coloring & Drawing: Markers, Crayons, Color Pencils

Answer Key: Assess for Completion

- Part 1: 6 jobs identified = 6 points total
- Part 2: 3 jobs identified and described = 6 points total
- Part 4: Robot drawing with 3 biomimicry-inspired parts drawn, identified, and explained = 9 points

Name Date

How Would an Octopus Clean Your Room?

Terms to Know: adaptation, design, disinfect, inspire, mimic, octagon, repel

Do you like to clean your room? What is the worst part? What if you designed a robot inspired by animals to help you? Finding a solution to a problem by mimicking something in nature is called "biomimicry."

Maybe a robot with arms like an octopus can put toys away. Or a robot that lights up like a firefly can help you see under a bed or inside a closet. Can you think of other animals with helpful adaptations to mimic?

Your group will design a robot to clean your room, inspired by a combination of body parts from three different real animals or arthropods.

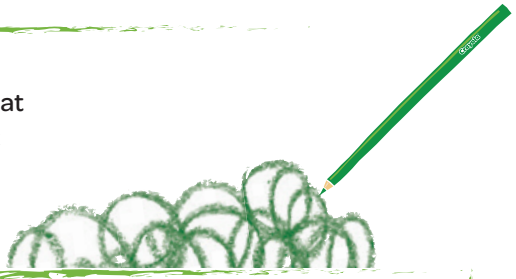
Part 1:

Identify six jobs that are part of cleaning a bedroom. For example, you might have to make the bed, vacuum, disinfect the desk, sort the toys, take out the trash, and put away clothes. What else do you do? You can write words or draw pictures.

1.	**4.**
2.	**5.**
3.	**6.**

Part 2:

Pick three of those six jobs in **Part 1** to solve with your robot. Define what you have to do, why your group does not like it, and what might make it easier. You can write words or draw pictures.



1. Job:

We do not like it because:

It would be easier with:

2. Job:

We do not like it because:

It would be easier with:

3. Job:

We do not like it because:

It would be easier with:

Part 3:

Explore nature for inspiration! Look for solutions by mimicking animals from the list on the next page or you can come up with your own ideas. How can these animals inspire a robot? How can they help solve your group's room-cleaning problems?

Octopus:
eight arms to pick up many things at once

NURC/UNCW and NOAA/FGBNMS

Shark:
skin fights germs and bacteria

Wikimedia Commons

Anteater:
to suck things up like a vacuum

Shutterstock

Ant:
strength for its body size

US Department of Agriculture (Flickr Photostream)

Giraffe:
long neck for reaching up high

PublicDomainPictures.net

Birds of prey like hawks and eagles:
vision to see from far away and find small items

US Fish & Wildlife Service

Firefly:
to light up dark spaces

Shutterstock

Elephant:
trunk for reaching high and low

US Fish & Wildlife Service (Flickr Photostream)

Cicada:
wings fight germs and bacteria

US Department of Agriculture (Flickr Photostream)

Owl:
see in dark and fly silently, to clean while you are sleeping

PublicDomainPictures.net

Spider:
super strong web glue to fix broken toys

Hagerty, Ryan, USFWS

Squirrel:
fuzzy tail for dusting

Schmierer, Alan, USFWS

Gecko:
sticky feet to climb up walls

PublicDomainPictures.net

Bees:
build strong honeycomb shelves, some have cleaning brushes on legs

US Department of Agriculture (Flickr Photostream)

Hummingbird:
fast wings for dusting

McKinney, Chelsea, USFWS

Opossum:
ability to remove, eat almost anything

USFWS Refuge Staff

Part 4:

Draw a picture of your group's new robot. Label each of the three parts of the robot, explain which animal you mimicked, and describe how that part will help clean your room. After your teacher has seen this picture, ask for more directions to create a 2D or 3D version in color.

Grades 3-5 Lesson Plan 1

What Do You Need?

Teacher Instructions and Key

Edwin Binney and C. Harold Smith founded the Binney & Smith Company in 1885. Today it is known as Crayola. They grew their company by listening to teachers and their consumers. In 1902, they invented chalk that did not leave clouds of dust in the air when it was erased. This dustless chalk kept classrooms cleaner and healthier. Alice Binney, a teacher, knew her students needed better crayons. Other crayons were pale and broke easily or they were expensive and toxic. Her husband Edwin listened to her and used a mixture of oil-based wax and pigments to create a new product in 1903—Crayola crayons!

News of the crayons spread quickly. By 1905, orders came from Korea, Denmark, India, and New Zealand! In **Part 1** of this activity, your students will look at an advertisement for Crayola crayons that appeared in a magazine for teachers in 1905. They will read the ad and answer questions to see how the company listened to and addressed the needs of teachers, students, and their consumers from the very beginning.

Starting in 1948, Binney & Smith held free workshops for teachers.They showed the many ways that Crayola art supplies could be used in all classes. As the company grew, they continued to listen to schools who—like families—wanted products without the mess, including paints, crayons, and markers that were easy to wash off clothes, walls, furniture, and children! To this day, Crayola engineers, product designers, and scientists innovate and invent new products because people need and want them.

What do you need in your classroom to make life easier for you and your students? What do you and your students think? In Part 2, you class will work in groups to identify a problem at your school by listening and observing. Then, they will define a design challenge for their group that solves the classroom problem they identified. These are the same design thinking skills used in the Workshop during the field trip to *Crayola IDEAworks®: The Creativity Exhibition*. Who knows, someday one of your student's inventions could be found in every classroom, right next to the Crayola crayons and markers!

Notes for Part 1

The original source for the advertisement used as a primary source is p. 125 in the March 1, 1905, edition of the *New York Teachers Monographs*, Volume 7 (New York, NY: American Book Company).

Notes for Part 2

This group project begins by having students ask teachers the same question Crayola asked educators, "What do you need?" It ends with students' plans for a new invention. These steps, part of the engineering design process, will guide your class through the lesson. Step 1 instructs the class to survey or interview teachers in

your school, if possible, to find out what inventions would make life in the classroom easier. How this communication takes place is up to you—electronic survey, personal interviews, or fliers in everyone's mailbox, for example.

If surveying staff is not feasible, students can offer their own ideas on what would make life in the classroom easier for everyone. Encourage them to think as simply or as high-tech as they want. As examples, one school placed small basketball hoops above trash cans to reduce the amount of litter on the ground, and decorative magnetic locker paper was invented by a middle school girl, giving students a damage-free way to easily decorate their lockers year after year.

Your class will need access to the internet for research in Part 2. They will also need supplies to create a diagram of their invention to present to the class. The Student Activity directions end with a drafting phase in the design process. However, feel free to extend the lesson into models made with classroom craft materials or even producing working prototypes. This provides an excellent opportunity to involve school clubs for maker space, construction, coding, art, and community service.

Answer Key

Part 1:

1. a material used by an artist, something used to make art
2. permanent and brilliant
3. Answers will vary but should address combining colors.
4. No waiting for colors to dry. No brushes to dry. No liquid colors to soil the hands and clothes.
5. 30
6. to supply, provide
7. "an-du-septic dustless crayon" or chalk
8. Answers will vary and should paraphrase the ad.

Part 2:
Assess based on completion of the six steps and the six questions answered.

What Do You Need?

Student Activities

Terms to Know: adapt, adjective, blueprint, commend, consumer, founded, diagram, draft, inspiration, pigment, prototype, toxic

Edwin Binney and C. Harold Smith founded the Binney & Smith Company in 1885. Today it is known as Crayola. They grew their company by listening to teachers and their consumers. In 1902, they invented chalk that did not leave clouds of dust in the air when it was erased. This dustless chalk kept classrooms cleaner and healthier. Alice Binney, a teacher, knew her students needed better crayons. Other crayons were pale and broke easily or they were expensive and toxic. Her husband Edwin listened to her and used a mixture of oil-based wax and pigments to create a new product in 1903—Crayola crayons!

News of the crayons spread quickly. By 1905, orders came from Korea, Denmark, India, and New Zealand! In Part 1 of this activity, you will look at an advertisement for Crayola crayons that appeared in a magazine for teachers in 1905. You will read the ad and answer questions to see how the company listened to and addressed the needs of teachers and students from the very beginning.

Starting in 1948, Binney & Smith held free workshops for teachers. They showed the many ways that Crayola art supplies could be used in all classes. As the company grew, they continued to listen to schools who—like families—wanted products without the mess, including paints, crayons, and markers that were easy to wash off clothes, walls, furniture, and children! To this day, Crayola engineers, product designers, and scientists innovate and invent new products because people need and want them.

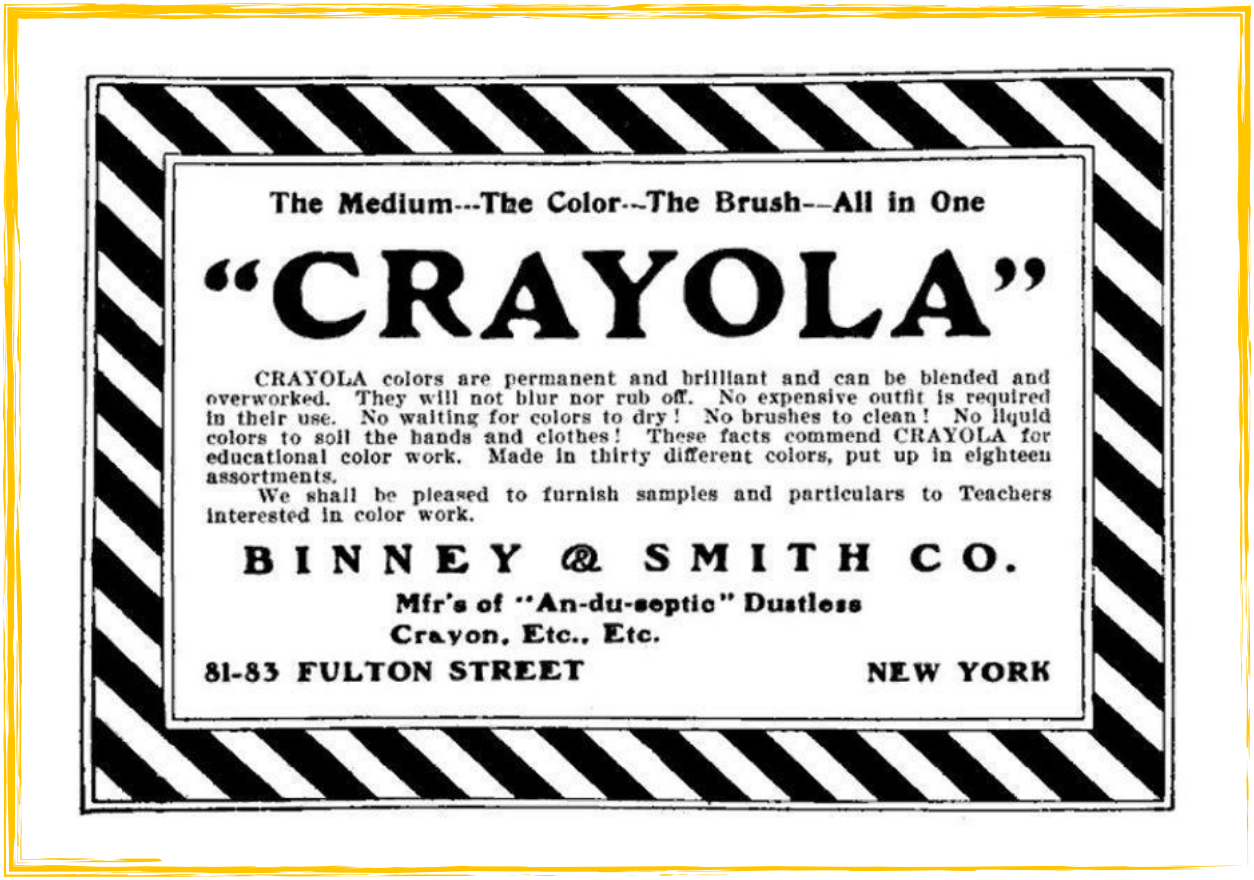
What do your teachers need in their classroom to make life easier for them and you? What do you think? What do your teachers think? In Part 2, you will work in groups to identify a problem at your school by listening and observing. Then you will define a design challenge for your group that solves this classroom problem. These are the same design thinking skills used in the Workshop during your field trip to *Crayola IDEAworks®: The Creativity Exhibition*. Who knows, someday your invention could be found in every classroom, right next to the Crayola crayons and markers!

Edwin Binney and C. Harold Smith founded the Binney & Smith Company, which we know today as Crayola.

Name Date

Part 1

This advertisement for Crayola crayons appeared in a magazine for New York teachers in 1905. Read the ad, then answer the questions that follow.



The Medium---The Color---The Brush---All in One

"CRAYOLA"

CRAYOLA colors are permanent and brilliant and can be blended and overworked. They will not blur nor rub off. No expensive outfit is required in their use. No waiting for colors to dry! No brushes to clean! No liquid colors to soil the hands and clothes! These facts commend CRAYOLA for educational color work. Made in thirty different colors, put up in eighteen assortments.

We shall be pleased to furnish samples and particulars to Teachers interested in color work.

BINNEY & SMITH CO.

Mfr's of "An-du-septic" Dustless Crayon, Etc., Etc.

81-83 FULTON STREET NEW YORK

1. What does the word "medium" mean in this advertisement? *The **Medium** – The Color – The Brush – All in One*

2. Which two adjectives describe Crayola colors in the first sentence of the paragraph?

3. What do you think "***blended and overworked***" means?

4. According to the advertisement, what are three ways crayons are better than paints?

5. In how many different colors did Crayola make crayons at that time?

6. What does the word "***furnish***" mean in this advertisement? We shall be pleased to furnish samples and particulars...

7. In 1905, the Crayola company was called "***Binney & Smith***" and "***crayon***" was sometimes used for chalk. What other Binney & Smith product is named in the ad?

In 1904, a box of Crayola crayons had eight colors and cost a nickel.

8. Explain in your own words how Crayola crayons helped teachers and students in 1905.

Part 2

This group project begins by asking your teachers "What do you need?" and ends with your plans for a new invention. These steps, part of the IDEA design process, will guide you. Answer the questions below as your group invents a new product for your classroom.

Step 1 IDENTIFY

Identify the problem. Interview teachers to ask them what would make life in the classroom easier. Your teacher will help you do the survey. If you can't contact other teachers, ask yourselves the same question: "What do we need to make life in our classroom easier?" What have you observed? Once you identify the problem your group wants to solve, it will become your design challenge.

What problem or need did your group identify?

Step 2 DEFINE

Define the details of the problem your group picked in **Step 1**. Your group will now do some research to investigate what has been done before. Do you need to invent something new? Did someone else try this idea before, but fail? How can you innovate or adapt something that already exists?

What did you discover during your investigation?

Step 3 EXPLORE

Brainstorm solutions to the need or problem you found in **Step 1**. Think outside of the crayon box. Be creative! No idea is too big or too small for this challenge. Keep a list of all of your group's ideas in case your first choice does not work out. Also, you may need to come back after Step 4 for inspiration to improve your design.

What is your group's best idea?

Explore and plan your solution. Explain its parts and how they work together. Make a diagram of your invention on separate paper. Label each part. Write a list of steps for how to use it. You might need to make a few diagrams before your group finds the right one. Think of this as the blueprint for a prototype. Make the final diagram of the invention big enough for the class to see during your group presentation.

How does your invention work? (Write a short summary.)

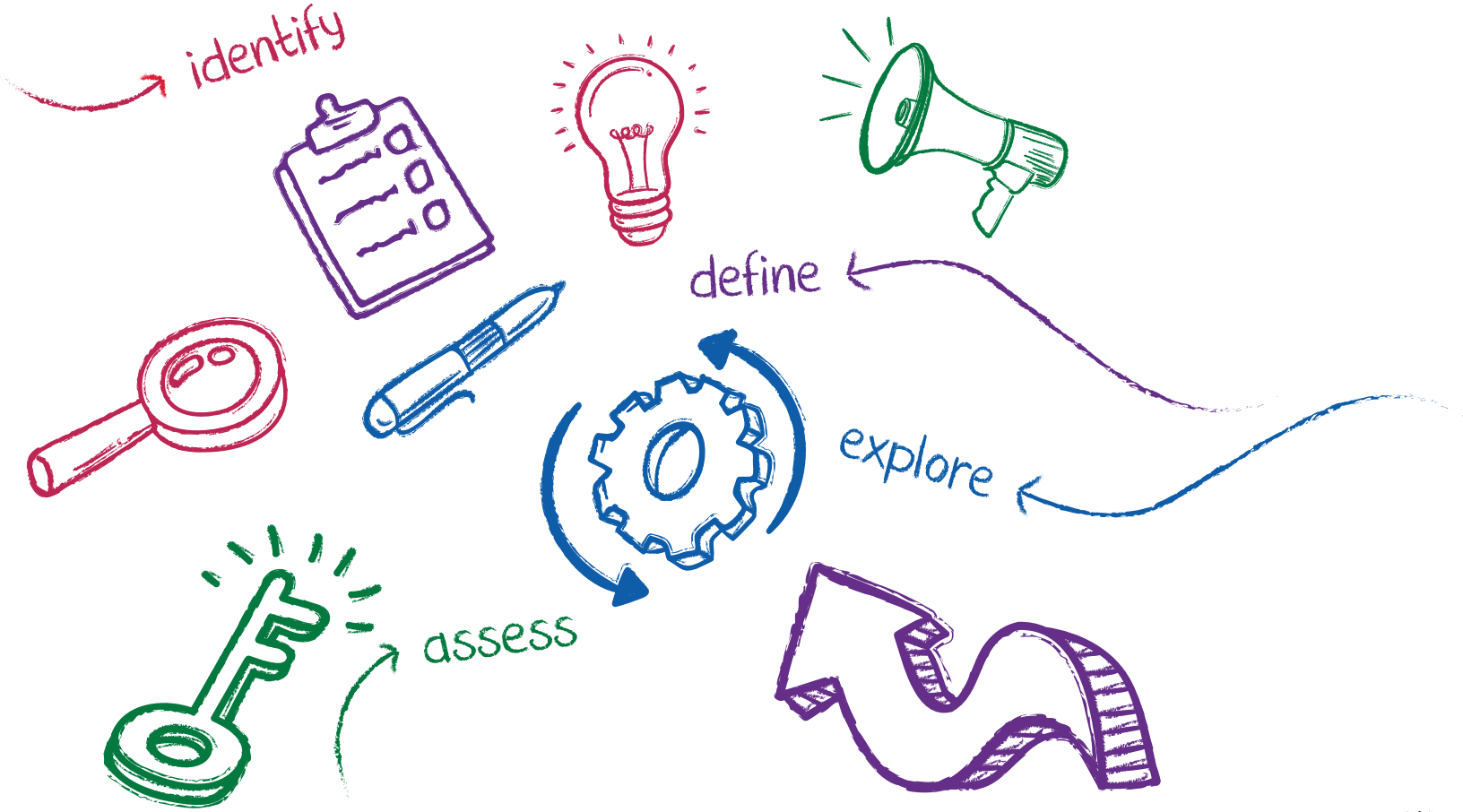
Present your invention to an audience – your class and your teacher. Begin with your group's challenge and your solution. Then use your diagram to describe the parts of your invention and how it works. Take questions. Ask everyone for ideas on how to make it even better. Take note of their suggestions. If you can, show your design to the teachers you interviewed at the beginning, too.

What feedback did you get on your design?

Step 4 ASSESS

Talk with your group about what you learned in **Steps 2 and 3**. You might need to rethink parts of your design based on what you learned from your work and from the feedback of your audience. Did they have useful questions and recommendations? Did their ideas give you new ideas?

How can your group improve your invention?



Grades 3-5 Lesson Plan 2

Pick & Pitch

Teacher Instructions and Key

A new community is being established on Mars in the Colorverse™ at *Crayola IDEAworks®: The Creativity Exhibition*. Your students will be challenged with producing enough food for the explorers living there. The differences between the atmospheres on Earth and Mars require innovation, invention, and inspiration in order to grow fruits and vegetables there. During your class field trip to *Crayola IDEAworks*, your students will use their critical thinking skills to tackle this problem at the Mars Garden. They will adjust the amount of light, water, and oxygen for plants living under a dome to produce as many pounds of food as possible.

Which plants do your students think should be in this first garden on Mars? In Part 1 of this lesson, they will work in teams to determine what is most important. Setting priorities is a design thinking skill your students will experience in the "Define" Workshop at *Crayola IDEAworks: The Creativity Exhibition*.

The plants that the teams select should meet certain conditions, from size and nutrition to growth rate and other uses. Food is the first priority, of course, but you can do many other things with plants. For example, since there won't be room to pack Crayola art supplies on this first trip, can the plants be used to make natural dyes? Students can choose two plants from a list provided or they can come up with their own. To guide their research, the teams will complete a chart with questions to help them evaluate the potential of their two plants.

In **Part 2**, each team will make a slide presentation explaining why their plants are best for the Mars station. Instruct your students on which format they should use, such as PowerPoint or Google Slides. The plant research completed in **Part 1** will become part of their presentation. Good thing practicing pitch skills is part of their field trip! The CER method (Claim, Evidence, and Reasoning) is useful for introducing scientific writing but feel free to use the opinion or argument writing method that best suits your students. At the end of the presentations, your class will reflect on their choices and take a vote on which two plants they recommend for the Mars Garden.

Answer Key

Part 1: Check for completion. The chart has 9 question rows and two plant columns, with a total of 18 spaces to be filled (18 points).

Part 2: 18 points total for the slide presentation:

- slide 1 = 3 pts
- slide 2 = 4 pts
- slide 3 = 4 pts
- slide 4 = 4 pts
- slide 5 = 4 pts

Pick & Pitch

Student Activities

Terms to Know: claim, colonist, evaluate, evidence, NASA, nutrition, pitch, potential, priority

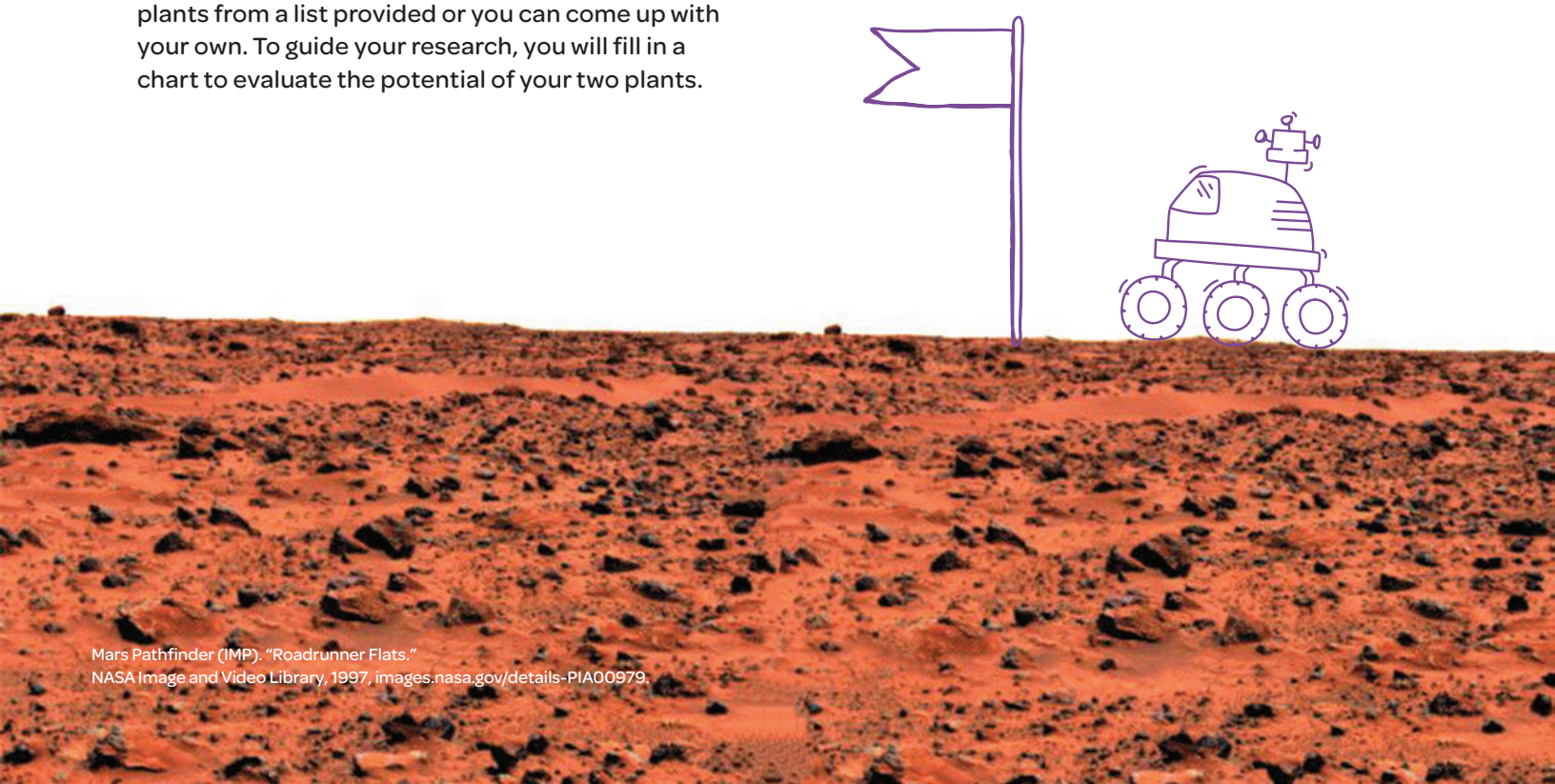
A new community is being established on Mars in the Colorverse™ at *Crayola IDEAworks®: The Creativity Exhibition*. You will be challenged with producing enough food for the explorers living there. The differences between the atmospheres on Earth and Mars requires innovation, invention, and inspiration in order to grow fruits and vegetables there. During your field trip to *Crayola IDEAworks*, you will tackle this problem at the Mars Garden. You will adjust the amount of light, water, and oxygen for plants living under a dome to produce as many pounds of food as possible.

Which plants do you think should be in this first garden on Mars? In **Part 1** of this lesson, you will work in teams to determine what is most important. Setting priorities is a skill you will practice in the "Define" zone of the IDEA Workshop at *Crayola IDEAworks: The Creativity Exhibition*.

The plants your teams select should meet certain conditions, from size and nutrition to growth rate and other uses. Food is the first priority, of course, but you can do many other things with plants. For example, since there won't be room to pack Crayola art supplies on this first trip, can the plants be used to make natural dyes? Your team can pick two plants from a list provided or you can come up with your own. To guide your research, you will fill in a chart to evaluate the potential of your two plants.

In **Part 2**, your team will make a slide presentation explaining why you picked the best plants for the Mars station. Good thing practicing your pitch skills is part of your field trip to *Crayola IDEAworks*! The plant research from **Part 1** will become part of your pitch. You will use it to support the claim, evidence, and reasoning in the slides your team makes. At the end of the presentations, your class will reflect on your choices and take a vote on which two plants they recommend for the Mars Garden.

Soil on Mars is unsafe for gardening so plants will grow in special greenhouses. This picture of the surface of Mars was taken in 1997 by Sojourner, a robotic NASA rover. NASA/JPL/USGS



Mars Pathfinder (IMP). "Roadrunner Flats."
NASA Image and Video Library, 1997, images.nasa.gov/details-PIA00979.

Name Date

Part 1: **Pick your Plants!**

Plants on this list are good options for Mars because scientists have already studied or tested them. Some grow well in the hydroponic systems that will be used in space. A hydroponic system is a way to grow plants without soil. Others already grow on the International Space Station (ISS) or in Mars-like conditions here on Earth. You are not limited to this list, however. Your team can pick any two plants that you think would be good for the Mars Garden.

Blueberries
Carrots
Cucumbers
Kale
Lettuces
Mint
Peanuts

Peppers
Potatoes
Quinoa
Radishes
Rice
Rye
Spinach

Soybeans
Strawberries
Sweet potato
Tomatoes
Wheat

Study your two plants by answering the questions in the chart on the next page. Begin your research in the media center and with your school's recommended safe search sites.

Huston, Cory, and NASA. "PONDS Watering System for Veggie." NASA Image and Video Library, 2018, images.nasa.gov/details-KSC-20180307-PH_CSH01_0001.

Three kinds of plants, including lettuce, in a growth chamber on the ISS were harvested in October of 2017. Both flowers and food grow on the ISS. NASA/Amanda Griffin.

Griffin, Amanda, and NASA. "Veggie Harvest." NASA Image and Video Library, 2017, images.nasa.gov/details-KSC-20171027-PH_AAG01_0001.

Tomato plant growth is tested inside a laboratory at NASA's Kennedy Space Center in Florida. They are growing on a system that could be used in space. NASA/Cory Huston.

NASA. "iss061e038290." NASA Image and Video Library, 2019, images.nasa.gov/details-iss061e038290.

NASA astronaut Christina Koch collects and packs mustard greens grown inside the ISS. The crew ate some and the rest were sent back to Earth for testing NASA.

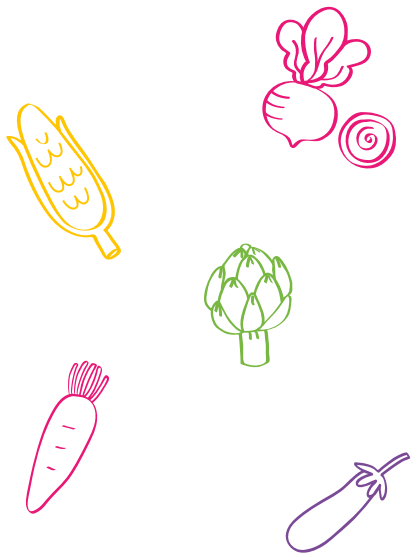






	Plant 1	Plant 2
1. Is it healthy? Which nutrients, vitamins, and minerals does it have?		
2. Can it be eaten raw? How much preparation or cooking does it need?		
3. How quickly does it grow? How long before there is enough to feed several people?		
4. How does it taste? Do most people want to eat it? Do you like it?		
5. Is it easy to grow more? How does it reproduce? Will it need pollinating?		
6. How big does it grow? Will it take up too much room?		
7. Can it be used to make natural dye? Is it safe to use in this way?		
8. Does it have uses as a medicine? How does it help?		
9. How else can it be used? What can be done with the parts of the plant you don't eat?		

Part 2: Plan your Pitch!



Now your team will make slides to pitch your plants to the class using claim, evidence, and reasoning. First state your claim that your teams' plants should go to Mars with the first explorers. Then give your evidence, which is the information you researched for in **Part 1**. Pick three of these facts about each plant to support your claim. You will explain the reasons why the evidence proves that your plants should be in the Mars Garden. Finally, your conclusion will describe how these two plants answer this question: **Which plants should be taken to the first community on Mars?** Think of your conclusion as a chance to advertise your plants to the class. Make a convincing and appealing pitch that they can't resist!

Use this guide for your slides. Remember to add images for your Mars Garden, including pictures of the plants your team picked.

Slide 1: Introduction (3 points)

- State your claim by answering this question: Which two plants should be taken to the first community on Mars?
- Add an image.

Slide 2: Plant 1, Evidence (4 points)

- 3 pieces of evidence (facts) you learned about Plant 1
- Add an image

Slide 3: Plant 1, Reasons (4 points)

- For each piece of evidence in slide 2, explain why that fact makes Plant 1 a good choice for a Mars Garden
- Add an image

Slide 4: Plant 2, Evidence (4 points)

- 3 pieces of evidence (facts) you learned about Plant 2
- Add an image

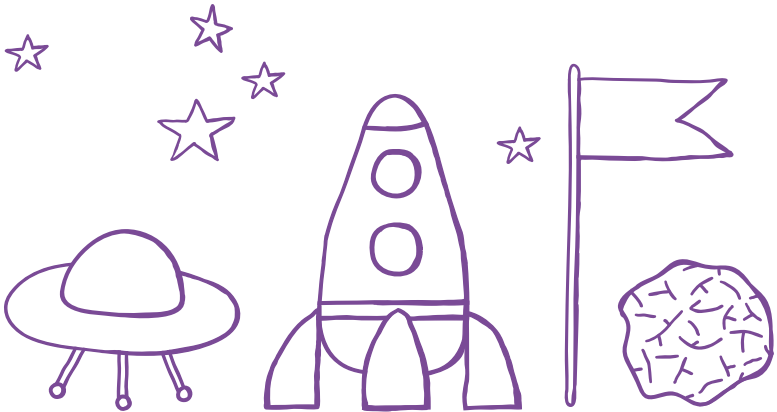
Slide 5: Plant 2, Reasons (4 points)

- For each piece of evidence in slide 4, explain why that fact makes Plant 2 a good choice for a Mars Garden
- Add an image

Slide 6: Conclusion (3 points)

- Restate your claim
- Add a final pitch or statement to convince your class that your team picked the best plants
- Add an image

After each team gives their pitch presentations, everyone will vote to select the two plants your class recommends for the first Mars Garden.



Grades 6-8 lesson Plan 1

Fuel the Future

Teacher Instructions and Key

The first color, a powder that Binney & Smith made, was black. In the late 1880s and early 1890s, they ground soot, added other ingredients, then packaged and sold it as a powdered pigment called carbon black. At the time, they worked from a small factory on the Hudson River in Peekskill, New York. However, they soon learned that the carbon black made with soot collected after burning natural gas, oil, and coal found in the mines of Pennsylvania was of much higher quality than what they were using.

Soon, Edwin Binney and C. Harold Smith considered moving to be closer to the sources for carbon black in Pennsylvania, where there were also many slate quarries. From the 1830s until World War II, Pennsylvania quarries produced more slate than anywhere else in the world. Mostly found in roofing shingles and building construction, it also had dozens of other uses. Blackboards at schools and individual writing tablets were made of slate. Students needed high-quality, slate pencils that were inexpensive and erased easily.

With the supply of slate scraps in the Pennsylvania quarries and the demand for slate pencils in schools, Binney & Smith wanted to bring these economic forces together. It was time for the company to examine its priorities. Should the factory stay in New York? What about the slate pencils? During your field trip to *Crayola IDEAworks®: The Creativity Exhibition*, your students will practice similar prioritizing steps to solve problems in the Workshop.

In **Part 1** of this lesson plan, students will examine maps to see what led Binney & Smith to a site on the Bushkill Creek for their first mill in Pennsylvania. In 1900, they bought a water-powered, stone grist mill from a man named Tilghman Kepler. Originally built in 1839, Kepler used it to grind grains that he sold in Easton. The new owners, Binney & Smith saw an opportunity to grind slate for pencils. Soon, they added talc and cement to the slate to invent their An-Du-Septic dustless chalk. This chalk, another product needed in schools, kept the air clean when blackboards were erased.

The Sanborn Map Company produced the maps your students will work with in **Part 1** of this lesson plan to compare and contrast Binney & Smith factory sites in 1904 and 1927. These fire insurance maps indicate building locations, distances, dimensions, of what materials buildings were constructed, the closest water sources, and other important details. The maps used in this lesson are in the public domain and available online from Penn State University Libraries:

- https://digital.libraries.psu.edu/digital/collection/maps1/id/7679/rec/4 1904
- https://digital.libraries.psu.edu/digital/collection/maps1/id/29200/rec/3 1927

For an extended comparison, another map of the same location is available from 1919: https://digital.libraries.psu.edu/digital/collection/maps1/id/8489/rec/2. If your students have difficulty viewing the fine print on the maps, offer magnifying glasses and they will become real historical detectives!

Over a century later, the Crayola company reviewed its priorities again. How was their factory fueled? Was there a better way? In 2010, Crayola began using renewable energy at its headquarters in Pennsylvania. They built a solar farm that produces enough power to make one billion crayons and save 1,900 tons of greenhouse gas per year. From water power at the beginning to solar power today—what will power Crayola factories in the next century? In **Part 2**, your students will work as part of a team to investigate and select the best source of renewable energy for large-scale industrial uses in the future. Each team will make a slide presentation for the renewable resource their group selected. Be sure to instruct your students on which format they should use, such as PowerPoint or Google Slides.

Answer Key

Part 1

1. 1904, slate pencils; 1927, slate pencils, chalk, crayons
2. 1904, made of wood; 1927, made of concrete
3. 1904, turbine waterwheel
4. Color
5. Each of the three features should be identified on both maps. The dam and head race are north of the mill and the tail race is south.
6. The railroad tracks on the maps, to the west of the factory, should be highlighted on both maps. Answers should include discussion of natural resources and raw materials, like slate and wax, coming in on the trains and finished products, like chalk and crayons, going out.
7. Answers will vary. Students may identify three of the many differences between the two maps.
8. Answers should explain its proximity to the natural resources they needed at the time and, most importantly, the roles of both a waterway and a railroad in the success of running their factory, based on the technology available in the early 20th century.

Part 2: 3 points per slide, 5 slides total = 15 points

Feuling the Future

Student Activities

Terms to Know: grains, grist, industrial, manufacturer, mill, panoramic, pigment, quarry, slate, talc, tannery, turbine

The first color, a powder that Binney & Smith made and sold, was black. In the late 1880s and early 1890s, they ground soot, added other ingredients, then packaged and sold it as a powdered pigment called carbon black. At the time, they worked from a small factory on the Hudson River in Peekskill, New York. However, they soon learned that the carbon black made with soot collected after burning natural gas, oil, and coal found in the mines of Pennsylvania was of much higher quality than what they were using.

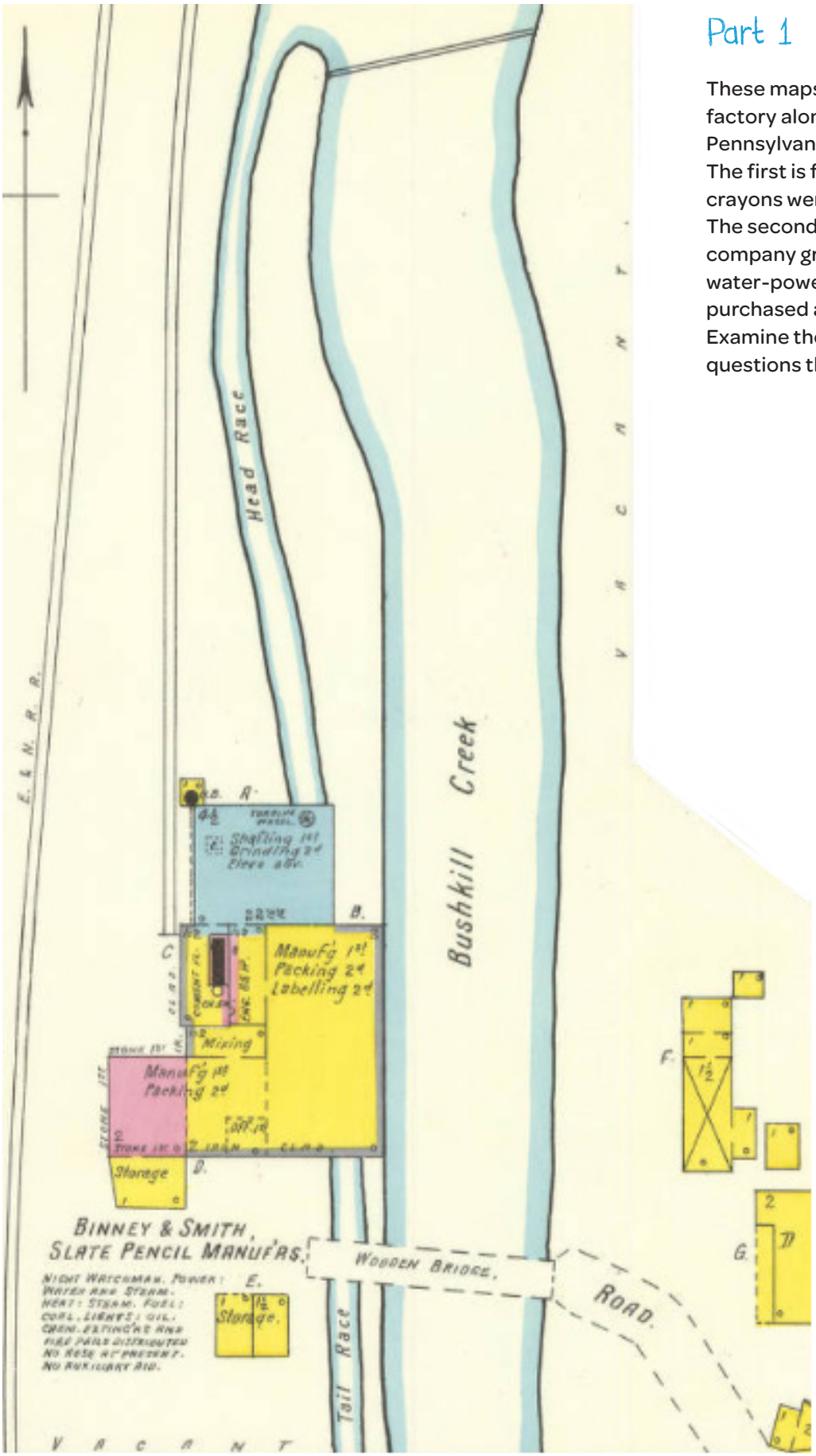
Soon, Edwin Binney and C. Harold Smith considered moving to be closer to the sources for carbon black in Pennsylvania, where there were also many slate quarries. From the 1830s until World War II, Pennsylvania quarries produced more slate than anywhere else in the world. Mostly found in roofing shingles and building construction, it also had dozens of other uses. Blackboards at schools and individual writing tablets were made of slate. Students needed high-quality, slate pencils that were inexpensive and erased easily.

With the supply of slate scraps in the Pennsylvania quarries and the demand for slate pencils in schools, Binney & Smith wanted to bring these economic forces together. It was time for the company to examine its priorities. Should the factory stay in New York? Should Binney & Smith invest in their red and black pigments equally? What about the slate pencils? During your field trip to *Crayola IDEAworks®: The Creativity Exhibition*, you will practice similar prioritizing steps in the Workshop –figuring out what's most important and what can wait.

In **Part 1** of this activity below, you will study historic maps to see what led Binney & Smith to a site on the Bushkill Creek for their first mill in Pennsylvania. In 1900, they bought a water-powered, stone grist mill from a man named Tilghman Kepler. Originally built in 1839, Kepler used it to ground grains that he sold in Easton. The new owners, Binney & Smith saw an opportunity to grind slate for pencils. Soon, they added talc and cement to the slate to invent their new dustless chalk. This chalk, another product needed in schools, kept the air clean when blackboards were erased.

Over a century later, the Crayola company reviewed its priorities again. How was their factory fueled? Was there a better way? In 2010, Crayola began using renewable energy at its headquarters in Pennsylvania. They built a solar farm that produces enough power to make one billion crayons and save 1,900 tons of greenhouse gas per year. From water power at the beginning to solar power today—what will power Crayola factories in the next century? In **Part 2**, you will work as part of a team to investigate a source of renewable energy for large-scale industrial uses in the future.

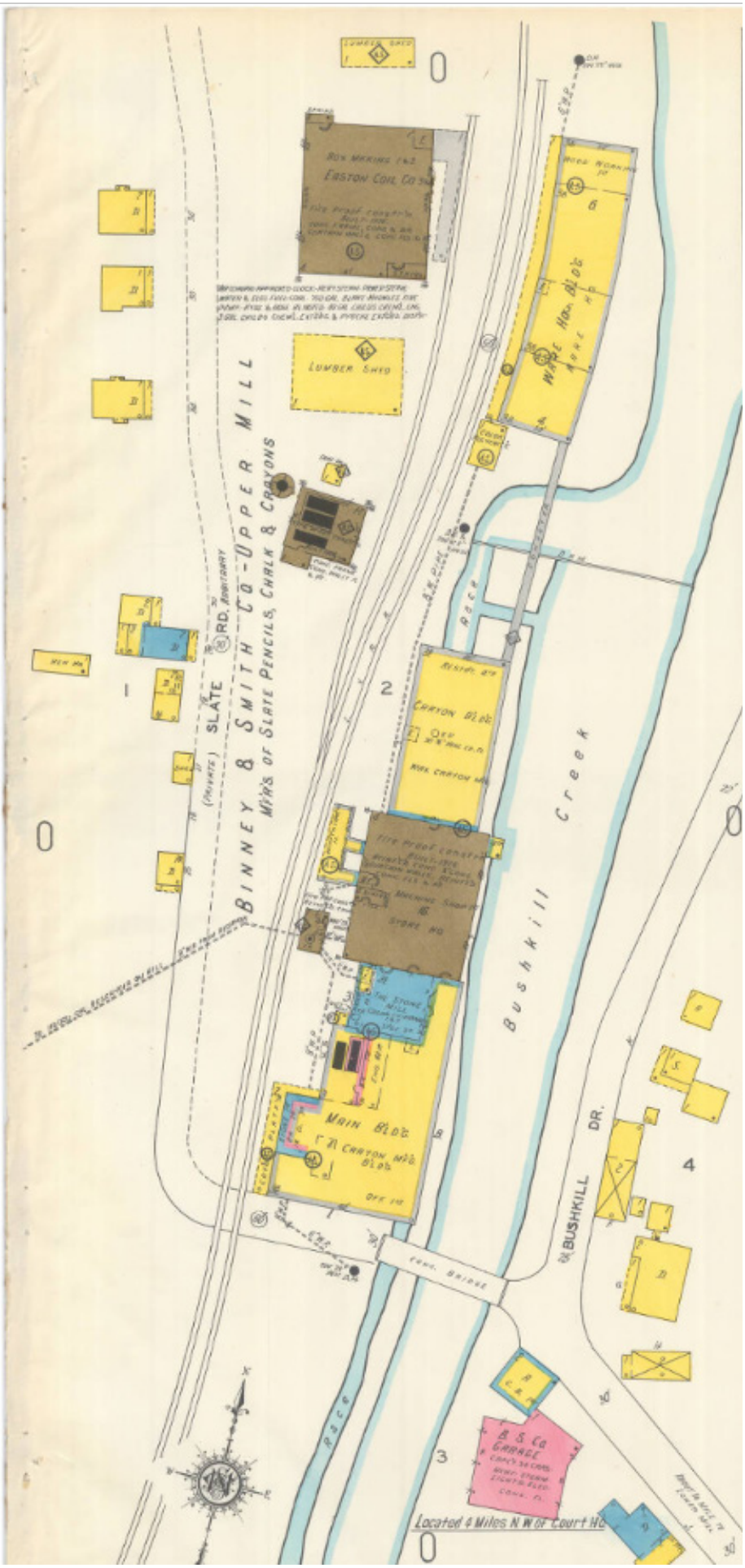
Name Date



Part 1

These maps show the Binney & Smith factory along the Bushkill Creek in Easton, Pennsylvania, during two times in history. The first is from 1904, when Crayola crayons were just becoming popular. The second, from 1927, shows how the company grew over 23 years. The original water-powered mill that Binney & Smith purchased appears in blue on both. Examine the maps closely and answer the questions that follow.

1904


BINNEY & SMITH CO - UPPER MILL
Mfrs. of SLATE PENCILS, CHALK & CRAYONS
LUMBER SHED
EASTON COIL CO
MAIN BLDG
CRAYON MFG BLDG
CRAYON BLDG
B. S. Co GARAGE
BUSHKILL DR.
Bushkill Creek
RACE
Located 4 Miles N.W. of Court Ho

1927

1. Find the titles of each of the maps. What was Binney & Smith known for manufacturing in 1904? In 1927?

2. How did the bridge over Bushkill Creek, south of the main factory, change between 1904 and 1927?

3. Which map identifies how water was used to power the original mill? What was the method?

Original stone mill, around 1900

4. According to the map, what was the original mill being used to grind in 1927?

5. For a water turbine to power a mill, first a dam is built across the source of running water. Then, some of the water is redirected to flow into the mill as a side stream called the head race. Once the water has turned the wheel, it exits on the other side of the mill through the tail race and rejoins the creek downstream. Circle each of these parts on both of the maps. Label them if they are not already identified on the maps.

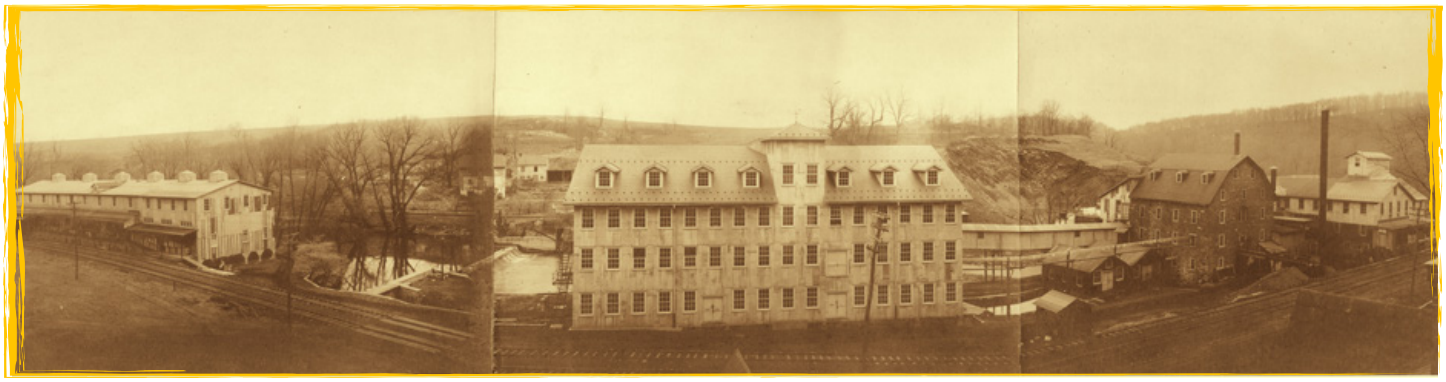
a. dam b. head race c. tail race

The Binney & Smith headquarters from 1916 until the 1970s, when they relocated to Forks Township. Can you find this building on the 1927 map? National Museum of American History, Archives Center: Binney & Smith, Inc. Records

6. Railroad tracks appear on both maps. In 1904, the Easton & Northern Railroad (E.&N.R.R.) served the Binney & Smith company. On the 1927 map, the track is labelled L.V.R.R., for the Lehigh Valley Railroad. Rail tracks crisscrossed this region to connect mines and quarries to manufacturers, and then from manufacturers to customers. Highlight the railroads on both maps. Then, explain both the resources and products the trains probably carried for Binney & Smith.

7. Identify three additional differences you see between the two maps.

8. Explain in your own words why Kepler's mill and its location on Bushkill Creek in Easton, PA, was a strategic spot for Binney & Smith to grow their company at the beginning of the 20th century.



A panoramic view of the mill looking east, taken from across the railroad tracks in 1961. Do you see the back of the old stone mill on the right and the dam and head race on the left?

A panoramic view of the mill looking west, taken from across Bushkill Creek in 1961. Do you see the dam on the far right and the top of the old stone mill on the left?

Part 2

Binney & Smith's first mill in Pennsylvania used hydropower on a small scale. Water flows in, turns a wheel connected to cogs and gears, and sets a mechanical process in motion to perform work. Modern hydropower plants operate on a vast scale and generate electricity for billions of people globally.

Knowing the dangers and limitations of fossil fuels, many companies want to use renewable resources to power their large factories. They are exploring which resources work best on an industrial scale. A few solar panels on the roof of your house may generate enough electricity for your family, but factories require massive amounts of energy to transform raw materials into finished goods. The Crayola solar farm contains 30,000 panels on 20 acres of land at their headquarters.

First water, now solar power. What's next? What do you think will run Crayola factories a century from now? Working in a group, investigate one of the renewable resources on this list or come up with your own. Maybe there are options scientists haven't considered yet but are still grounded in today's science and technology.

Geothermal
Biomass
Methane biogas
Biofuels
Wind power
Ocean thermal energy
Ocean tidal energy
Hydrogen

Begin your research in the media center at your school and on recommended safe search sites. The guide below will help you create a report with slides containing information about the energy source your group chose. The content you need to find is detailed for each slide. Present your findings to your class.

Slide 1 (3 points)

- Identify your renewable energy source
- Define the energy source
- Add an image

Slide 2 (3 points)

- Explain how it is harnessed and how it is used to produce energy
- Add an image

Slide 3 (3 points)

- Identify two benefits of using this source to power factories
- Add an image

Slide 4 (3 points)

- Acknowledge limitations or drawbacks, and whether they can be fixed
- Add an image

Slide 5 (3 points)

- Conclude by explaining why this is a good source for large-scale energy production in the future
- Recommend where factories should be located to make best use of the source
- Add an image

Crayola solar farm

Mathematics, Science, Arts
Statistics & Data, Earth Science, Life Science, Physical Science, Visual Art

Grades 6-8 Lesson Plan 2

Sounds of the Reef

Teacher Instructions and Key

Deep under the Colorverse™ Sea, a problem is brewing. Coral reefs are disappearing, and we need a way to help them repopulate. In the last 40 years, reef coverage around the world has declined 30 to 50%. In some places near Florida, the loss is close to 90%. Coral reefs aren't part of most people's daily lives, so their loss may not seem like a big deal. But healthy corals are important for humans. The reefs protect coastal communities from flooding and provide food, jobs, and tourism opportunities. Many of our medicines come from nature, and there are creatures that live nowhere but coral reefs that may hold the key to future cures for disease. Corals are the slow-growing animals that build the reefs, which becomes the habitat for everybody else who lives there.

Once corals are gone, they don't come back easily. Warming oceans affect the balance between corals and the algae they eat. When corals are stressed or dying, they lose their natural color. This is called "bleaching" because you can see the white skeleton of the corals. A bleached reef takes a long time to recover—if at all. Corals grow slowly under good conditions but under stress they may simply die off. Bleaching is not the only risk to coral reefs. Damage is also caused locally by humans who overfish and pollute the water.

Coral Reef Threats

Local	Global
Unsustainable fishing	Climate change
Water pollution	Ocean acidification
Habitat destruction	Ozone depletion

Because multiple factors threaten reefs, scientists and volunteers investigate the problem from as many angles as they can. For example, marine biologists look at ways to quickly grow corals in a protected environment and then transplant those corals into areas damaged by bleaching to restore the ecosystem. Experts need to identify which types of coral will survive best in changing conditions and then define the most effective places to restore damaged habitats. Biologists explore and assess ways to repair reefs by transplanting baby corals from human-built nurseries back into reef ecosystems. They have found that some species of staghorn coral can be harvested in the wild, grown in labs, and then successfully returned to damaged reefs.

The Fish Soundscape in the SeaBase at *Crayola IDEAworks®: The Creativity Exhibition* demonstrates another strategy. There, your students can create a "fish concert" by adding sounds back to a damaged reef to attract new fish and help restore this vital underwater ecosystem. How does this work? Scientists play the sounds of a healthy reef to attract the fish. It encourages young fish to repopulate a degraded reef by making it sound like a place where they would choose to live. Like any ecosystem, coral reefs have complex food webs. If too many herbivore species are overfished, too much seaweed-like algae grows on the reef and smothers the corals. If corals die from disease or bleaching, the reef structure

erodes, leaving less habitat and fewer hiding places for herbivorous fish to escape predators. Without herbivores, carnivores go hungry. By grazing algae, the herbivores clear space for baby corals to settle, giving them a chance to grow and compete for space on the reef. Without the recruitment of baby corals, a reef will have a hard time recovering.

In this lesson plan, your students will put their IDEA skills to work and analyze the amount of damage coral reef ecosystems in the United States have already endured, review the science of sound waves and how they are studied to help coral reefs, and then use visual interpretations of these vibrations to create signature sound art.

Notes for Part 3

Materials:

- Computer with internet access, microphone, and printer
- Suggested Crayola art supplies:
  - Paints: Tempera, Acrylic, Watercolor, Paint Brush Pens
  - Modeling Compounds: Air Dry Clay, Modeling Clay, Model Magic
  - Coloring & Drawing: Markers, Pearlescent Cream Sticks, Oil Pastels, Colored Pencils, Metallic Outline Paint Markers
  - Surfaces: Canvases, Card Stock, Construction Paper, Tracing Paper, Giant Paper Pad, Giant Marker & Watercolor Pad, Sketch Pad

Steps:

1. For this art project, students will need a digital image captured from a sound. There are several ways to accomplish this. Your students' school-issued devices may already come equipped with such software or your media and IT specialists may have programs they use. Begin by investigating those options. Several free online audio platforms only require a screenshot, print screen, or screen capture to save an image:

   https://musiclab.chromeexperiments.com/Spectrogram (also available as a smartphone app)

   https://www.audacityteam.org/

   https://twistedwave.com/online

2. Have students choose the sound they want to capture. Short phrases work best. It could be an important word or phrase like "Happy Birthday" or "I love you" if they are making the art as a gift or something personally meaningful for themselves. It could be a prerecorded tone that is visually appealing. Or it could be one of the spectrograms or waveforms from a reef to use in a campaign spreading awareness about the plight of the world's corals.

3. Students will perform and capture the images of their signature sound waves. After they have been saved, import the images into Google Docs or the photo editor software used by your school.

   Within that program, they will be able to crop, edit, rotate, adjust the contrast, change the colors, etc. as they see fit before printing the final product. Students can choose

between simply manipulating their image digitally and printing or using the printed version as inspiration.

4. Once printed, the image can be transferred to canvas, construction paper, or the surface of the student's choice and enhanced with Crayola art supplies. Your students might want to paint over the printed image, incorporate it in a drawing, use it as a model to recreate in 2D or 3D form, texturized as a collage—their signature sound wave art will truly be a one-of-a-kind voice print!

5. If your students need some inspiration or are having a hard time envisioning their final product, search for "signature sound wave art" images online for a variety of examples to show them.

6. Display the final projects as an art exhibit around the room. Make sticky notes available for students to leave positive feedback next to their classmates' work.

Answer Key

Part 1:

1. South Florida, it already starts at a low number

2. 0%, for both

3. ca. 2030, approximately 15%

4. No effect; the lines match. Florida's reefs are already so damaged that reducing greenhouse gases alone isn't enough to help them recover.

5. Atlantic = Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks. Pacific = Commonwealth of the Northern Mariana Islands, Guam, Hawaiian Archipelago, American
Samoa, Pacific Remote Island Areas.

6. 5/9 = 56%

7. a. no, b. Pacific

8. Answers will vary but should mention that more difficult access can mean less human contact and limited human use, thus less damage caused by humans.

9. Answers should mention the issues associated with local threats listed in the chart from the introduction (unsustainable fishing, water pollution, habitat destruction).

10. Florida is considered impaired, and already has extensive reef damage that will require great effort to recover. Hawaii scored "fair" and the coral coverage is greater than Florida's and can still benefit from reducing greenhouse gases.

Part 2: 1d, 2a, 3c, 4i, 5e, 6h, 7b. 8g, 9f, 10j

Sounds of the Reef

Student Activities

Terms to Know: acidification, acoustic, archipelago, crest, degraded, density, depletion, impaired, mitigation, trough, unsustainable

Deep under the Colorverse™ Sea, a problem is brewing. Coral reefs are disappearing, and we need a way to help them repopulate. In the last 40 years, reef coverage around the world has declined 30 to 50%. In some places near Florida, the loss is close to 90%. Coral reefs aren't part of most people's daily lives so that may not seem like a big deal. But healthy corals are important for humans. The reefs protect coastal communities from flooding and provide food, jobs, and tourism opportunities. Many of our medicines come from nature, and there are creatures that live nowhere but coral reefs that may hold the key to future cures for disease. Corals are the slow-growing animals that build the reefs, which becomes the habitat for everybody else who lives there.

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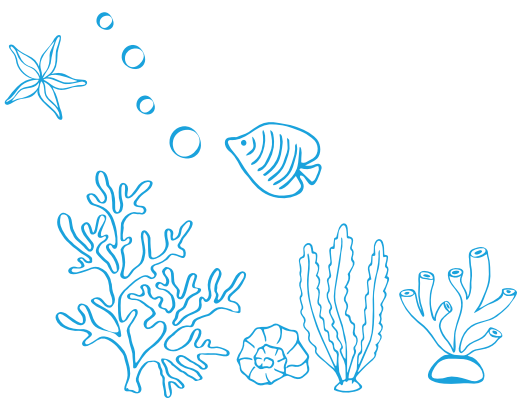
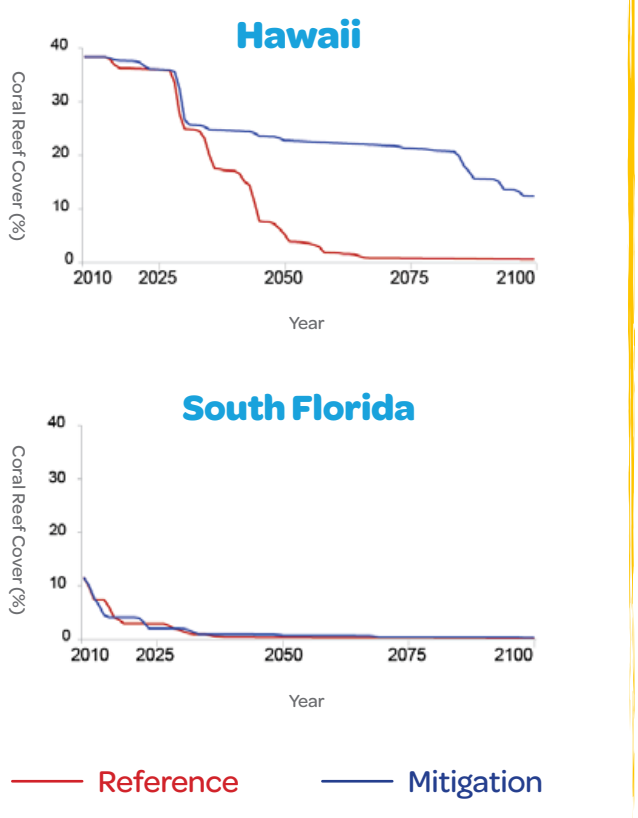
In the activities below, you will analyze the amount of damage coral reef ecosystems in the United States have already endured, review the science of sound waves and how they are studied to help coral reefs, and then use visual interpretations of these vibrations to create signature sound art.



Name Date

Part 1

An increase in greenhouse gases from human pollution, like carbon dioxide and methane, is connected to climate change and rising ocean temperatures. Warmer oceans are perhaps the greatest global threat to coral reefs. They cause bleaching events that damage and kill coral reefs. Scientists hope that if we start reducing greenhouse gases now, we can save reefs in the future. The line graphs below show the percent change in coral reef cover in Hawaii and South Florida. The blue line is the change in coral cover predicted with global greenhouse mitigation and the red line is without any intervention. Use these two graphs to answer questions #1-4.



U.S. Environmental Protection Agency, Climate Actions Benefit Report, Coral Reefs, https://www.epa.gov/cira/climate-action-benefits-coral-reefs

1. The y-axis (vertical) on both line graphs show the percent of reef area in each location covered by living coral. Which of the two ecosystems, Hawaii or South Florida, had lower coral coverage at the start of this study in 2010? How can you tell?

2. The red lines on the graphs are reference lines. They predict coral coverage amounts if we do not make any changes in greenhouse gas emissions. By the year 2100, what percent of these regions are predicted to still be covered by living corals if nothing is done to reduce greenhouse gases and, therefore, lower ocean temperatures?

3. The blue lines predict what the coral coverage could be with mitigation (reducing greenhouse gases). When are the effects of mitigation predicted to start making a difference in Hawaii? What percent of these regions are predicted to still be covered by living corals in 2100 if greenhouse gases are reduced?

4. Describe the effect that reducing greenhouse gases is predicted to have on coral reefs in South Florida. What conclusion can you make from the data?

Next, use this chart to complete questions #5-10. It lists the conditions of nine major U.S. coral reef ecosystems as graded by NOAA, the National Oceanic and Atmospheric Administration.

Status of U.S. Coral Reef Ecosystems

Reef Ecosystem	Ocean	Score
Florida		**Impaired**
Puerto Rico		**Fair**
U.S. Virgin Islands		**Fair**
Commonwealth of the Northern Mariana Islands		**Fair**
Guam		**Fair**
Hawaiian Archipelago		**Fair**
Flower Garden Banks		**Good**
American Samoa		**Good**
Pacific Remote Island Areas		**Good**

5. Use an atlas to locate the nine U.S. coral reef ecosystems. Two are near states and the others are in American territories and commonwealths. Fill in the "Ocean" column in the chart with either "Atlantic" (including the Caribbean Sea and the Gulf of Mexico) or "Pacific."

National Oceanic and Atmospheric Administration Coral Reef Information System, National Coral Reef Monitoring Program Status Reports, www.coris.noaa.gov/monitoring/status_report/

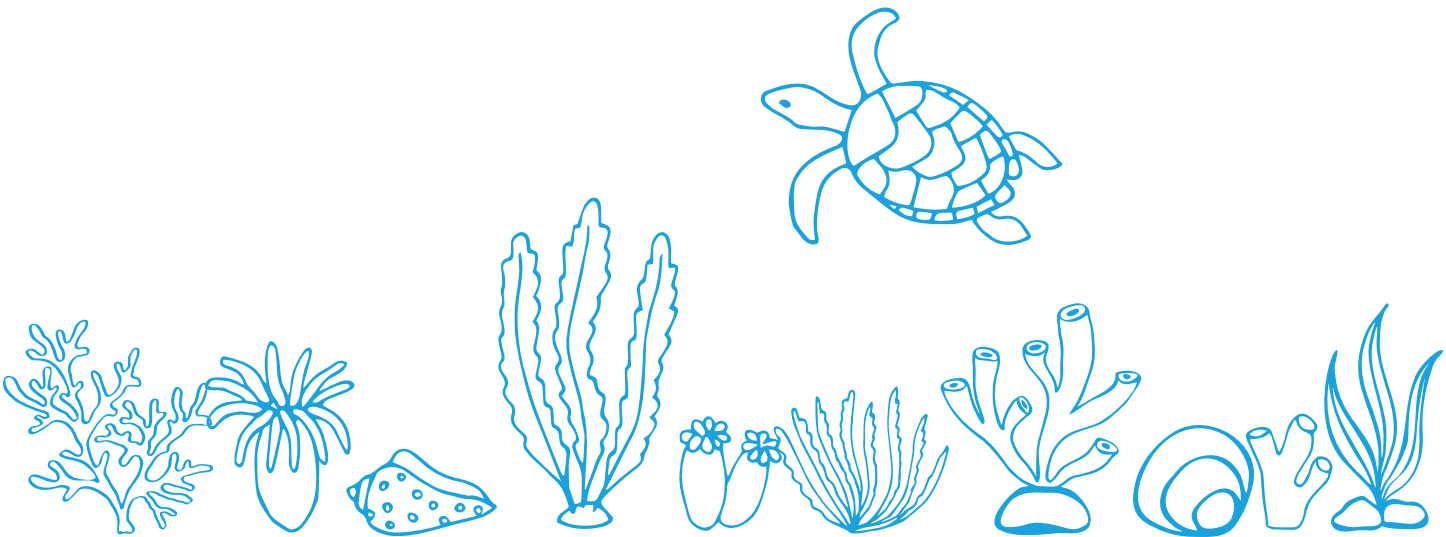
6. What percent of the U.S. reef ecosystems scored "fair" in their condition reports?

7. a. The highest-ranking score possible in the status report is "very good." Do any of the reefs meet those conditions?
b. Overall, which ocean's reef ecosystems are in better condition?

8. The Flower Garden Banks reef are located in deep waters and harder to access than the other Atlantic Coast reefs. How might that account for their score, compared to others in the same ocean?

9. Florida's reefs are impaired. How does Florida's human its population and the popularity of its beaches put its reefs at great risk from local threats?

10. For Hawaii and Florida, how do the scores in this chart support the predicted coral coverages in the line graphs you used for questions #1-5? Explain.



Part 2

What does a healthy reef sound like? Whether they are eating, looking for mates, or protecting their habitat, the residents of a reef have a lot to "say." It's a noisy world if you know how to listen or where to look. Sound waves travel faster and farther through water than through air, especially in seawater because of the greater density of particles to transmit vibrations. Use this matching activity as a quick review of the science of sound before you begin turning images of sound waves into works of art.

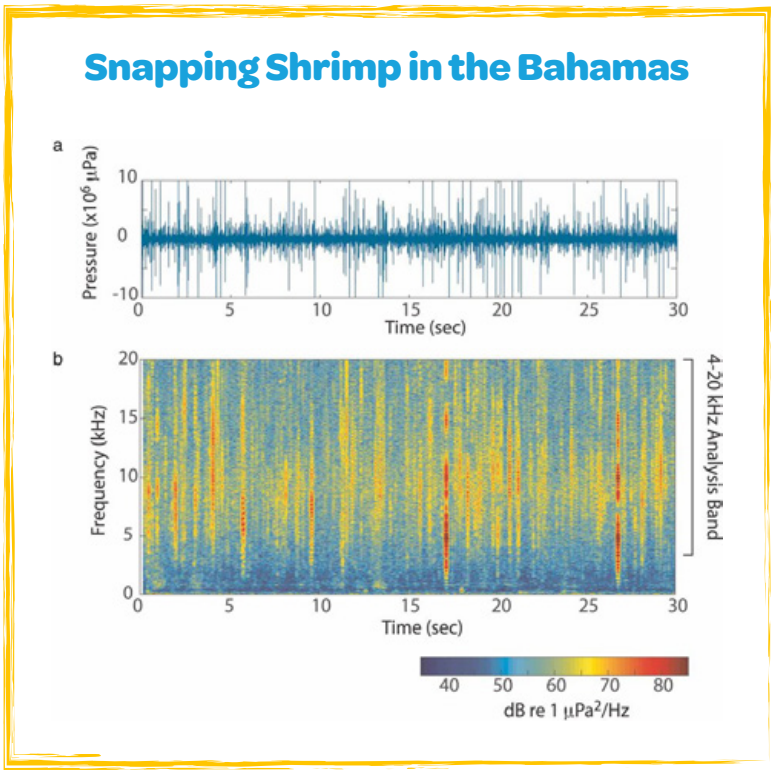
a. Amplitude
b. Compression
c. Decibel
d. Frequency
e. Hertz
f. Intensity
g. Longitudinal
h. Rarefaction
i. Wavelength
j. Medium

1. _____ number of vibrations, or complete waves or cycles, produced in one second; humans hear it as pitch
2. _____ measure of how powerful sound waves are in terms of pressure, it is the maximum displacement from equilibrium, the distance to a compression or a rarefaction
3. _____ unit of measure for a sound's intensity
4. _____ minimum distance in which a sound wave repeats itself, the length of one complete wave cycle; for example, the distance between one compression and the next
5. _____ unit of measure for a sound's frequency
6. _____ point in a longitudinal wave where pressure is lowest and particles are furthest apart, seen as a trough on a graph
7. _____ point in a longitudinal wave where pressure is highest and the particles are closest together, seen as a crest on a graph
8. _____ a mechanical wave, also called compressional, in which pressure moves particles parallel with the direction of the wave
9. _____ amount of energy a wave carries past a certain point each second; humans hear it as loudness
10. _____ matter through which a sound wave travels; can be a gas, liquid, or solid

Part 3

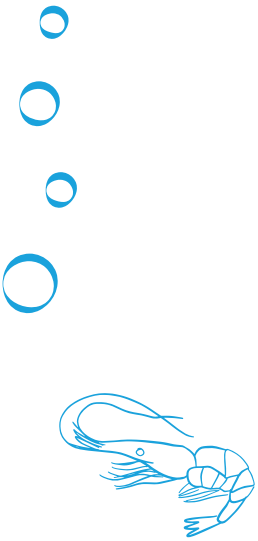
When scientists study sounds to attract life to a degraded coral reef, they need to know which tones appeal to the animals. But humans don't hear the same way as fish do, so we use special acoustic equipment to examine their sounds, which can be visualized as graphs. In some views, a compression is a crest and a rarefaction is a trough. In others, frequencies are different colors. Graphing sound wave amplitudes and frequencies creates an image as unique as a fingerprint and as stunning as a work of art.

Here, https://freesound.org/people/jeo/sounds/479072/, you can both see and hear the sound from a chorus of fish off the coast of Australia at dawn. Listen and see the sounds of more fish here: https://dosits.org/galleries/audio-gallery/#fish. The grunts, knocks, rasps, buzzes, and pulses all have meanings. They vary depending on whether the animal is trying to attract a mate, defend a nest, threaten a competitor, ward off a predator, or even just eat.



Bohnenstiehl, D. & Lyon, R. & Caretti, Olivia & Ricci, Shannon & Eggleston, David. (2018). Investigating the utility of ecoacoustic metrics in marine soundscapes. Journal of Ecoacoustics. 2. R1156L. 10.22261/JEA.R1156L. Available via license: Creative Commons Attribution 4.0 International.

Fish tend to produce lower frequency sounds. Invertebrates, like shrimp, make higher frequencies. Listen to snapping shrimp, some of the loudest animals on Earth, on the Great Barrier Reef in Australia: https://www.nhm.ac.uk/content/dam/nhmwww/discover/audio/sound-of-coral-reef.mp3. In the images to the left from snapping shrimp in the Bahamas, the pressure of the sound wave is on the top and the frequency is in the bottom graph. This is called a spectrogram.



With the help of technology you probably already have at school, you will create unique and meaningful pieces of art by capturing and elaborating images from sea creatures or of your own voice. Your signature sound art can range from printing a screenshot to recreating the rainbow of a spectrogram with paints to sculpting a 3D model of your own voice waveform. Your IDEA skills will come in handy!

Materials:

- Computer with internet access, microphone, and printer
- Suggested Crayola art supplies:
  - Paints: Tempera, Acrylic, Watercolor, Paint Brush Pens
  - Modeling Compounds: Air Dry Clay, Modeling Clay, Model Magic
  - Coloring & Drawing: Markers, Pearlescent Cream Sticks, Oil Pastels, Colored Pencils, Metallic Outline Paint Markers
  - Surfaces: Canvases, Card Stock, Construction Paper, Tracing Paper, Giant Paper Pad, Giant Marker & Watercolor Pad, Sketch Pad

Steps:

1. Follow your teacher's instructions on how to use the app or program to digitally capture and save a sound image.

2. Decide on the sound you want to capture. Short phrases work best. It could be an important word or phrase like "Happy Birthday" or "I love you" if you are making the art as a gift or something personally meaningful for yourself. It could be a prerecorded tone that is visually appealing. Or it could be one of the spectrograms or waveforms from a reef to use in a campaign spreading awareness about the plight of the world's corals.

3. Perform and capture the image of your signature sound wave. After it has been saved, import the image into Google Docs or the photo editor software used by your school.

4. Within that program, you can crop, edit, rotate, adjust the contrast, change the colors, etc. before printing the final product. You can choose between simply manipulating the image digitally and printing or using the printed version as inspiration.

5. Once printed, the image can be transferred to canvas, construction paper, or the surface of your choice and enhanced with Crayola art supplies. You might want to paint over the printed image, incorporate it in a drawing, use it as a model to recreate in 2D or 3D form, texturize it as a collage—your signature sound wave art will truly be a one-of-a-kind voice print!

6. Work with your teacher to organize and display your sound art in a special classroom exhibition. Write a label that explains the inspiration for your sound wave.

THE IDEA DESIGN THINKING PROCESS

Creativity isn't just a talent, it's a skill students can learn, practice, and use to bring their ideas and plans to life. In fact, Crayola has been innovating, inventing, and influencing creativity for over 100 years! In *Crayola IDEAworks®: The Creativity Exhibition*, your class will develop Design Thinking skills in the Workshop before they enter the Colorverse™ to put them to the test. There, they will travel to the city, into space, and under the sea to use their new IDEA skills to solve problems based in current science.

Why is Design Thinking important?
Considering the rapidly changing world in which we live, today's students need to be adaptable and flexible in their thinking in order to be prepared to face new situations. Design Thinking is a tool you can use with your students to help them develop confidence in their abilities to respond to contemporary challenges. How? By being able to identify and create innovative solutions in an empathetic, insightful, and understanding way.

What is Design Thinking?
It is an inventive process through which problems are identified, solutions are proposed and produced, and results are evaluated. At the core of Design Thinking is flexible problem solving for people. Promoting this human centered approach means framing problems by describing them as human needs. The success of these ideas depends on how accurately and deeply they address the problems that others face. This process requires students to interview people about their needs or ask themselves what it's like to be that person.

What can Design Thinking look like in your classroom?
For questions that need answers or challenges that must be met in any content area, students work together to agree on the criteria for their design solutions. After selecting their tools and materials, they support each other to produce a working prototype. With feedback from the group, teams modify and improve their design before they test it in the context it will be used. Finally, it's time to reflect: What worked? What didn't? Why? The skills and habits required of students who effectively "design think"—including creativity, persistence, adaptability, and collaboration—are the same skills and habits that will make them successful in the classroom and beyond.

IDENTIFY

Find the intended problem to be solved along with the desired outcomes. Cultivate empathy and understanding for the people who need this solution.

DEFINE

Investigate and develop the required knowledge and skills supported by teacher-led instruction, guided practice, and reflection.

EXPLORE

Brainstorm, sketch, write, experiment and construct prototypes. Create, reflect, revise to select the most effective design solution.

ASSESS

Present, explain, and test the solution with an audience. Consider feedback for improvement and connection to real-life applications.

A CRAYOLA CHRONOLOGY

TEACHERS:
Below is a timeline of significant moments in the colorful history of Crayola. This information can be used in your classroom:

- For exercises in historical geography, by mapping specific locations related to the Crayola story.
- As a resource for biographies of key people involved in the development of the Crayola brand.
- To develop group study aids, such as trivia contests and game or quiz shows. As writing prompts and research project topics across the curriculum.
- As writing prompts and research project topics across the curriculum.

1864 Joseph Binney founds Peekskill Chemical Works in upstate New York to manufacture carbon black.

1880 Joseph Binney sets up his headquarters in New York City. His son, Edwin, and nephew, C. Harold Smith, soon join the company.

1885 Joseph Binney retires. Edwin and C. Harold Smith form a partnership, "Binney & Smith." They make the red oxide pigment in barn paint and carbon black in car tires.

1891 Edwin Binney receives a patent on May 26 for his invention to efficiently manufacture carbon black.

1900 Binney & Smith makes slate school pencils at the company's new mill on Bushkill Creek in Easton, PA. They win a gold medal for their inexpensive black color "Peerless Black" at the Paris Exposition.

1902 Binney & Smith works on the first dustless school chalk. The company serves as a general distributor for several carbon black producers, introducing it to other countries. They develop the Staonal black wax marking crayon, which leads to inventing Crayola crayons.

1903 The first box of eight crayons sells for a nickel. Alice Binney, Edwin's wife and a former teacher, comes up with the name Crayola: "craie," the French word for "chalk," and "ola," for "oleaginous," or "oily."

1904 The company wins a gold medal at the St. Louis World Exposition for their An-Du-Septic Dustless Chalk.

1911 C. Harold Smith, the "Carbon King," works with the B.F. Goodrich Company to use black carbon in their car tires.

1913 Binney & Smith introduces Rubens drawing crayons for art students.

1922 Binney & Smith produces watercolor paints.

1931 C. Harold Smith dies.

1934 Edwin Binney dies.

1936 Binney & Smith is a founding member of the Crayon, Watercolor, and Craft Institute to promote product safety in art materials. Today it is the Art & Creative Materials Institute.

1943 James Wright accidentally discovers Silly Putty.

1948 Binney & Smith offers in-school workshop training for teachers across the country, which continues today.

1949 The company introduces a box of 48 crayons and begins selling products in stores, not just to schools.

1952 Binney & Smith opens a factory in Winfield, KS, to handle their growing business. An inventor named Sidney Rosenthal creates a felt-tip marking tool that becomes known as a marker.

1958 Binney & Smith debuts the Crayola 64 Box with a built-in sharpener. Prussian blue becomes "Midnight Blue." It is the first Crayola crayon color to get a new name.

1959 The Crayola 72-crayon box is introduced with 73 crayons due to a last-minute packaging change.

1962 "Pink Beige," the "flesh" crayon color becomes "Peach," because not everyone has the same skin color.

1969 The company opens an additional factory in Easton, PA, to keep up with their growth.

1975 Binney & Smith opens a factory in Pastaje, Mexico.

1976 The company headquarters relocates from New York City to Forks Township, PA.

1977 Silly Putty joins the Binney & Smith family of products.

1978 Crayola crayons celebrate their 75th anniversary and Crayola markers are introduced.

1984 The Crayola brand becomes part of Hallmark Cards, Inc. of Kansas City, MO. The Crayola Dream-Makers program is launched in schools across the country.

1987 Washable markers are introduced.

1988 Crayola introduces colored pencils.

1990 Eight crayon colors are retired: Maize, Lemon Yellow, Blue Gray, Raw Umber, Green Blue, Orange Red, Orange Yellow, and Violet Blue.

1992 Crayola introduces skin-tone based, multicultural crayons to let children accurately depict themselves.

1993 Consumers name 16 new Crayola crayon colors in honor of the brand's 90th birthday, including Purple Mountains' Majesty, Razzmatazz, Timberwolf, Cerise, and Shamrock.

1996 Fred Rogers of "Mister Rogers' Neighborhood" makes the 100 billionth Crayola crayon.

1998 A 1958 Crayola 64 box becomes part of the Smithsonian Institution's National Museum of American History. Crayola crayons are inducted into the National Toy Hall of Fame in Rochester, NY.

1999 For the third time in Crayola history a crayon is renamed when "Indian Red" becomes "Chestnut."

2000 The Color Census, the first online poll of consumers' favorite Crayola Colors, ranks blue as #1.

2001 Silly Putty is inducted into the National Toy Hall of Fame.

2002 Kids can reuse and recycle crayons by melting down old ones to make new ones with the Crayola Crayon Maker, named Best Toy of the Year by Child Magazine.

2003 Binney & Smith celebrates 100 years of making the world a more colorful place. The World's Largest Crayon, is unveiled on October 11 in Easton, PA: 1,500 lbs., 15 ft. high, 16 in. wide, in America's favorite color, blue.

2005 Crayola commissions a national survey that reveals that if kids could erase a problem from the world, it would be violence. Crayola donates $100,000 to Students Against Violence Everywhere (SAVE) to support anti-violence education programs.

2007 On January 1, Binney & Smith is officially renamed Crayola.

2008 Crayola celebrates the 50th Birthday of its famous 64-ct. crayon box.

2010 Crayola first offers art tools specifically for babies and toddlers.

2011 Crayola Solar Farm is completed with more than 30,000 solar panels producing three megawatts of electricity—enough to make one billion crayons and 700 million markers a year. The National Inventors Hall of Fame inducts Edwin Binney in recognition for his 1891 invention to manufacture carbon black.

2012 Sally Putnam-Chapman, co-founder Edwin Binney's great-granddaughter, dedicates Edwin's Garden on Crayola property. The garden produces one ton of vegetables per year, donated to feed local children.

2013 Crayola celebrates 110 years of manufacturing crayons. Crayola launches ColorCycle for K-12 students to collect used markers and send them in to be converted into energy.

2017 A new color, Bluetiful, is introduced. Scientists discovered it accidentally in 2009 while experimenting with materials used in electronics.

Sources

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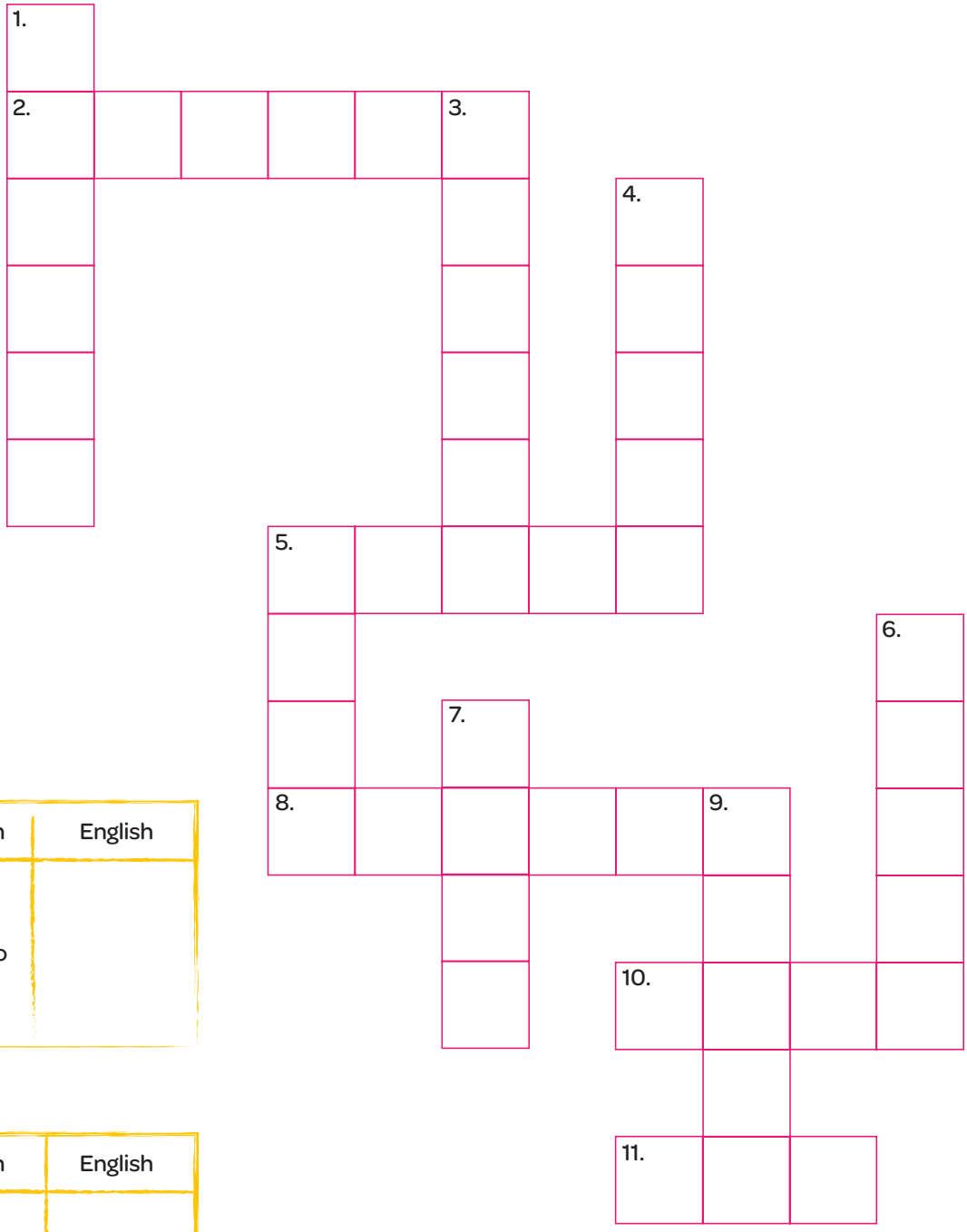
- https://www.crayola.com/-/media/Crayola/About-Us/History/CrayolaTimeline_2016
- http://www.crayola.ca/about-us/company-profile/history.aspx
- http://www.crayola.co.uk/about-us/company-profile/history.aspx
- http://www.crayola.be/about-us/company-profile/histoire.aspx
- https://www.toyhalloffame.org/toys

Name Date

Crossword Puzzle: Colorful in Any Language

The 12-box of crayons contains a dozen of the most requested colors in the Crayola collection. Since crayons are available on every continent in the world (except for Antarctica), their labels appear in multiple languages. Translate these popular French and Spanish colors into English and then complete the crossword. HINT: You may want to have a 12-box of crayons nearby!



Across

	French	Spanish	English
2.	indigo	indigo	
5.	vert	verde	
8.	jaune	amarillo	
10.	rose	rosado	
11.	rouge	rojo	

Down

	French	Spanish	English
1.	violet	violeta	
3.	orange	naranja	
4.	brun	café	
5.	gris	gris	
6.	noir	negro	
7.	bleu	azul	
9.	blanc	blanco	

Name Date

Word search: Names in Nature

Where do crayons get their names? Bluetiful, one of the newest colors, was discovered by scientists experimenting with electronics. The colors hidden in this word search, all inspired by Mother Nature, are named after plants—including fruits and vegetables. Creativity is everywhere, naturally.

Y	T	T	W	H	O	B	Y	D	G	R	A	K	V	S
V	N	W	N	R	C	N	N	O	T	E	P	Z	A	U
Z	J	P	C	A	A	A	L	B	M	D	R	V	M	B
R	Y	H	E	G	L	D	A	F	A	N	I	R	A	P
K	I	W	O	R	E	P	Y	B	L	E	C	G	S	R
D	R	H	Z	N	I	W	G	S	C	V	O	G	P	B
J	A	Z	R	I	V	W	I	G	I	A	T	M	A	V
M	N	O	L	E	M	O	I	S	E	L	Q	E	R	J
L	D	P	L	Y	P	V	K	N	T	U	I	X	A	N
S	H	A	M	R	O	C	K	O	K	E	N	X	G	Y
C	O	R	N	F	L	O	W	E	R	L	R	E	U	N
I	Y	W	M	O	E	Q	Z	S	I	M	E	I	S	V
O	G	U	W	Q	K	W	R	I	D	T	F	D	A	W
Y	L	I	S	M	M	P	E	A	C	H	C	B	Y	K
P	X	H	N	T	U	N	T	S	E	H	C	A	L	W

APRICOT
ASPARAGUS
CHESTNUT
CORNFLOWER
EGGPLANT
FERN
GOLDENROD
LAVENDER
MAHOGANY
MELON
ORCHID
PEACH
PERIWINKLE
PLUM
SHAMROCK
WISTERIA

Name Date

Cryptogram: Drawing Inspiration

On June 1, 1981, Mister Rogers' Neighborhood aired an episode called "Competition." In it, he draws a house with crayons and makes this comment as a way of expressing feelings of contentment with your own limitations.

Use the key to match the numbers to their letters to solve the puzzle. Two of the letters have been filled in to get you started (A = 8 and D = 15).

Key

A	B	C	D	E	F	G	H	I	J	K	L	M
8	23	9	15	7	24	5	25	4	18	14	21	22

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
20	3	11	6	26	12	1	16	13	2	17	19	10

D
15 | 3 19 | 3 | 16 21 | 4 | 14 | 7 1 | 3 d a
15 | 26 | 8 | 2

2 | 4 | 1 | 25 a
9 | 26 | 8 | 19 | 3 | 20 | 12 ? 4 ‘ 22 20 | 3 | 1

13 | 7 | 26 | 19 d
5 | 3 | 3 | 15 a
8 | 1 4 | 1 . 23 | 16 | 1

4 | 1 d
15 | 3 | 7 | 12 | 20 ‘ 1 22 | 8 | 1 | 1 | 7 | 26 .

4 | 1 ‘ 12 1 | 25 | 7 24 | 16 | 20 3 | 24 d
15 | 3 | 4 | 20 | 5

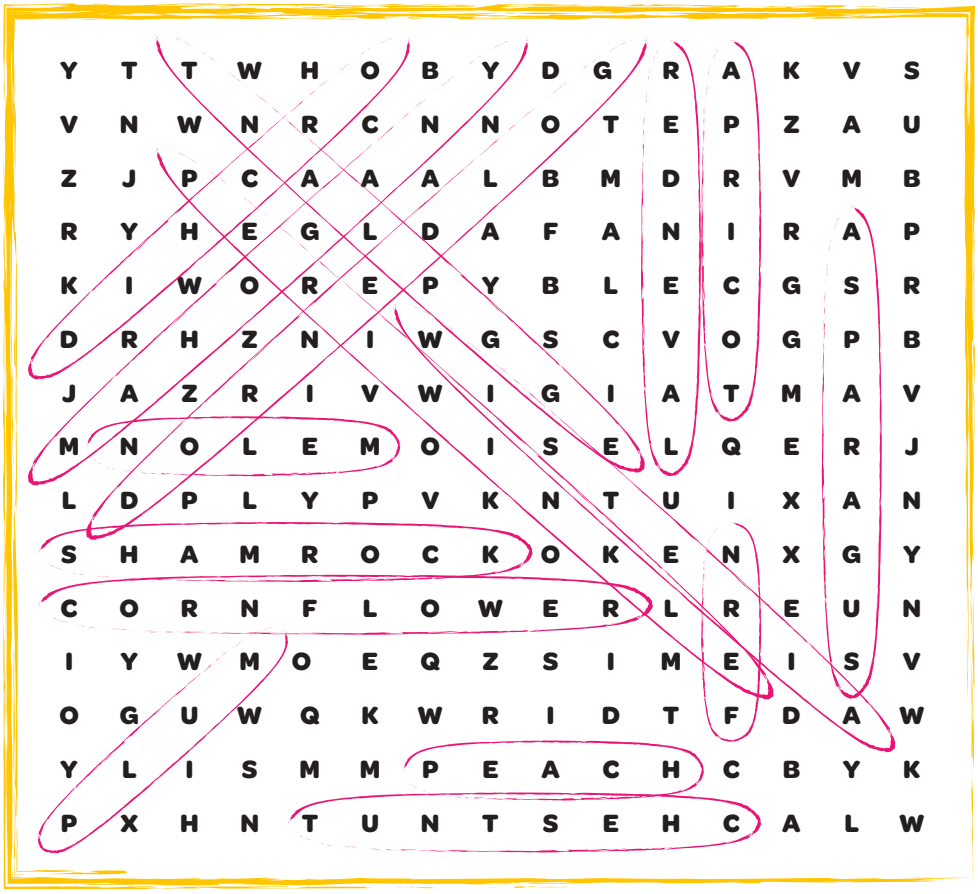
4 | 1 a
1 | 25 | 8 | 1 ‘ 12 a
4 | 22 | 11 | 3 | 26 | 1 | 8 | 20 | 1 .

Answer Key

Crossword

Across: 2. Indigo, 5. Green, 8. Yellow, 10. Pink, 11. Red
Down: 1. Violet, 3. Orange, 4. Brown, 5. Gray, 6. Black, 7. Blue, 9.White

Wordsearch



Cryptogram

Do you like to draw with crayons? I'm not very good at it. But it doesn't matter.
It's the fun of doing it that's important

Curriculum Correlations

We know how important it is for you to justify field trips and document how instructional time is spent outside of your classroom. With this in mind, both the activities in this Educator Guide and the experiences your students have during their field trip to *Crayola IDEAworks®: The Creativity Exhibition* are correlated to the Next Generation Science Standards, Common Core State Standards for English Language Arts, Common Core State Standards for Mathematics, C3 Framework for State Social Studies Standards, and the National Core Arts Standards. These connections are arranged by content area and grade level. The Pennsylvania Academic Standards follow the national curricula to assist with your local planning needs.

NATIONAL CONTENT STANDARDS

Grades K-2

Next Generation Science Standards

- Grade K: K-PS2-1, K-PS2-2, K-LS1-1, K-ESS2-2, K-ESS3-1, K-ESS3-3
- Grade 1: 1-LS1-1 w
- Grade 2: 2-PS1-1, 2-PS1-3, 2-LS2-1, 2-LS4-1
- Grades K-2: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3

Common Core State Standards for English Language Arts: CCSS.ELA-LITERACY.

- Grade K: RI.K.4, RI.K.10, W.K.2, W.K.6, SL.K.1, SL.K.2, SL.K.5
- Grade 1: RI.1.4, RI.1.10, W.1.2, W.1.6, SL.1.1, SL.1.2, SL.1.5
- Grade 2: RI.2.4, RI.2.10, W.2.2, W.2.6, SL.2.1, SL.2.2, SL.2.5

Common Core State Standards for Mathematics: CCSS.MATH.CONTENT.

- Grade K: CC.B.4, CC.B.5, CC.C.6, MD.A.1, MD.A.2, MD.B.3, G.A.2, G.A.3, G.B.4, G.B.5
- Grade 1: 1.NBT.A.1, 1.MD.A.1, MD.A.2, 1.G.A.2
- Grade 2: 2.MD.A.1, 2.MD.A.2, 2.G.A.1

C3 Framework for Social Studies State Standards:

- D1.3.K-2., D2.Geo.5.K-2., D2.Geo.9.K-2., D3.2.K-2., D4.1.K-2., D4.3.K-2., D4.6.K-2., D4.7.K-2.

National Core Arts Standards: Visual Arts (VA)

- Grade K: Cr1.1.Ka, Cr1.2.Ka, Cr2.1.Ka, Pr4.1.Ka, Re.7.1.Ka, Re.7.2.Ka, Re8.1.Ka, Re9.1.Ka, Cn10.1.Ka
- Grade 1: Cr1.1.1a, Cr1.2.1a, Cr2.1.1a, Cr2.3.1a, Re.7.1.1a, Re.7.2.1a, Re8.1.1a, Re9.1.1a
- Grade 2: Cr1.1.2a, Cr1.2.2a, Cr2.1.2a, Cr2.3.2a, Pr4.1.2a, Pr4.1.Ka, Pr6.1.2a, Re9.1.2a, Cn10.1.2a

Grades 3-5

Next Generation Science Standards

- Grade 3: 3-LS1-1, 3-LS4-3, 3-LS4-4, 3-PS2-1, 3-PS2-2, 3-ESS3-1
- Grade 4: 4-LS1-1
- Grade 5: 5-LS1-1, 5-ESS3-1
- Grades 3-5: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3

Common Core State Standards for English Language Arts: CCSS.ELA-LITERACY.

- Grade 3: RI.3.1, RI.3.2, RI.3.3, RI.3.4, W.3.1, W.3.4, W.3.6, W.3.7, W.3.8, SL.3.1, SL.3.4
- Grade 4: RI.4.1, RI.4.2, RI.4.3, RI.4.4, W.4.1, W.4.4, W.4.6, W.4.7, W.4.8, SL.4.1, SL.4.4
- Grade 5: RI.5.1, RI.5.2, RI.5.3, RI.5.4, W.5.1, W.5.4, W.5.6, W.5.7, W.5.8, SL.5.1, SL.5.4

C3 Framework for Social Studies State Standards:

- D3.2.3-5., D4.6.3-5., D4.3.3-5.

National Core Arts Standards: Visual Arts (VA)

- Grade 3: Cr1.1.3a, Cr1.2.3a, Cr2.1.3a, Cr3.1.3a, Pr5.1.3a, Re.7.2.3a, Re8.1.3a, Re9.1.3a, Cn10.1.3a
- Grade 4: Cr1.1.4a, Cr1.2.4a, Cr2.1.4a, Cr3.1.4a, Pr5.1.4a, Re.7.1.4a, Re.7.2.4a, Re8.1.4a, Re9.1.4a
- Grade 5: Cr1.1.5a, Cr1.2.5a, Cr2.1.5a, Cr2.3.5a, Pr6.1.5a, Re.7.1.5a, Re8.1.5a, Re9.1.5a

Grades 6-8

Next Generation Science Standards

- Life Sciences: MS-LS1-4, MS-LS1-5, MS-LS2-1, MS-LS2-4, MS-LS2-5
- Earth & Space Sciences: MS-ESS3-3, MS-ESS3-4, MS-ESS3-5
- Physical Sciences: MS-PS2-2, MS-PS4-2
- Engineering, Technology & Applications of Science: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3

Common Core State Standards for English Language Arts, CCSS.ELA-LITERACY.:

- WHST.6-8.1, WHST.6-8.2, WHST.6-8.7, WHST.6-8.8, WHST.6-8.9, RH.6-8.4., RH.6-8.7., RST.6-8.3., RST.6-8.4., RST.6-8.7.

Common Core State Standards for Mathematics, CCSS.MATH.CONTENT.

- Grade 6: 6.RP.A.3, 6.RP.A.3.C, 6.SP.A.1, 6.SP.B.5
- Grade 7: 7.SP.A.1, 7.SP.B.3
- Mathematical Practice: CCSS.MATH.PRACTICE.MP2, CCSS.MATH.PRACTICE.MP4

C3 Framework for Social Studies State Standards:

- D2.Eco.1.6-8., D2.Eco.2.6-8., D2.Eco.6.6-8., D2.Eco.7.6-8., D2.Geo.2.6-8., D2.Geo.3.6-8., D2.Geo.4.6-8., D2.His.1.6-8., D2.His.14.6-8., D3.1.6-8., D3.4.6-8., D4.3.6-8., D4.6.6-8., D4.7.6-8.

National Core Arts Standards: Visual Arts (VA)

- Grade 6: Cr1.1.6a, Cr1.2.6a, Cr2.1.6a, Cr2.3.6a, Pr5.1.6a, Re.7.2.6a, Re8.1.6a, Re9.1.6a, Cn10.1.6a
- Grade 7: Cr1.1.7a, Cr1.2.7a, Cr2.1.7a, Cr2.3.7a, Pr4.1.7a, Pr5.1.7a, Re.7.2.7a, Re8.1.7a, Re9.1.7a
- Grade 8: Cr1.1.8a, Cr1.2.8a, Cr2.1.8a, Cr2.3.8a, Pr4.1.8a, Pr5.1.7a, Pr6.1.8a, Re.7.2.8a, Re8.1.8a, Re9.1.8a

PENNSYLVANIA STATE ACADEMIC STANDARDS

Grades K-2

Environment and Ecology

- Grade K: 4.1.K.D, 4.1.K.F, 4.3.K.A, 4.5.K.C, 4.5.K.D
- Grade 1: 4.1.1.A, 4.1.1.D, 4.1.1.F, 4.3.1.A, 4.5.1.C, 4.5.1.D
- Grade 2: 4.1.2.A, 4.1.2.D, 4.1.2.E, 4.1.2.F, 4.2.2.C, 4.4.2.C, 4.5.2.C, 4.5.2.D

Science and Technology and Engineering Education

- Grade K: 3.1.K.A5, 3.1.K.A9, 3.2.K.B6
- Grade 1: 3.1.1.A2, 3.1.1.A9, 3.2.1.B1
- Grade 2: 3.1.2.C2, 3.1.2.C4

English Language Arts

- Grade K: CC.1.2.K.F, CC.1.2.K.J, CC.1.4.K.A, CC.1.4.K.W, CC.1.5.K.A, CC.1.5.K.B, CC.1.5.K.D
- Grade 1: CC.1.2.1.F, CC.1.2.1.J, CC.1.4.1.A, CC.1.4.1.W, CC.1.5.1.A, CC.1.5.1.B, CC.1.5.1.D, CC.1.5.1.F
- Grade 2: CC.1.2.2.F, CC.1.2.2.J, CC.1.4.2.A, CC.1.4.2.W, CC.1.5.2.A, CC.1.5.2.B, CC.1.5.2.D, CC.1.5.2.F

Mathematics

- Grade K: CC.2.1.K.A.1, CC.2.1.K.A.2, CC.2.1.K.A.3, CC.2.3.K.A.1, CC.2.3.K.A.2, CC.2.4.K.A.1, CC.2.4.K.A.4
- Grade 1: CC.2.1.1.B.1, CC.2.3.1.A.1, CC.2.4.1.A.1
- Grade 2: CC.2.3.2.A.1, CC.2.4.2.A.1

Social Studies

- Grade K: 5.2.K.B, 5.4.K.B
- Grade 1: 5.2.1.B
- Grade 2: 5.2.2.B, 7.4.2.A

Approaches to Learning Through Play

- Grade K: AL.1.K.A1, AL.1.K.B1, AL.1.K.C1, AL.2.K.B1, AL.2.K.D1, AL.3.K.A1, AL.3.K.B1, AL.3.K.C1, AL.4.K.A1, AL.4.K.C1
- Grade 1: AL.1.1.A1, AL.1.1.B1, AL.1.1.C1, AL.2.1.B1, AL.2.1.D1, AL.3.1.A1, AL.3.1.B1, AL.3.1.C1, AL.4.1.A1, AL.4.1.C1
- Grade 2: AL.1.2.A1, AL.1.2.B1, AL.1.2.C1, AL.2.2.B1, AL.2.2.D1, AL.3.2.A1, AL.3.2.B1, AL.3.2.C1, AL.4.2.A1, AL.4.2.C1

Arts and Humanities

- Grade K: 9.1.M.K.J1, 9.1.V.K.A1, 9.1.V.K.B1, 9.1.V.K.E1
- Grade 1: 9.1.M.1.J1, 9.1.V.1.A1, 9.1.V.1.B1, 9.1.V.1.E1
- Grade 2: 9.1.M.2.J1, 9.1.V.2.A1, 9.1.V.2.E1

Grades 3-5

Environment and Ecology

- Grade 3: 4.1.3.D, 4.1.3.E, 4.1.3.F, 4.4.3.B, 4.4.3.C, 4.4.3.D
- Grade 4: 4.1.4.A, 4.1.4.C, 4.1.4.D, 4.1.4.E, 4.1.4.F, 4.3.4.A, 4.4.4.B, 4.4.4.D, 4.5.4.C
- Grade 5: 4.1.5.F, 4.2.5.C, 4.4.5.C

Science and Technology and Engineering Education

- Grade 3: 3.1.3.A2, 3.1.3.A3, 3.1.3.A5, 3.1.3.A9, 3.1.3.B1, 3.1.3.C1, 3.2.3.B6, 3.4.3.A3, 3.4.3.B4, 3.4.3.C1, 3.4.3.C2, 3.4.3.C3, 3.4.3.D1, 3.4.3.D2, 3.4.3.D3, 3.4.3.E1, 3.4.3.E2, 3.4.3.E7
- Grade 4: 3.1.4.A2, 3.1.4.A3, 3.1.4.A5, 3.1.4.A9, 3.1.4.B2, 3.1.4.C1, 3.1.4.C2, 3.2.4.B1, 3.2.4.B5, 3.3.4.B1, 3.4.4.A1, 3.4.4.A2, 3.4.4.A3, 3.4.4.B1, 3.4.4.B2, 3.4.4.B3, 3.4.4.C1, 3.4.4.C2, 3.4.4.D1, 3.4.4.D3, 3.4.4.E2
- Grade 5: 3.1.5.A3, 3.1.5.A9, 3.1.5.C1, 3.2.5.B1, 3.2.5.B5, 3.4.5.A1, 3.4.5.B1, 3.4.5.B3, 3.4.5.C1, 3.4.5.C3, 3.4.5.D1, 3.4.5.D2, 3.4.5.D3, 3.4.5.E7

English Language Arts

- Grade 3: CC.1.2.3.A, CC.1.2.3.B, CC.1.2.3.C, CC.1.2.3.E, CC.1.2.3.F, CC.1.2.3.G, CC.1.2.3.K, CC.1.4.3.G, CC.1.4.3.H, CC.1.4.3.I, CC.1.4.3.J, CC.1.4.3.U, CC.1.4.3.V, CC.1.4.3.W, CC.1.5.3.A, CC.1.5.3.D
- Grade 4: CC.1.2.4.A, CC.1.2.4.B, CC.1.2.4.C, CC.1.2.4.E, CC.1.2.4.F, CC.1.2.4.G, CC.1.2.4.K, CC.1.4.4.G, CC.1.4.4.H, CC.1.4.4.I, CC.1.4.4.J, CC.1.4.4.U, CC.1.4.4.V, CC.1.4.4.W, CC.1.5.4.A, CC.1.5.4.D
- Grade 5: CC.1.2.5.A, CC.1.2.5.B, CC.1.2.5.C, CC.1.2.5.E, CC.1.2.5.F, CC.1.2.5.G, CC.1.2.5.K, CC.1.4.5.G, CC.1.4.5.H, CC.1.4.5.I, CC.1.4.5.J, CC.1.4.5.U, CC.1.4.5.V, CC.1.4.5.W, CC.1.5.5.A, CC.1.5.5.D

Social Studies

- Grade 3: 7.4.3.B, 8.1.3.B, 8.1.3.C, 8.2.3.A
- Grade 4: 5.3.4.G, 7.4.4.B, 8.1.4.B, 8.1.4.C, 8.2.4.B
- Grade 5: 5.2.5.B, 7.4.5.B, 8.2.5.B

Arts and Humanities: Visual Arts

- Grade 3: 9.1.3.B, 9.1.3.J, 9.1.3.K, 9.2.3.F, 9.3.3.A
- Grade 5: 9.1.5.B, 9.1.5.J, 9.1.5.K, 9.2.5.F, 9.3.5.A

Family & Consumer Sciences: Food Science & Nutrition

- Grade 3: 11.3.3.C, 11.3.3.E

Grades 6-8

Environment and Ecology

- Grade 6: 4.1.6.D, 4.1.6.F, 4.5.6.A, 4.5.6.A, 4.5.6.D
- Grade 7: 4.1.7.A, 4.1.7.C, 4.1.7.D, 4.1.7.E, 4.1.7.F, 4.3.7.A, 4.3.7.B, 4.4.7.A, 4.5.7.C, 4.5.7.D
- Grade 8: 4.3.8.A, 4.3.8.C, 4.5.8.C, 4.5.8.D

Science and Technology and Engineering Education

- Grade 6: 3.1.6.A2, 3.1.6.A9, 3.2.6.B1, 3.4.6.A1, 3.4.6.B4, 3.4.6.C1, 3.4.6.C2, 3.4.6.C3, 3.4.6.D1
- Grade 7: 3.1.7.A8, 3.2.7.B1, 3.4.7.A1, 3.4.7.B2, 3.4.7.B3, 3.4.7.B4, 3.4.7.C1, 3.4.7.C2, 3.4.7.D1, 3.4.7.E3
- Grade 8: 3.3.8.A2, 3.4.8.A3, 3.4.8.B1, 3.4.8.B2, 3.4.8.B3, 3.4.8.C1, 3.4.8.D1, 3.4.8.E6

Reading and Writing in Science and Technical Subjects Grades 6-8:

- CC.3.5.6-8.C, CC.3.5.6-8.D, CC.3.5.6-8.G, CC.3.6.6-8.B, CC.3.6.6-8.E, CC.3.6.6-8.F, CC.3.6.6-8.H

Reading and Writing in History and Social Studies Grades 6-8:

- CC.8.5.6-8.D, CC.8.5.6-8.G, CC.8.6.6-8.B, CC.8.6.6-8.E, CC.8.6.6-8.F

Mathematics

- Grade 6: CC.2.4.6.B.1
- Grade 7: CC.2.2.7.B.3, CC.2.4.7.B.2

Social Studies

- Grade 6: 6.1.6.B, 6.2.6.A, 6.2.6.E, 6.5.6.F, 7.1.6.B, 7.2.6.A, 7.3.6.A, 7.4.6.B, 8.2.6.A, 8.2.6.C
- Grade 7: 6.1.7.B, 6.2.7.A, 6.2.7.E, 6.5.7.F, 7.1.7.B, 7.2.7.A, 7.3.7.A, 7.4.7.B, 8.2.7.A, 8.2.7.C
- Grade 8: 6.1.8.B, 6.2.8.A, 6.2.8.E, 6.5.8.F, 7.1.8.B, 7.2.8.A, 7.3.8.A, 7.4.8.B, 8.2.8.A, 8.2.8.C

Arts and Humanities, Visual Arts Grade 8:

- 9.1.8.B, 9.1.8.J, 9.1.8.K