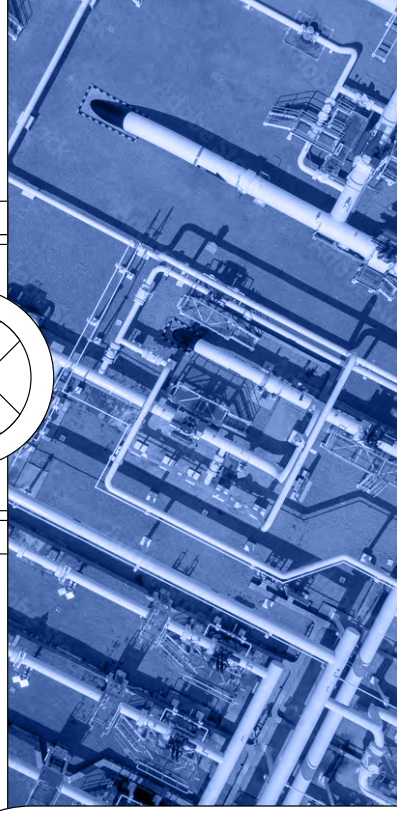


INGAA Foundation

ADVOCACY & ENGAGEMENT RESOURCES

INGAA FOUNDATION

The NEED Project
Putting Energy into Education

TABLE OF CONTENTS

INTRODUCTION

Thank you for volunteering to visit a classroom or community event!

Your engagement efforts play a crucial role, offering benefits such as:

- Helping students make rich connections between natural gas content and real-world applications.
- Showcasing industry career opportunities to students.
- Cultivating advocates for our industry.
- Assisting educators in planning engaging, interactive, and informative lessons.
- Providing students with opportunities to build confidence in Science, Technology, Engineering, and Mathematics (STEM) fields.

INGAA Foundation advocacy and engagement resources aim to allow members to learn more about their communities, act as mentors to students, and foster good relationships and engagement opportunities with local schools, clubs, and/or community groups.

This guide contains activities members can select for use in community engagement efforts. Each activity outline provides step-by-step guidance for preparing an event or visit, presenting and conducting activities, and building connections in the community. Before committing to an advocacy or engagement effort, be sure to review the ***Get Ready, Get Set, Go! Checklist*** and watch the recorded training videos for your selected activities. These resources will help ensure your efforts are well-prepared, effective, and impactful.

Thank you again for serving as a champion of our industry. Following your volunteer event, please provide feedback on the resources used and anything you may have learned via the Evaluation tools beginning on ***page 72***. This feedback is critical to ensure that the INGAA Foundation can continuously improve its materials, the volunteer and student experience, and content effectiveness. Evaluations can be submitted digitally to **foundation@ingaa.org**.

INGAA FOUNDATION

GET READY, GET SET, GO!

A "how-to" checklist for preparing community engagement activities.

Check out the Introductory Training Video to get started!

Get Ready

- Establish a line of communication with the classroom teacher, educator, or event organizer. Ask for specific details about:
  - timing of the visit or event, and how long you will engage with students personally
  - number of students in group
  - grade level(s) of the target audience
  - desired subject matter or educational standards/skills to be targeted
  - rules for entering the facility
  - physical attributes of space (seating and furniture available in the workspace, access to water/electricity, etc.)
  - materials restrictions
  - technology availability – Wi-Fi, projector, screen, speakers, etc., and required dongles/ports
  - if photography is allowable and shareable (media release)
- Consult the ***Asset and Activity Planning Table***. Select an activity based on the setting and goals of the event, your comfortability with the topic, relevance for the grade/subject matter of audience, and information provided by organizers and educators about the event and participants.
  - Some activities may be better suited for tabling events like fairs and community days, whereas others may be better for group sessions such as "Take Your Child To Work" day, and others might be best in a classroom setting. Consult the table for guidance.
  - While this guide is geared towards working with student populations, many of these activities are also very well suited for working with adults in the community. Many of the activities can and have been used for internal educational events within a company, community meetings, and public hearing/info sessions. Consult the table and follow the checklist as if the community members are your "students." Just as a museum exhibit for children may be tailored to a younger audience, parents and teachers also learn by viewing and doing activities with their children in such situations.
- Read through the entire activity – including the activity outline and student handout, (where applicable), any relevant slides and affiliated script, and become familiar with all procedural steps. View the training video to review any concepts and walk through the activity. Enlist the help of other professionals on your team for assistance on the day.
- Confirm the activity with teacher/educator/organizer to make sure it will be appropriate. Discuss supplies and determine if there might be any supplies (scissors, tape, beakers, safety glasses, etc.) that might already be available to the classroom or setting. Confirm any additional last-minute details.

Get Set

- Review the training video and instructions for the activity selected. Read the "Steps to Simplify/Amplify" within the activity guidance and become familiar with how you may condense or extend learning on the day.
- Complete the activity on your own to anticipate any challenges and troubleshoot any issues that might arise. If you create something, save it as a model for your visit.
- Gather materials needed and ensure extras for contingencies.
- If providing collateral or prizes, gather these and form a plan for how you will distribute items as prizes.
- Preview the exit tickets and teacher evaluations. Decide which you will provide.
- Make copies of activities and student evaluations (if delivering in paper).
- Download, personalize, and/or hide (shorten) the slide deck for appropriateness based upon grade level, setting, and the event or company goals.
- Read any safety notes and prepare a safety moment for use at the start of the session.
- Confirm with the educator/teacher/organizer one last time. Ensure technology and Wi-Fi connections are available and be sure you have what is required for sharing any asset you will display. Make sure to highlight any expectations or needs you have of the educator and confirm building entry and parking policies.

Go!

- Arrive early to allow for check-in, set-up, and any last-minute issues.
- Pass out any supplies, copies, and safety equipment.
- Introduce yourself and provide a safety moment (if applicable).
- Conduct your presentation and activity. Try to engage students in discussion, hands-on, or both as much as possible.
- Take photos (if permitted).
- Distribute assessments and share surveys with educator/teacher/leader/organizer.
- Clean up.
- Follow up after the session. Share any photographs, links to resources, and additional opportunities. Submit any paper evaluations to **foundation@ingaa.org**.

SAFETY FOR STEM CHECKLIST

These safety protocols are commonly used in the science classroom and in a laboratory setting. Many may not be applicable for your outreach setting, but it is important to read and be aware of any and all safety procedures that may arise.

Eye Safety

- Wear safety glasses when performing experiments.

Chemical Safety

- Avoid chewing gum, personal beverages, and food in lab settings.
- Do not smell, touch, or taste liquids unless instructed to do so.
- Keep liquid containers closed except when using them.
- Do not mix any materials without specific instructions.
- Do not shake or heat liquids or solids without specific instructions.
- Dispose of used lab materials as instructed. Do not pour chemicals back into a container without specific instructions to do so.
- If a liquid or solid accidentally touches your skin, immediately wash the area with water and inform an adult.
- Keep long hair pulled back and secured.
- Be careful of loose clothing.

Fire Safety

- Do not heat any substance or piece of equipment unless specifically instructed to do so.
- Be careful of loose clothing. Do not reach across or over a flame.
- Keep long hair pulled back and secured.
- Do not heat any substance in a closed container.
- Always use tongs or protective gloves when handling hot objects. Do not touch hot objects with your hands.
- Keep all lab equipment, chemicals, papers, and personal items away from the flame.
- Extinguish the flame as soon as you are finished with the experiment and move it away from the immediate work area.

Heat Safety

- Always use tongs or protective gloves when handling hot objects and substances.
- Keep hot objects away from the edge of the experiment surface––in a place where no one will accidentally come into contact with them.
- Remember that many objects will remain hot for a long time after the heat source is removed or turned off.

Glass Safety

- Never use a piece of glass equipment that appears to be cracked or broken.
- Handle glass equipment carefully. If a piece of glassware breaks, do not attempt to clean it up yourself. Inform an adult.
- Glass equipment can become very hot. Use tongs or gloves if glass has been heated.
- Clean glass equipment carefully before packing it away.

ASSET AND ACTIVITY PLANNING TABLE

This planning table provides a quick reference to help select activities you might use. Please read each activity or watch the training clip to determine if it is a good fit for your engagement efforts.

Topic	Activity	Grade Level	Pages	Slide Deck & Slide Numbers	Time to Complete	Setting Suggestions
Energy Sources & Natural Gas Basics	Coloring Sheets	ES	29-32	▪ Sandy's Deep Dive Adventure	▪ Activity: 15-30 minutes ▪ Slides: 15 minutes	▪ Table/Fair ▪ Classroom ▪ Take Your Child to Work Day
	Candy Collector	ES, MS, HS	33-34	▪ Let's Talk About Energy, slides 1-18 OR ▪ Our Future with Natural Gas, slides 1-21	▪ Activity: 30 minutes ▪ Slides: 15 minutes	▪ Classroom ▪ Large group ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups
	Navigating Natural Gas Relay	ES, MS	35-36	▪ Sandy's Deep Dive Adventure OR ▪ Let's Talk About Energy, slides 1-18	▪ Activity: 20-30 minutes ▪ Slides: 15 minutes	▪ Classroom ▪ Large group ▪ Take Your Child to Work Day ▪ Scouting groups
	Renewable Natural Gas in a Bag	All	37-40	▪ Let's Talk About Energy, slides 1-18 OR ▪ Our Future with Natural Gas, slides 1-28	▪ Activity: 15 minutes and up ▪ Slides: 15 minutes	▪ Classroom ▪ Table/Fair ▪ Take Your Child to Work Day
	A Natural Gas Story	All	41-48	▪ Sandy's Deep Dive Adventure OR ▪ Let's Talk About Energy, slides 1-23 OR ▪ Our Future with Natural Gas, slides 1-28	▪ Activity: 20 minutes and up ▪ Slides: 15 minutes	▪ Classroom ▪ Scouting groups ▪ Table/Fair (with modifications)
Natural Gas in Depth	The Natural Gas Pipeline	MS, HS	49-54	▪ Let's Talk About Energy, slides 1-23 OR ▪ Our Future with Natural Gas, slides 1-35	▪ Activity: 15-30 minutes ▪ Slides: 15 minutes and up	▪ Classroom ▪ Smaller groups ▪ Take Your Child to Work Day ▪ Table/Fair (with modifications)
	A Natural Gas Story	All	41-48	▪ Sandy's Deep Dive Adventure OR ▪ Let's Talk About Energy, slides 1-23 OR ▪ Our Future with Natural Gas, slides 1-28	▪ Activity: 20 minutes and up ▪ Slides: 15 minutes	▪ Classroom ▪ Scouting groups ▪ Table/Fair (with modifications)
	Build a Pipeline	ES, MS	55-58	▪ Sandy's Deep Dive Adventure OR ▪ Let's Talk About Energy, slides 1-23	▪ Activity Part 1: 5-20 minutes ▪ Activity Part 2: 5-20 minutes ▪ Slides 15 minutes	▪ Classroom ▪ Table/Fair ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups

Key

▪ ES = Elementary School ▪ MS = Middle School ▪ HS = High School

Topic	Activity	Grade Level	Pages	Slide Deck & Slide Numbers	Time to Complete	Setting Suggestions
Natural Gas in Depth	Pipeline Push	MS, HS	59-64	▪ Let's Talk About Energy, slides 1-23 OR ▪ Our Future with Natural Gas, slides 1-35	▪ Activity: 30 minutes and up ▪ Slides 15 minutes and up	▪ Classroom ▪ Table/Fair as demonstration ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups
	Separator Simulation	All	65-66	▪ Let's Talk About Energy, slides 1-18 OR ▪ Our Future with Natural Gas, slides 10-19+	▪ Activity: 5 minutes ▪ Slides: 10-15 minutes	▪ Classroom ▪ Small groups ▪ Table/Fair ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups
	Volume Demonstration	HS	67-68	▪ Our Future with Natural Gas, slides 14-19+	▪ Activity: 10 minutes ▪ Slides: 15-20 minutes	▪ Classroom ▪ Small groups ▪ Table/Fair ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups
Careers and The Future of Natural Gas	Candy Collector	All	33-34	▪ Let's Talk About Energy, slides 1-18 OR ▪ Our Future with Natural Gas, slides 1-21	▪ Activity: 30 minutes ▪ Slides: 15 minutes	▪ Classroom ▪ Large group ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting group
	Pipeline Push	All	59-64	▪ Let's Talk About Energy, all slides OR ▪ Our Future with Natural Gas, slides 1-21, 39-46	▪ Activity: 30 minutes and up ▪ Slides 15 minutes and up	▪ Classroom ▪ Table/Fair as demonstration ▪ Take Your Child to Work Day ▪ Adult groups ▪ Scouting groups
	Career Roundup	All	69-71	▪ Let's Talk About Energy, slides 1-4,10-14, 24-33 OR ▪ Our Future with Natural Gas, slides 1-28	▪ Activity: 20 minutes ▪ Slides: 15 minutes	▪ Classroom ▪ Take Your Child to Work Day ▪ Large groups
	Renewable Natural Gas in a Bag	All	37-40	▪ Let's Talk About Energy, all slides OR ▪ Our Future with Natural Gas, slides 1-4, 10-15, 39-46	▪ Activity: 15 minutes and up ▪ Slides: 15 minutes	▪ Classroom ▪ Table/Fair ▪ Take Your Child to Work Day
	Coloring Sheets	ES	29-32	▪ Sandy's Deep Dive Adventure	▪ Activity: 15-30 minutes ▪ Slides: 15 minutes	▪ Table/Fair ▪ Classroom ▪ Take Your Child to Work Day

Key

▪ ES = Elementary School ▪ MS = Middle School ▪ HS = High School

SLIDES & SCRIPTS

Several slide decks have been prepared for members to use in their engagement efforts in a classroom or speaker setting. Each slide deck includes an accompanying script to help presentations run smoothly.

Slides are not recommended for use if conducting fair or table-style outreach events.

Instructions and Tips for Use

- Preview and select the slides that best fit the grade of students, the topic, and the activity that you will use for your engagement. Confirm this content with the educator/teacher/organizer of the community engagement to ensure it is a good fit. *Slides are comprehensive and cover several topics. It is recommended that slides are shortened from the full deck before delivery in the middle and high school settings.*
- Download the slides locally to your device.
- Familiarize yourself with the slides and the script. Customize slide two to add your personalized information and customize any other slides as needed.
- Find the section of content, if applicable, that you will share. Reference the table on page 6 or the activity guidance for suggestions on slides to share or skip. Hide any slides you will not be using or presenting. [On a PC, right click on the slide and select "Hide Slide." On a Mac, Ctrl+click on the slide and select "Hide Slide."]
- Err on the side of "less is more" with students. Break up slides with activities, questions, and prizes where you can. Encourage engagement where it is built into slides and scripts, and in addition to those prescribed slides.
- Share any video or supplementary resources ahead of time with the teacher/educator/organizer. You may opt to share the slides as well for teachers to introduce or follow up with any concepts you will not be delivering.

Sandy's Deep Dive Adventure

Audience: Grades K-3

Time to Complete Full Slide Deck: 15 minutes

Description: A story-based slide deck that aims to introduce young students to natural gas through a story. In the story, Sandy, a young shark, prepares for a classroom presentation and learns about natural gas by interviewing her aunt who works in the natural gas industry. This slide deck includes the least technical information of all the three and is best for very young students or a quick visit. If students have more technical questions or the teacher wishes for more information to be passed on, opt for the Elementary/Middle set of slides. Simply read the story as written in the script. Slides 2 and 10 incorporate questions and discussion. Slide 13 has review pointers.

SLIDE 1

Opening Slide for Sandy's Deep Dive Adventure

SLIDE 2

***be sure to customize slide!**

Hello. Thank you for having me to your classroom. My name is _____ and I work for _____. My job is _____. Today we're going to learn about natural gas through a fun little story called Sandy's Deep Dive Adventure.

SLIDE 3

It's Monday morning, and Sandy Shark wakes up excited for the week ahead. They have all their homework finished, they practiced all weekend for the big swim meet coming up, and they are excited to have their favorite clam chowder breakfast their dad makes every Monday before they go to school.

SLIDE 4:

At the end of the school day, Sandy's teacher, Mrs. Swims, talks to the students about an assignment.

"Ok, class, before we head out for the day, just a reminder that your energy projects are due by the end of this week," Mrs. Swims said. "Remember, there is a lot you can discover about the different ways we use and access energy, and I look forward to hearing more from each of you on Friday!"

SLIDE 5

"Oh yeah," Sandy thought. "I was so busy with swimming and my other assignments that I forgot about the project — mine is on natural gas. I am not sure where to start, but I know my dad will help me!"

SLIDE 6

Back home that evening, Sandy asks for help with the energy project.

"Dad, I have no clue where to start with my natural gas project," said Sandy. "Everyone in my class has started, and they have really cool topics like solar or water. I mean, we love the water. Why couldn't I have gotten that topic, it would have been super easy!"

"I think you mean hydroelectric, Sandy," Sandy's dad replied. "But there is plenty you can learn about natural gas. I think you should call your aunt Finda, she works on the Two Reefs natural gas pipeline."

"A pipeline, I think I've seen one of those before!" exclaimed Sandy, "I'll give aunt Finda a call tonight, thanks dad!"

SLIDE 7

"Hey, aunt Finda, it's me Sandy. I'm working on a school project about natural gas, and my dad said you work with pipelines?"

"That's right!" replied her aunt. "I am a pipe liner, which means I help to construct pipelines and make sure that they are safe for our communities and neighbors and that the natural gas is transported properly."

"Wow, that's super cool," Sandy replied. "But aunt Finda, what is natural gas anyway? Is it like the gas my little brothers always have?"

"No, not exactly," replied Aunt Finda with a smirk, "Natural gas is like treasure pockets under the earth. Hundreds of millions of years ago, the remains of tiny plants and animals that lived in the water were covered by soil and rock. Pressure and heat then turned some of these materials into something special — natural gas!"

"Whoa, so you're saying you basically work with dinosaurs. That's awesome!" exclaimed Sandy.

"Natural gas is a fossil fuel, but the organisms that made natural gas are older than dinosaurs," replied their aunt. "The natural gas is then accessed by drilling deep into the ground. Pipelines safely transport the gas to facilities where it is transformed into electricity to power our homes. Some houses and businesses get the gas directly, where they use it to cook, heat their water or keep their homes comfortably warm!"

"I think my home uses natural gas — I see my dad cooking all the time over these blue flames on the stove," said Sandy. "Have I told you about his clam chowder?!"

"That would be it!" replied her aunt. "Natural gas has other uses as well. It can also be used to create everyday items like cellphones, plastics, toothpaste and fabrics."

SLIDE 8

"So, you mean I'm able to brush my teeth — and boy do I have a lot of teeth— because of natural gas?" Sandy asked.

SLIDE 9

"And even my phone is made from natural gas?!"

"That's right, natural gas doesn't just power our homes and businesses. It makes everyday life possible!" replied her aunt.

"Thanks, aunt Finda, I never knew that natural gas was used in so many ways. Now I feel confident my project will get an A+."

SLIDE 10

The next morning, Sandy checks in with her dad before heading out to school.

"Thanks for telling me about aunt Finda, Dad," said Sandy. "She told me so much about natural gas and how it is used in so many ways. I think her job is cool, too!"

"I'm glad she was able to help," replied her dad. "Did you think about what you are going to say for your presentation today?"

"Well, there's so much I could talk about and I'm not sure exactly what I want to focus on for my presentation," Sandy answered.

Questions:

- What would you say if you were Sandy?
- What have you learned about natural gas so far?
- What are some things that are made from natural gas?
- How does natural gas get to our homes?

SLIDE 11

That Friday morning, Mrs. Swims addressed the students, "Good morning, class! I hope everyone is ready to present today. Take a few minutes to get prepared, and then we will get started.

SLIDE 12

"Hey, Sandy! How did your project turn out?" asked Sandy's friend Gilbert. "I had wind power. It was a lot of fun to learn about!"

"Well, Gilbert, I had natural gas, and at first I wasn't sure what to talk about, but I called my aunt Finda, who works in the industry, and she told me about all of its benefits," Sandy replied.

"Natural gas, huh? I read about that for my presentation. It's a great partner for wind power! When it's not a windy day or the weather is bad, we have natural gas as a dependable fuel source." Gilbert said.

SLIDE 13

When it was their turn, Sandy proudly went to the front of the room and shared all the benefits of natural gas with the class.

After the presentations, Mrs. Swims congratulated the class on their energy projects. She even gave Sandy a special shoutout for the most unique presentation that the class heard that day since she talked about her aunt Finda's career. In fact, the class was so interested in learning more, Mrs. Swims added much of the information you have learned about today to their next science lesson.

Review

Mrs. Swims made a True/False quiz for Sandy's class. How would you answer each question? Give me a "thumbs up" for true and "thumbs down" for false.

[ALL STATEMENTS ARE TRUE]

- We should only use gas appliances with adult supervision.
- Natural gas doesn't have a color or smell, so gas companies make it smell like rotten eggs.
- If you smell natural gas: Don't use electricity.
- If you smell natural gas: Don't look for the leak.
- If you smell natural gas: Tell an adult and go outside.

Let's Talk About Energy

Audience: Grades 4-8 (Upper Elementary, Middle School)

Time to Complete Full Slide Deck: 35-45 minutes

Description: This slide deck provides an introductory overview of energy, natural gas, natural gas industry goals, safety, and careers in the industry. *The full set is not suggested for use on one single visit, as it would be too much information and likely lose the attention of your audience.* The slides are broken up into sections; you may opt to present a specific section based on what might coordinate with the activity you have selected, the content pertinent to what students are presently studying, or what is relatable to your career, for example.

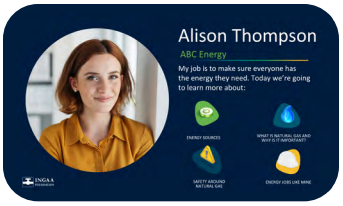
It is strongly suggested that you introduce yourself and begin with slide 2 and slides 10-18 to set the stage for any discussion related to natural gas. Slides 3-9 may be helpful for younger students to understand energy, but these could also serve as review of prior content. Check with the teacher to see if it is helpful or necessary.

A script for each slide is provided in the presenter notes of the file in addition to this guide.

SLIDE 1

Opening Slide

SLIDE 2

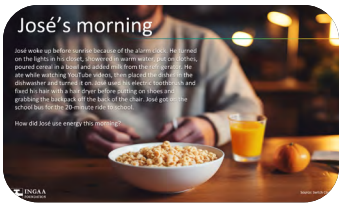


***be sure to customize slide!**

My name is _____ and I am a TITLE, with COMPANY. Today I'd like to share a little bit about ____(fill in from choices below)_____.

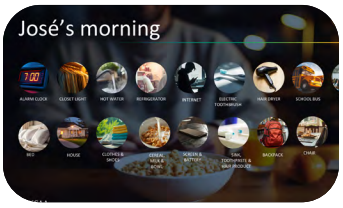
- Energy Sources
- Natural Gas and why it is important
- Safety
- Energy Careers

SLIDE 3



Let's read about José's morning. Does this morning routine sound familiar? What are all the ways José used energy? How did you use energy this morning? Talk to your neighbor and compare your morning with José's. (review examples on next slide)

SLIDE 4



How many of these items did we name? Which ones did we miss?

What about these items? (click to reveal bed, house, clothes, etc.) Do these items use energy by themselves? Why are they on the list?

The items on the top line use energy directly. The items below may not use energy on their own, but it took energy to make them, build them, cool them, or shop for them! They are called indirect energy users. Everything we do involves energy in some way.

SLIDE 5

What do you think it means to be called a renewable resource?

Renewable energy sources are energy sources that are constantly renewed or replenished by natural processes quickly.

- Solar energy comes from the sun.
- Wind energy comes from moving air.
- Hydropower energy comes from flowing water.
- Biomass energy is made from living things — such as plants and animals — most commonly using plants, wood and waste.
- Geothermal energy comes from heat beneath the earth's surface.

Where have you seen examples of each of these?

SLIDE 6

What do you think it means to be called a nonrenewable resource?

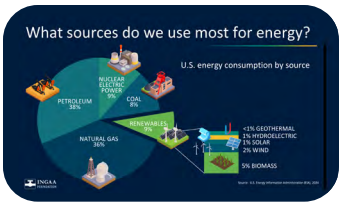
Nonrenewable energy sources are energy sources that can not be renewed or replenished before we will use them completely.

- Coal is a fossil fuel in the form of a black rock.
- Oil, also known as petroleum, is a fossil fuel, too. It is the number one source of energy used in the U.S. and in much of the world.
- Natural gas is most often a fossil fuel, found with petroleum underground.
- Nuclear energy is energy from a nuclear reaction of special radioactive atoms.

Where have you seen examples of each of these?

Renewable and nonrenewable resources often must be used together. One alone won't give us all the energy we need in the ways we need to use it.

SLIDE 7



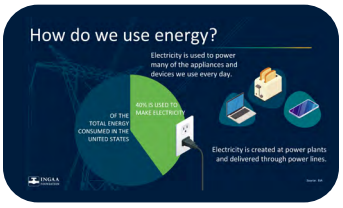
What sources do we use most for energy? Of all the sources we listed, renewable and nonrenewable? Which ones do you think we use most and least?

(CLICK to reveal)

In the U.S. petroleum is our most used source. We use it for transportation and making lots of products. Natural gas isn't too far behind and is used to make lots of products, generate electricity, and heat and cook in homes.

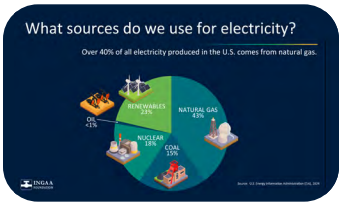
Which sources surprise you on this list? Why?

SLIDE 8



In the U.S., the largest chunk of our energy is used to make electricity (over 40%). Can you name some things in your life that use electricity? What would your day look like without electricity?

SLIDE 9



Since a lot of our energy goes into making electricity, what sources of energy do you think make the most electricity?

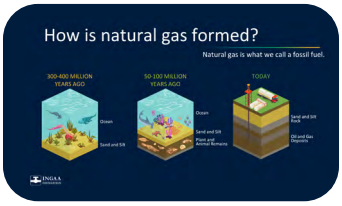
(CLICK to reveal)

In the U.S., natural gas is our most used source for electricity generation. We use it to create heat and turn a turbine.

SLIDE 10

Natural gas comes from the ground beneath your feet — deep, deep underground. But you can't just plug a phone into the ground and expect it to charge, right? How do we make natural gas work for us, and why do we use it?

SLIDE 11



Most of the natural gas we use today was formed hundreds of millions of years ago, before the dinosaurs roamed the earth! Much of the earth that we know as land today was under water, and these oceans were filled with tiny plant and animal organisms. We call natural gas a fossil fuel because it was formed from the remains of those tiny plants and animals that died and were buried under lots and lots of sand, and silt. As the layers of sediment built up it turned to rock, and more layers piled on top created heat and pressure. This heat and pressure and lots and lots of time changed the fossil organisms chemically into natural gas – tiny bubbles of odorless fuel! We can dig down and bring it to the surface to be used.

SLIDE 12

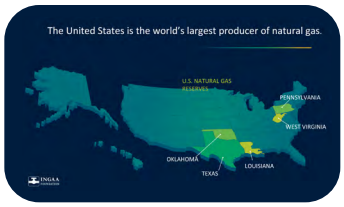
What do we do with natural gas? Who uses it at home, and how?

Natural gas is good for heating and cooking. But, we can also make it into many products. Can anyone name something they think might be made from natural gas?

(CLICK to reveal)

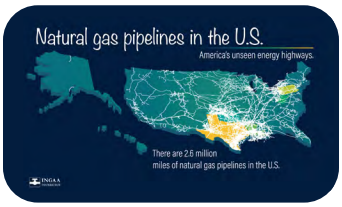
Tires, toothpaste, crayons, paintbrushes, phones, cooking and transportation fuels, LOTS and lots of things! Natural gas is used to make a lot of plastics – what around the room is plastic?

SLIDE 13



The United States produces more natural gas than any other country! It supplies more than 1/3 of our energy, and generates the largest amount of our electricity. But where do we find it? Many states have natural gas underground, but most natural gas is found in Texas, Oklahoma, Louisiana, West Virginia, and Pennsylvania.

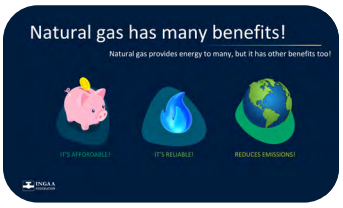
SLIDE 14



Do you live in one of those states? Even if you do, do you live right by the natural gas? How do we move it to where people need it? Gases are hard to trap and contain, so we use pipelines to transport it. There are enough pipelines (mostly underground) to stretch to the moon and back almost nine times!

Pipelines are considered a transportation mode, like a bus or ship, and it is the safest transportation method in the U.S.!

SLIDE 15



Natural gas is a good fuel for energy and electricity for many reasons.

It is often less expensive than other fuels for heating and electricity.

Natural gas pipelines are often underground, meaning natural gas can almost always make it to customers without issue.

Natural gas is a cleaner burning fossil fuel compared to coal and oil, which means it can reduce harmful pollutants and gases in our atmosphere.

SLIDE 16

Natural gas is helping to lower carbon emissions as people transition away from dirtier fossil fuels.

SLIDE 17

Renewable Natural Gas (RNG) can also be called biomethane. RNG is a fuel made from the waste of living things that can be used to power homes, businesses and even vehicles.

RNG is made from agricultural waste, landfill waste, and wastewater treatment plants, RNG is chemically identical to conventional natural gas. However, RNG has a lower carbon footprint, or emissions impact, because it recycles existing carbon rather than adding new carbon from nonrenewable energy sources. RNG can be injected into existing natural gas pipelines, providing a renewable and sustainable energy source for heating, electricity and transportation.

SLIDE 18

Researching and developing new, cutting-edge technologies as well as partnering with renewable resources — such as energy that comes from the sun or wind — is a top priority for natural gas companies. And, as the sun does not always shine and the wind does not always blow, natural gas is a good partner to use with renewables to ensure energy is always flowing.

SLIDE 19

Natural gas is very safe, but part of my job is also ensuring that people like you are safe around natural gas.

SLIDE 20

What do these items have in common?

- Ovens
- Water Heaters
- Fireplaces

That's right; they all are either heating or are producing a flame! That is why talking to an adult about these appliances is so important. You should never use any of these appliances unsupervised. Talk to a parent or guardian to see if you have any appliances in your home that use natural gas.

SLIDE 21

As we talked about, natural gas is an odorless and colorless gas. However, it has been given a particular smell to help identify if there has been a leak. The smell is a nasty one, purposefully given to catch your attention — it is the smell of rotten eggs!

Who has smelled a rotten egg? Give me a thumbs up if you like the smell, thumbs down if you don't!

SLIDE 22

If you smell the rotten egg smell of gas, act fast! Here are some tips if you think there has been a natural gas leak in your home:

- Don't use any electricity — Don't turn off the television or flip any light switches.
- Do not look for the leak — leave that for the professionals.
- Be sure to notify an adult verbally and go outside.

SLIDE 23

Underneath your home are utility pipes and wires, providing your home with energy sources such as natural gas, electricity and water. So, before you or your family dig on any property, (maybe to plant a tree or garden or place a fence), talk to an adult about 811.

811 is the national call-before-you-dig phone number. Anyone who plans to dig on their property should call 811 or go to their state 811 center's website to request that the location of buried utilities be marked with paint or flags. This is so you don't unintentionally dig into an underground utility line.

SLIDE 24

What do you want to be when you grow up? [ask for some volunteers]

Energy is important to almost every job you might want. Firefighters need fuel to power their trucks, doctors need bright lights and comfortable offices, and chefs need energy to power their kitchens to make delicious meals!

SLIDE 25

Just like all the things you all want to be when you grow up, jobs in the energy industry are important and can be fun, too. And energy industry companies do more than you think! The natural gas industry employs 4 million Americans. It takes a lot of smart, hard-working people to keep our energy flowing.

What kind of jobs do you think are available in the energy and natural gas industries?

SLIDE 26

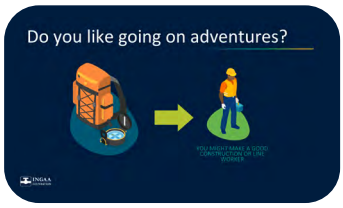
There are so many jobs in the energy industry and specifically dealing with natural gas, we need chemists, geologists and other scientists, engineers, builders and construction crews, and environmental specialists to name just a few! Each job plays a key role in making sure we have the energy and materials we need.

SLIDE 27

Raise your hand if you like science and/or math…

If you like these subjects, you might make a great engineer one day!

SLIDE 28



Raise your hand if you like going on adventures…

If you're an adventurous person, a lot of energy jobs involve working outside like line workers who repair power lines after a storm, pipeline construction workers who build the pipelines that allow natural gas to flow all throughout the country, or even an operator out at sea on a natural gas rig.

SLIDE 29

Raise your hand if you like investigating mysteries and doing research…

If this sounds interesting to you, you might enjoy being a leak survey technician to help make sure everyone's homes are safe and gas isn't released into the air.

SLIDE 30

Raise your hand if you like talking with people…

If you're a people-person, you might like being a team leader or being a call center operator talking to and helping people who use and need energy.

SLIDE 31

Raise your hand if you like cool rocks or digging…

If you like these activities, a career as a geologist might be perfect for you!

SLIDE 32

Jobs in the energy industry often have:

- Good pay
- Long, stable career
- Jobs all around the world
- Opportunities to travel
- Different types of school & training options
- Help build our clean energy future

There are also jobs that require different levels of education. With some you'll need to go to college and get a degree, but with others you can go through a training program after high school and get a specialized certificate for what you want to do.

SLIDE 33

We need innovators like you to continue working toward a clean energy future, to keep our planet healthy and our power on! Thank you for allowing me to come visit and learn with you today!

Our Future With Natural Gas

Audience: Grades 9-12 (High School)

Time to Complete Full Slide Deck: 45-60 minutes

Description: This slide deck provides a very comprehensive overview of energy, natural gas, natural gas industry goals, safety, and careers in the industry. *The full set is not suggested for use on one single visit, as it would be too much information and likely lose the attention of your audience.* The slides are broken up into sections and you may opt to present a specific section based on what might coordinate with the activity you have selected, the content pertinent to what students are presently studying, or what is relatable to your career, for example.

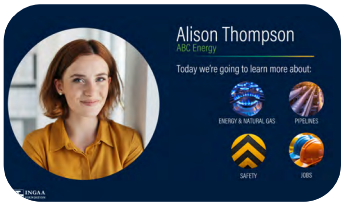
It is strongly suggested that you introduce yourself beginning with slide 2 and slides 10-20 to set the stage for any discussion related to natural gas. Slides 3-9 may be review for some students and can be considered optional.

A script for each slide is provided in the presenter notes of the file in addition to this guide.

SLIDE 1

Opening Slide

SLIDE 2

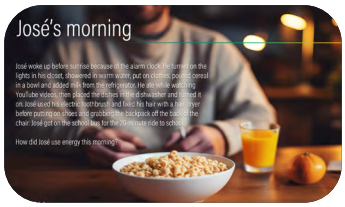


***be sure to customize slide!**

My name is _____ and I am a TITLE, with COMPANY. Today I'd like to share a little bit about ____(fill in from choices below)_____.

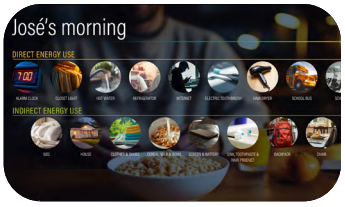
- Sources of Energy
- Natural Gas & The Natural Gas Industry
- How Pipelines Connect Us
- Natural Gas Safety
- Energy Careers for the Future

SLIDE 3



Take a look at José's morning. Does this morning routine sound familiar? What are all the ways José used energy? What other examples of energy use happen in your daily routine? (review examples on next slide)

SLIDE 4



What things power each of the examples of direct energy use?
What is the difference between direct energy use and indirect energy use? How do these items have energy.

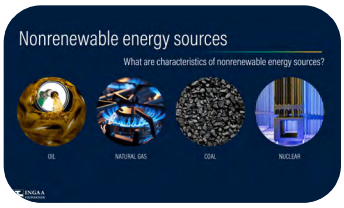
SLIDE 5

Let's back up and talk about where our energy comes from.

What are the characteristics of renewable energy sources, and how would we define "renewable"? Renewable energy comes from virtually unlimited, naturally replenished resources. These sources of energy are an important part of our energy mix, but can be dependent on other factors, such as weather conditions. They are sometimes intermittent, and mostly carbon-free, often described as clean.

- Solar energy comes from the sun and can be converted to heat or electricity.
- Wind energy comes from wind spinning giant turbines that generate electricity.
- Hydropower is energy coming from water. The power of water flowing can move turbines or water wheels to generate electricity.
- Biomass is renewable organic material that comes from plants and animals. Biomass can be burned directly for heat or converted to liquid and gaseous fuels through various processes.
- Geothermal energy comes from heat beneath the earth's surface — water or steam is used for heating and generating electricity.

SLIDE 6

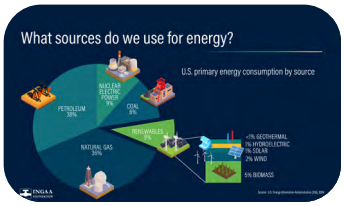


What might describe the characteristics of nonrenewable energy sources, and how would we define the term "nonrenewable?"

Nonrenewable energy sources are that cannot be replenished by natural processes as quickly as we will need or use them. Most sources were formed from fossilized plants and animal remnants from millions of years ago. The fossil fuel sources are harnessed through a combustion process which is reliable, and fairly "easy" to produce energy, however, produce carbon emissions.

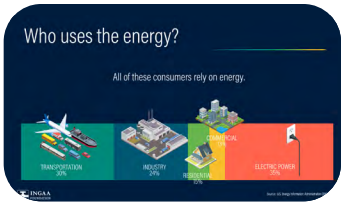
- Oil, also known as petroleum, is a fossil fuel and is the primary source of energy for the world today. It is used to fuel transportation, generate electricity and in the production of materials used for many everyday products.
- Natural gas is a cleaner burning fossil fuel. It is used to generate electricity, for heating and cooking, and as an industrial product for making goods.
- Coal is a fossil fuel in the form of a black rock. Coal burned to generate electricity.
- Nuclear energy is a carbon-free energy source produced through a process called fission, where heat, produced by splitting uranium atoms, boils water to make steam which turns turbines to generate electricity.

SLIDE 7



The U.S. consumes a lot of energy each year. The majority of this energy comes from nonrenewable sources – namely petroleum and natural gas. Less than 10% of our total energy consumed comes from renewable sources.

SLIDE 8



Each of these "sectors" of our economy describes a consumer of energy. As you can see, some things use more energy than others.

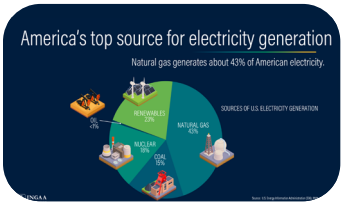
Electric power generation (power plants) consumes the most of our energy – 35%. Transportation (vehicles and movement of goods) uses 30%.

Industry uses 24% to make heat and/or produce products for consumers (manufacturing, agriculture, forestry, mining, construction, etc.)

Residential and Commercial consumers use energy in similar ways – for heating and cooking – in homes, businesses, schools, churches, and hospitals.

What source do you think generates the most of our electricity?

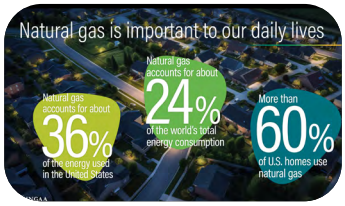
SLIDE 9



Most electricity in the U.S. is generated by heating energy sources to create steam. This steam is then used to spin turbines, powering electrical generators.

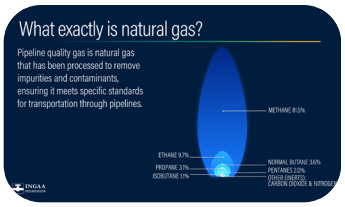
Natural gas is a crucial resource when it comes to electricity production. Over 40% of all electricity produced in the United States comes from natural gas.

SLIDE 10



Natural gas is an important source for U.S. energy - for home heating and cooking, for industry, and for electricity generation. It is also used similarly across the globe.

SLIDE 11



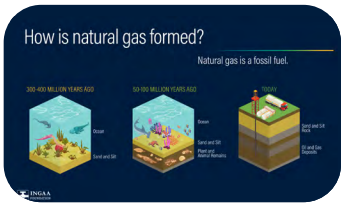
Now, let's answer a simple question — what exactly is natural gas?

Natural gas is a fossil fuel — a naturally occurring mixture of hydrogen and carbon (hydrocarbon) that is primarily composed of methane, along with smaller amounts of other gases like ethane, propane and butane.

It's found deep beneath the Earth's surface and is colorless and odorless in its natural state — until gas companies add a harmless chemical called mercaptan to give it its distinctive "rotten egg" smell, to keep us safe and alert us of its presence.

Methane, the main component, is a simple molecule with one carbon atom and four hydrogen atoms. This simplicity makes it super-efficient, producing more heat and light energy by mass than other hydrocarbons and less carbon emissions than coal or oil. It is the cleanest-burning fossil fuel.

SLIDE 12



Much of the natural gas we find and use today began as microscopic plants and animals living in shallow marine environments hundreds of millions of years ago, prior to dinosaurs roaming the Earth. As living organisms, they absorbed energy from the sun, which was stored as carbon molecules in their bodies. When they died, they sank to the bottom of the sea and were covered by layer after layer of sediment.

As this organic feedstock became buried deeper in the earth, heat, combined with the pressure of compaction, converted some of the biomaterial into natural gas. This process, called thermogenic methane production, results in natural gas being trapped in rock formations deep underground.

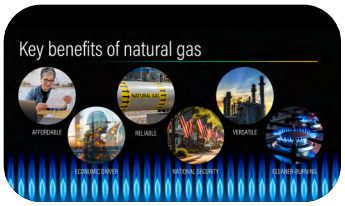
SLIDE 13

Natural gas can be made into a huge variety of products we use every day. What are some items you think might come from natural gas? (answers appear with click)

One of the main ways natural gas is involved with the production of these items is through plastics. Plastics can be produced from natural gas and the feedstocks derived from natural gas.

Natural gas contains a key ingredient called ethane, which is a building block of plastics. Ethane is extracted from natural gas, separating it from the methane, and then sent to what is a called an ethane cracker plant. There it is heated to extreme temperatures — 1,500ºF — which causes the molecular bonds to "crack" and form different bonds, resulting in a new molecule called ethylene.

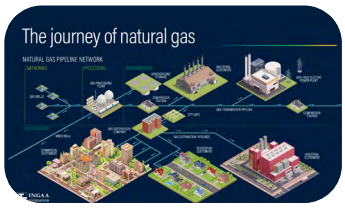
SLIDE 14



Natural gas has several key benefits that make it a valuable energy source.

- Affordable: Natural gas tends affordable due to its abundance and efficient extraction and distribution processes.
- Reliable: Natural gas is a dependable energy source and can provide consistent power and act as an excellent partner to renewables.
- Versatile: it can be used for electricity generation, heating, industrial processes and as a feedstock for producing a wide range of products, and as a transportation fuel (compressed natural gas (CNG) and LNG) especially for heavy-duty vehicles like buses and trucks.
- Economic Driver: The natural gas industry supports millions of jobs and fostering economic development.
- National Security: Since almost all the natural gas we use is produced here, it reduces the reliance on foreign energy sources and potential supply disruptions.
- Cleaner-burning: it's a cleaner-burning fuel, emitting less carbon dioxide and other pollutants than coal or oil. This makes it a significant player in reducing greenhouse gas emissions.

SLIDE 15

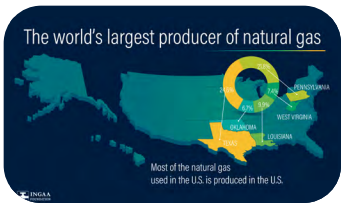


The journey of natural gas starts with exploration. Geologists use techniques like seismic surveys to identify potential gas reserves. Once they find a promising spot, drilling begins.

After the gas is extracted, it's processed to remove impurities, and the clean gas is then transported through pipelines for distribution or converted to LNG (Liquefied Natural Gas) for export.

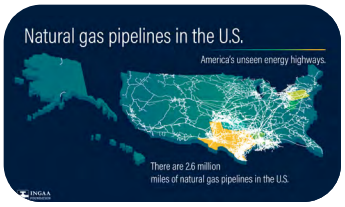
Storing natural gas is also key to ensuring a steady supply, especially during the high-demand periods of winter and summer. The most common way to store it is in underground facilities, such as depleted gas fields, aquifers or salt caverns but we can also store it in tanks above ground in smaller quantities.

SLIDE 16



The U.S. produces more natural gas than any other country. The largest reserves are in Texas, Pennsylvania, West Virginia, Louisiana and Oklahoma — these five states also represent our biggest producers of natural gas in 2023 and 2024.

SLIDE 17



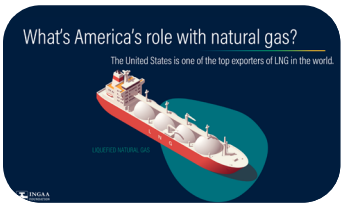
Have you ever seen a pipeline?

Pipelines connect us by delivering products like natural gas, gasoline, diesel, jet fuel and home heating oil to where they are needed, every day. Pipelines also transport carbon dioxide and hydrogen!

There are 2.6 million miles of natural gas pipelines in the U.S. This includes 2.3 million miles of gas distribution and over 300,000 miles of gas transmission pipelines. (This would stretch to the moon and back almost nine times.)

These pipelines are largely unseen and exist almost everywhere to transport natural gas from where it is produced to processing centers where it is purified. From there, smaller buried distribution pipelines deliver the natural gas directly to our homes and businesses.

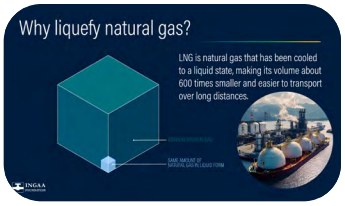
SLIDE 18



The U.S. can export natural gas to other countries for higher costs. The U.S. began exporting LNG from the lower 48 states in 2016, and exports more via ship than pipelines.

What is LNG and why do we liquefy it? [answered on next slide]

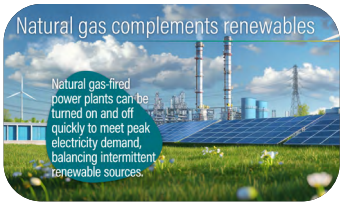
SLIDE 19



LNG is natural gas that has been cooled to a liquid state, where the volume becomes about 600 times smaller than its gaseous volume, making it easier to store and transport over long distances, especially to markets that lack pipeline infrastructure.

LNG is important to the global energy ecosystem, as it allows access to a lower carbon source for energy in areas where it is not accessible.

SLIDE 20



Natural Gas plays a critical role in today's energy ecosystem and as we look to the future, its importance is expected to grow as countries transition to lower-carbon energy systems. Natural gas can be transported easily with proper infrastructure, and it can be used as an alternative for other sources when needed. By complementing intermittent renewable energy sources like wind and solar, natural gas helps ensure a stable and consistent energy supply.

SLIDE 21

SLIDE 22

Let's talk about natural gas and its role in helping lead the way to a cleaner energy future.
With the push for cleaner energy, more and more countries are trying to cut down on carbon emissions, maintaining natural gas as a key component in that mix. Because of its affordability, reliability, versatility — and of course because it burns cleaner than other non-renewable energy sources— natural gas will have a vital role in the transition to a cleaner energy future.

SLIDE 23

When it comes to emissions, we're looking at greenhouse gases (GHG): CO_2, methane, nitrous oxide and fluorinated gases — carbon dioxide and methane are often the major focus. These gases exist naturally in our atmosphere and trap thermal energy, which we need on our planet to sustain life.

Throughout its history, the Earth's climate has been changing. However, the changes we are seeing now are happening at a much faster rate than they would naturally. Why? The cause is from humans emitting excess carbon dioxide and other greenhouse gases into the atmosphere, where they build up and slowly increase the temperature of our planet.

Why is climate change bad?

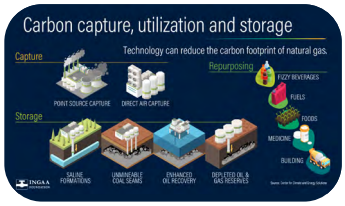
[Some potential answers include:]

- Hotter temperatures
- More severe storms
- Increased drought
- A warming, rising ocean
- Loss of species
- More health risks

SLIDE 24

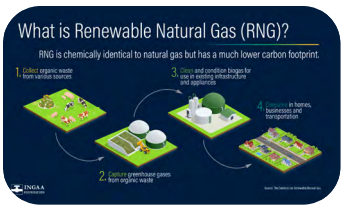
What are some solutions to reduce CO_2 emissions and what is the industry doing to help? [answers appear on click]

SLIDE 25



Carbon capture, utilization and storage (CCUS) technologies are innovations that involve capturing CO_2 emissions from natural gas power plants and other industrial sources. This CO_2 can then be transferred by pipeline to a safe storage site to be injected deep underground where it can remain permanently separated from the atmosphere, or it can be repurposed and recycled in a multitude of ways.

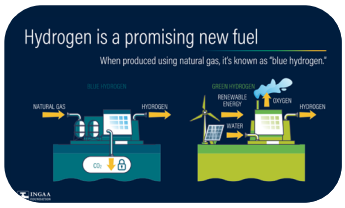
SLIDE 26



Renewable Natural Gas (RNG), also known as biomethane, is a waste-derived fuel that can be used to power homes, businesses and even vehicles.

Produced from organic waste, such as agricultural residues, landfill waste and wastewater treatment plants, RNG is chemically identical to conventional natural gas but has a much lower carbon footprint, as it recycles carbon that is already in the ecosystem rather than adding new carbon from non-renewable energy sources. RNG can be injected into existing natural gas pipelines, providing a renewable and sustainable energy source for heating, electricity and transportation and is part of the broader trend toward decarbonizing the natural gas supply chain.

SLIDE 27

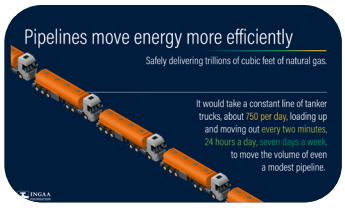


Hydrogen may also play large role in energy transitions as it can be fuel used for electricity generation, transportation, and heat without generating carbon dioxide.

When produced using natural gas through a process called steam methane reforming (SMR) combined with CCUS, it's known as "blue hydrogen. "Green hydrogen" is produced from renewables with electrolysis.

SLIDE 28

SLIDE 29

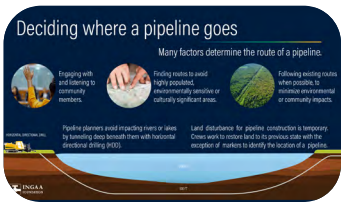


American pipelines transport natural gas from nearly 275,000 gas wells in various production areas of the country over hundreds or even thousands of miles to customers in cities, towns and industrial facilities.

The capacity of energy moved by pipelines is well beyond the capacity that could be moved by other forms of transportation currently available such as by truck or by rail.

The railroad-equivalent of this single pipeline would be a train of 225 28,000-gallon tank cars.

SLIDE 30



Many factors go into determining the route a pipeline will travel. Engaging with and listening to community members where a pipeline will be located is a very important part of the process.

During the planning for a new pipeline, pipeline operators map out potential routes to avoid areas that are highly populated, environmentally sensitive or have cultural significance.
Operators will also try to follow existing pipeline or power line routes to minimize new environmental or community impacts.

SLIDE 31

Pipelines are considered a transportation method. They are considered the safest way to delivery energy!

SLIDE 32

Technology plays a key role in keeping pipelines safe.
[Highlight the technologies shown]

SLIDE 33

What are some ways pipelines help our communities? [appear on click]

Pipelines deliver fuels to our homes, provide a source for products we use every day, support farmers with fuel and fertilizer products, deliver fuels for transportation, and allow us to rely on fuel produced in our own country without importing from global supply.

SLIDE 34

Pipelines will need to be built to transport low-carbon energy products and large-scale networks of carbon dioxide. And hydrogen pipelines are needed to meet national and global emissions reduction goals.

SLIDE 35

SLIDE 36

811 is the national call-before-you-dig phone number. Anyone who plans to dig should call 811 or go to their state 811 center's website a few business days before digging to request that the approximate location of buried utilities. They will be marked with flags to notify anyone before digging. A simple call can prevent serious accidents by ensuring you don't accidentally hit a buried pipeline.

Of course, safety isn't just about the pipelines — it's also about how we use natural gas at home. Keeping your home safe means maintaining your gas appliances regularly. That includes everything from your furnace to your water heater. Here's a tip: if you ever smell that familiar 'rotten egg' odor, it could be a sign of a gas leak. In that case, leave your home immediately and call for help.

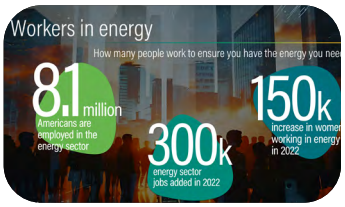
SLIDE 37

Safety for workers is just as crucial as public safety. Every day, thousands of employees operate in environments where safety protocols are followed — from mandatory personal protective equipment (PPE) to regular safety training, the industry is committed to keeping workers safe on the job.

There are also new wearable technology and other innovations designed to protect workers in addition to entire careers dedicated to safety in the natural gas field. Whether it's pipeline safety inspectors, gas leak technicians or health and safety officers, these professionals are the backbone of the industry's safety efforts.

SLIDE 38

SLIDE 39

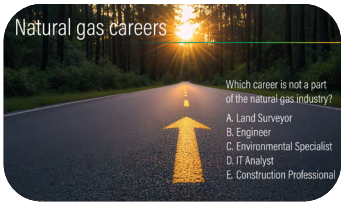


The energy industry is growing to take on the opportunities and some of the challenges that we have discussed. Clean energy jobs have increased 3.9% and women specifically made up more than half of new workers joining the industry in 2022. The energy industry is one where any of you could have an amazing career.

SLIDE 40

Not only do careers in this industry offer good benefits and fair wages, but they also provide the chance to be part of the future of energy.

SLIDE 41



Can you guess which of these careers is not a part of the natural gas industry?

That was a trick question — these are all careers within the natural gas industry. Careers in this industry are diverse, offering opportunities for both those with and without a college degree.

SLIDE 42

For those interested in pursuing a college degree in science, mathematics, engineering or other related STEM fields, one of these careers might be a great fit for you after graduation.

While salaries and benefits can range by field, location and seniority, there are a wide variety of career pathways someone might take to get into this industry for degree seekers and non-degree seekers alike.

Additionally, these salaries and benefits do not necessarily reflect the total compensation possibilities with respect to overtime, per diem, vehicle allowances/reimbursements and much more.

SLIDE 43

For those interested in heading directly into the workforce after obtaining a high school diploma or GED, many of these career opportunities are ready to accept workers with no prior experience. These jobs typically still require some form of certification, apprenticeship/internship or other form of on-the-job training to ensure workers feel confident and prepared for their roles.

Additionally, these salaries and benefits do not necessarily reflect the total compensation possibilities with respect to overtime, per diem, vehicle allowances/reimbursements and much more.

SLIDE 44

What do you YOU want to look for in a new job? This list describes many of the benefits of working in this industry!

And while those careers may seem expected within this industry, there are also plenty of career opportunities that you might not expect. All of them benefit from the list you see here, but others include:

- Accountant
- Attorney
- HR Professional
- Truck Driver
- Office Manager
- Data Analyst
- Communications Manager
- Real Estate Agent
- Government Affairs Specialist
- Public Relations Specialist
- Health & Safety Specialist
- Sales Representative
- ....and many more!

SLIDE 45

Pipelines help support not only the jobs of those working on them, but so many other jobs that our communities rely on.

NATURAL GAS BASICS
COLORING SHEETS

Check out this training and informational video!

Topic

Energy Sources & Natural Gas Basics

Grade Level

Elementary, grades K-5 (best suited for K-3)

Time

30 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is most often a nonrenewable fossil fuel, but natural gas can also be produced from renewable sources.
- Natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.

Materials

- Colored pencils, markers, crayons, etc.
- Coloring sheet(s) of choice
- Safety equipment: PPE, mercaptan cards, etc.

Relevant Slides

- Sandy's Deep Dive Adventure

Background Information

Coloring sheets are a great activity for a quick visit to a classroom or handout for community fair or table-style event. The slides can be used or skipped. Each coloring sheet aims to introduce or reinforce basics about natural gas and the industry. Select one or provide all. If visiting a classroom, check to ensure that art supplies are available.

Basic Steps

1. Introduce yourself with the powerpoint and read through "Sandy's Deep Dive Adventure" slides as a story.
2. Demonstrate safety equipment. Discuss what to do if you smell natural gas.
3. Hand out the coloring pages. Give students time to color them and then read the captions together. Discuss and review the important points on each and review the discussion questions.
4. Pass out an ***Elementary Exit Ticket*** or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- How is natural gas used?
- How is natural gas moved?
- What is something that wasn't included in the slides/story that might be made from natural gas?
- What should you do if you smell gas?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

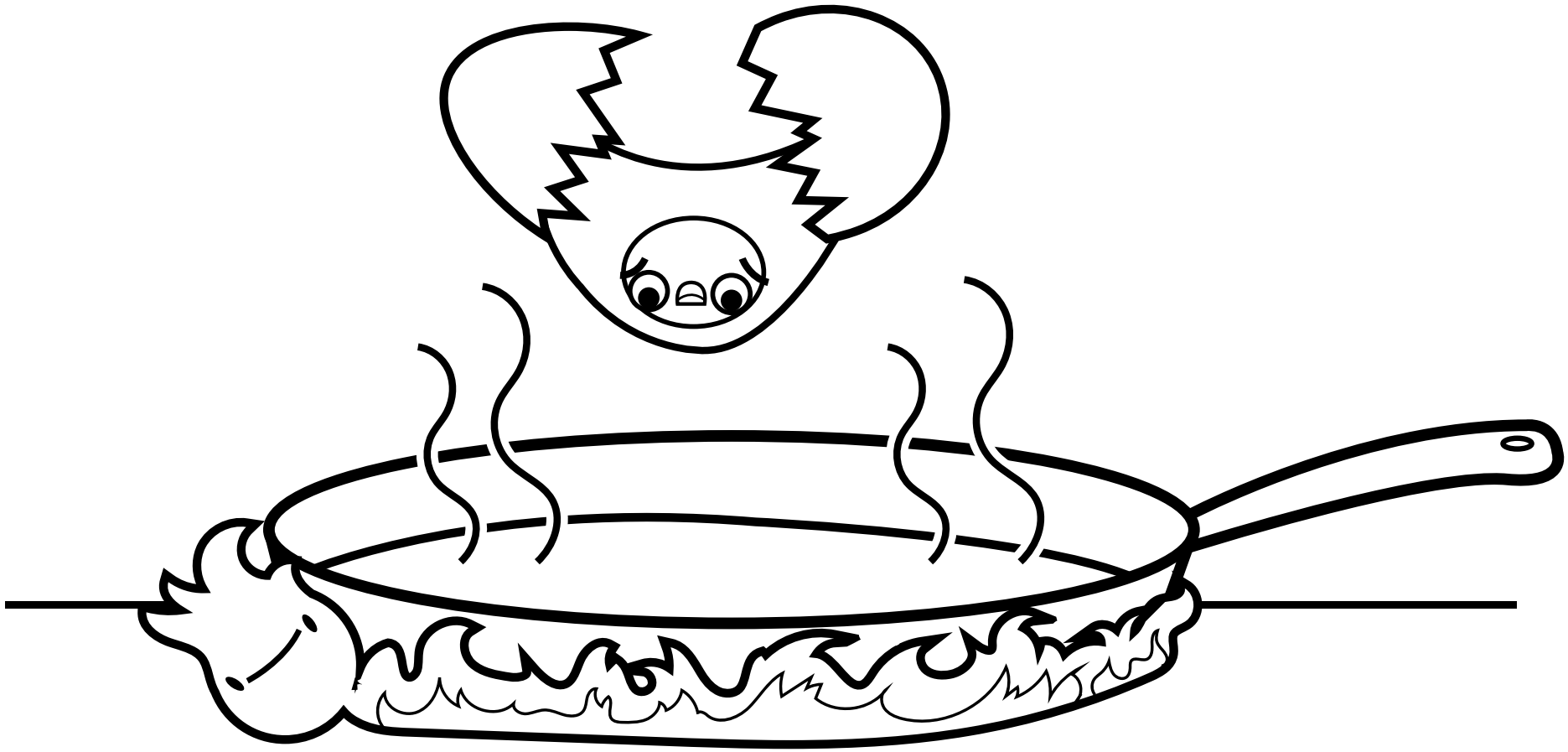
- Provide the "Sandy's Deep Dive Adventure" slide deck to the educator to preview with the students if time is very limited. Discuss the basics on the slides, the discussion questions, and simply focus on the coloring sheets and safety elements of natural gas.

Amplify the Content

- Have students modify the story of "Sandy's Deep Dive Adventure", adding to it by writing a sequel about natural gas safety.

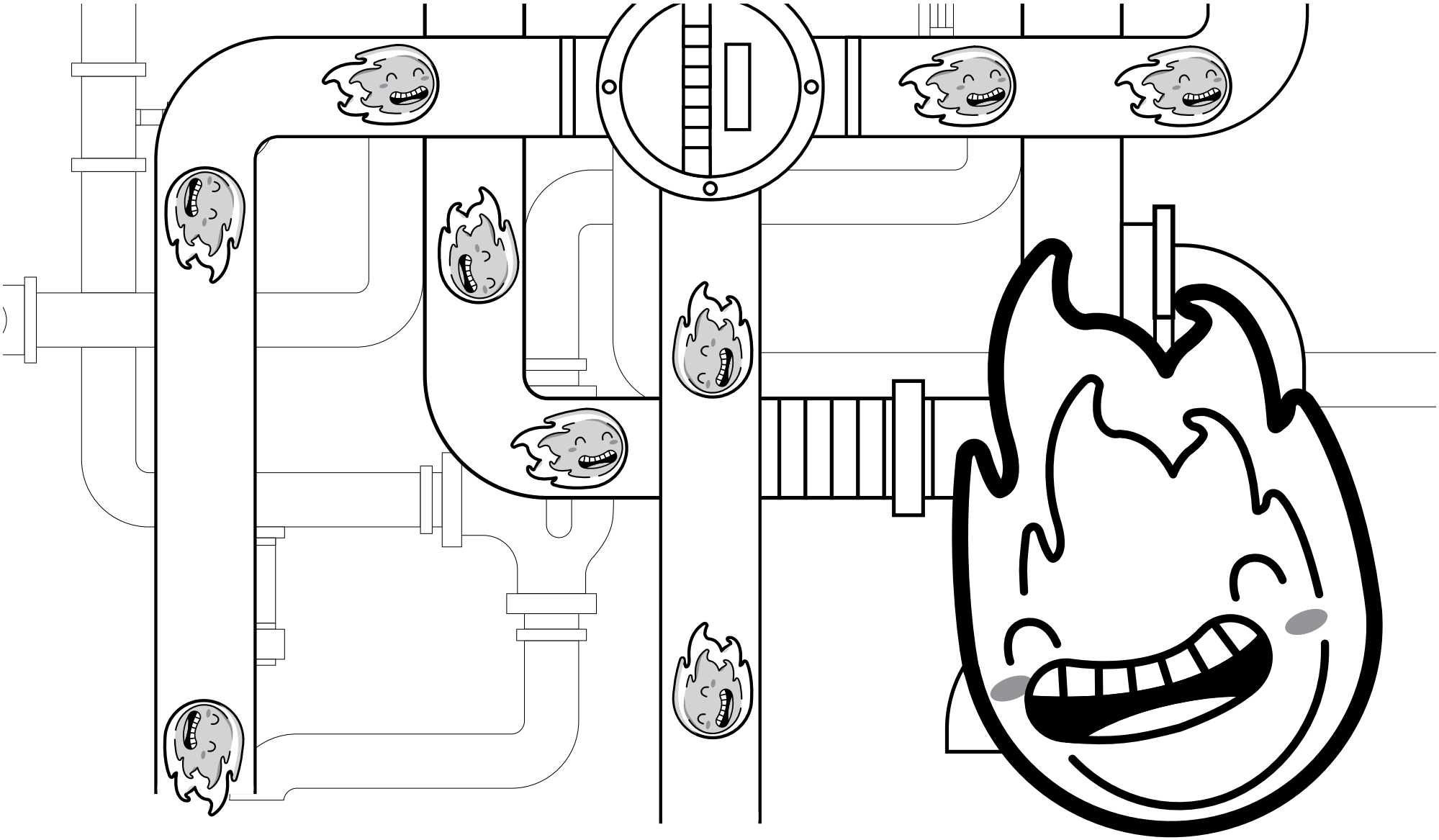
Additional Resources

- U.S. Department of Energy, Energy Information Administration Kids Page: **www.eia.gov/kids/energy-sources/natural-gas/**
- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- The INGAA Foundation: **www.ingaa.org/issue/safety/**
- American Gas Association, Kids and Natural Gas Safety Video: **https://youtu.be/nMEh4j_G8Nw?si=wm0lONqmnwFhrsbg**
- Virginia Natural Gas, Safety Activities for Kids: **www.virginianaturalgas.com/safety/safety-activities-for-kids.html**
- Student Energy, Natural Gas 101 Video **https://youtu.be/-njmj0diWu8**



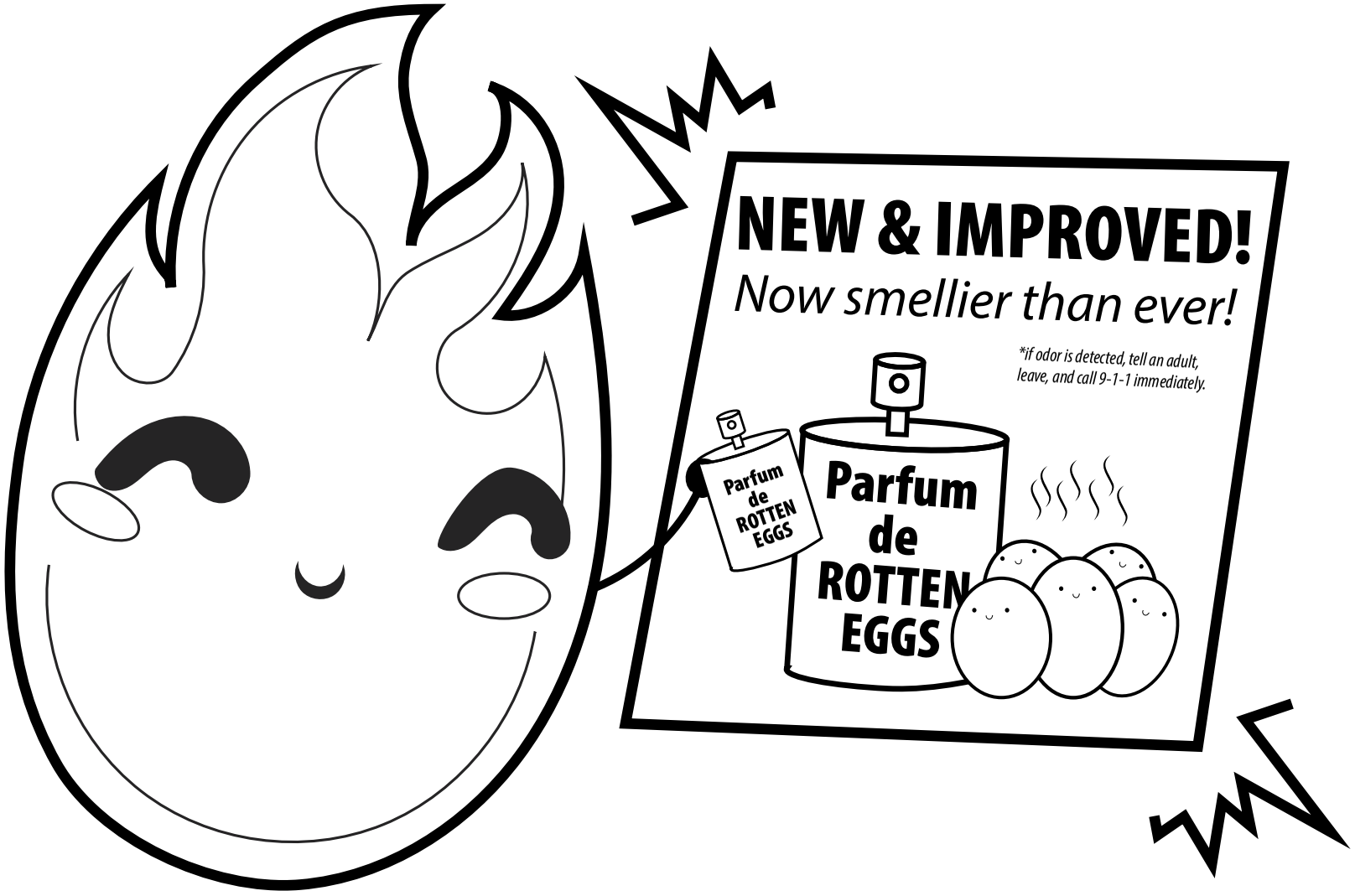
WE USE NATURAL GAS EVERY DAY

Almost everyone uses natural gas.
Many homes use natural gas for heat.
So do schools and hospitals.
Many stoves and water heaters use natural gas, too.



NATURAL GAS IS TRANSPORTED IN PIPELINES

We move natural gas from one place to another in pipelines.
Pipelines bring natural gas from wells to processing plants, then on to our homes, businesses and factories.



NATURAL GAS SMELLS LIKE ROTTEN EGGS!

Natural gas has no color or smell in nature.
We add a smell to it for safety before it comes to homes and businesses. If you smell the rotten egg smell of natural gas, leave the area immediately and tell an adult!

CANDY COLLECTOR

Check out this training and informational video!

Topic

Energy Sources & Natural Gas Basics, Future of Natural Gas

Grade Level

Elementary, grades K-5
Middle, grades 6-8
High School, grades 9-12

Time

45 minutes

Science Content

- Energy is involved in everything we do.
- We use energy to support our lifestyle.
- Recovering energy sources can have its challenges and these challenges sometimes determine the sources we use.
- Energy sources can be classified as renewable or nonrenewable.
- Natural gas is a clear, colorless, odorless gas made mostly of methane. Natural gas is a nonrenewable fossil fuel.
- Oil and natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.

Materials

- M&Ms or similar candies (or non-food tokens)
- Jelly beans or similarly-sized candies (or non-food tokens)
- Bowls
- Bathroom-sized paper cups
- Straws
- Timer or phone with stopwatch setting

Relevant Slides

- Sandy's Deep Dive Adventure

OR

- Let's Talk About Energy, Slides 1-6, then 7-18

OR

- Our Future with Natural Gas, Slides 1-6, then 7-21

Background Information

This is a fun game to introduce students to energy sources and how we harness them, as well as the terms "renewable" and "nonrenewable." Students will get a closer look at how to use renewable and nonrenewable sources together in order to prolong the availability of nonrenewable resources, like natural gas, and maximize the potential of renewable resources like wind and solar. This activity can be played in small groups, but it is strongly suggested to set up the activity with individual sets of supplies to minimize germs around students. Consider providing supplies that are individually wrapped (straws, packs of candy, etc.), for ease of distribution.

Basic Steps

1. Set up the activity prior to engaging with the students. Set up requires that each student receives 2 small bowls, 1 small cup, approximately 20-30 M&Ms, and 1 straw to start.

   NOTE: Two "Fun Size" bags of M&Ms will be adequate for each student. If you use wrapped jelly beans (or similar), you may also pass those out at this time. If not, wait until step 9 below.

2. Introduce natural gas to the students by showcasing the slides that introduce the students to you, your company, and energy basics.
3. Explain to the students that you will play a game to think about how we use energy. Tell them that this game will use candy, but it is important that they do not eat any candy until the game is over. Remind students that natural gas is one example of an energy source. Describe the game play scenario for the students as follows:

   Pretend you are settling in a new town, just like the settlers did long ago. Your job is to find the energy sources that people in your town can use to cook with and light their homes. The candy in this game represents the energy sources. Place all of the M&Ms into one bowl and do not eat any candy until the end of the game. This bowl of candy is your earth filled with energy sources. Place the empty cup beside the bowl. This is your storage tank. Your job will be to get energy out of the earth bowl and into the storage tank cup, but you may ONLY use the tool provided – a straw. You may not use your hands to move the candy, the bowl, or the cup!

4. Tell the class they will have "one year" or 15 seconds to move as much energy from the bowl to the cup as they are able. Remind them they may not use their hands; they may only use the straw. Ask them to set the third bowl to the side, they will need it later.
5. Set the timer and tell students when to begin. Give alerts every few seconds with the time remaining. Tell students to put their straws down when time is up.
6. Tell students that at the end of the year, they must count how much "energy" or candy made it into their cup. Ask students to hold up their hands/fingers for how much energy they recovered and tally up or record their energy pieces on a piece of scratch paper.
7. Prompt the students to get ready for "year 2." But explain that the candy in their cup from "year 1" was used by the town and must be discarded. Tell them to pour the candy from the cup into the empty bowl. This is the discard bowl.
8. Have the students repeat steps 4-7 for "year 2" and "year 3". After three years, ask students how much "energy" they have left. Ask them to predict and share how much longer their energy will last? Ask them to explain what they might do if their town no longer has energy.

CONTINUED ON NEXT PAGE

9. Explain that you are going to play the game again now, but in the modern day. Give the following scenario for students:

   Now we are going to repeat the game in the modern day. In the modern day we have energy available to us just like we did when we first settled. Place ALL of your M&Ms back into bowl one. In modern day, we also have some new energy resources that have been found. Place three (only 3) jellybeans into your bowl as well. These are energy, but a new type! Set up your cup as your storage tank and the third bowl as your discard bowl in a row again. In the modern day, we have also realized we have new technologies that help us use energy more wisely. We do not need to move as many pieces of energy as we did in the past. In this round you will ONLY move four (4) total pieces of energy candy into the cup using your straw. You will have 15 seconds to get four pieces of candy. Stop when you get four.

10. Set the timer. Review the procedure if necessary, and conduct the steps again, giving students 15 seconds to move the candy into their cup. Ask students to share how successful they were. Ask if they had any challenges this time, now that the jellybeans were in their bowl?
11. Instruct the class to follow the same procedure from before, moving the M&Ms to the discard bowl to set up for the next round. However, explain that the new energy sources, the jellybeans, go back into bowl one.
12. Repeat another round of 15 seconds, with students recovering four pieces of energy into their cup. Ask students if their strategy changed for this round and to explain why. Repeat the process of moving jellybeans back to bowl one and M&Ms to the discard bowl.
13. Complete another round or two, based upon time. Clean up and direct students to eat any candy as allowable.
14. Continue with the slides if time allows, and share information on natural gas and the industry.
15. Pass out an ***Exit Ticket*** for the appropriate grade level, or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What did the M&Ms represent in the game. What did the jellybeans represent in the game?
- What type of energy source is natural gas – renewable or nonrenewable?
- What are the reasons we don't use only one source as a society? How does it help us when we use energy sources strategically together?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Shorten the activity by doing less rounds of play in both scenarios.

Amplify the Content

- Have students graph their candy "curves" over time. A Google sheet is also a fun way to compare individual results with a class.
- Adjust candy numbers for different students to showcase how energy source availability and access can differ.
- Incorporate safety and other show and tell items to make the natural gas connections more robust.
- Compare the activity model to the real world with older students. Discuss similarities and differences considering geography, geology, economics, behaviors, etc.

Additional Resources

- The NEED Project, Energy Infosheets: **www.need.org/need-students/energy-infobooks/**
- U.S. Department of Energy, Energy Information Administration Kids Page: **www.eia.gov/kids/energy-sources/**
- Switch Energy Project, What is Energy Video: What is Energy: Foundation of Modern Life: **www.youtu.be/By2Omyxb88g?si=jTfAT3VxITDu-wiC**
- Smile & Learn, What is Energy? Video: **www.youtu.be/aFpC1vAIgNc?si=CQyFZTlD6nB3qI6E**

NAVIGATING NATURAL GAS RELAY

Topic

Energy Sources & Natural Gas Basics

Grade Level

Elementary, grades K-5
Middle, grades 6-8

Time

45 minutes

Science Content

- Energy is involved in everything we do.
- Natural gas is a clear, colorless, odorless gas made mostly of methane. Natural gas is a nonrenewable fossil fuel.
- Oil and natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Natural gas can be used to create many products.

Materials

- Shoebox or container with solid (not transparent) sides
- Items made from natural gas
- Items NOT made from natural gas
- Paper

Relevant Slides

- Sandy's Deep Dive Adventure

OR

- Let's Talk About Energy, slides 1-18

Background Information

The industrial sector accounts for roughly one-third of all natural gas consumed. Natural gas is a heat source to manufacture products and is also a good feedstock or building block for others. This activity aims to introduce students to the multitude of products in our world that are created with natural gas. Students will be divided into teams that will work in relay fashion to identify as many items in a box as they can. The winning team will recall and correctly identify the most items in the time allowed.

Basic Steps

1. Ahead of your event or visit, assemble a "Navigating Natural Gas Box." A shoe box or box from any home delivery should work, so long as it has opaque sides. Gather an appropriate number of supplies for placing inside the box. It is suggested to have at least 15 items, if not more. Most items should be made from natural gas (petrochemicals), but be sure to include at **least one item** that is **NOT** made from natural gas.
   - **Natural gas items could include:** allergy medicine, anti-freeze, bandages, bug spray, cell phone, crayon, dish soap, diaper, fertilizer, fishing line, foam plate or cup, food wrapper (plastic), golf ball, glue, household cleaner wipes, insulated wiring, lipstick/lip gloss, makeup, medication bottle, pantyhose, paint, paintbrush, perfume, PVC pipe elbow, safety glasses, toy car (plastic), tooth brush, trash bag, water bottle (plastic)
   - **Items not made from natural gas could include:** aluminum foil, fork, golf pencil, key, magnet, paper, penny, pumice stone, wood

Check out this training and informational video!

2. Set up the room for the game ahead of your presentation. Place the box in an area of the space where students will not be able to see inside the box before the activity starts. Create "relay stations" where teams will congregate during the game with a pencil and paper for each team. Stations should be far enough away from the box that they cannot see inside it, even if it is open. You will need to know how many students you have in order to set up teams of manageable sizes for the activity.
3. Introduce natural gas to the students by showcasing the slides that introduce the students to you, your company, energy and natural gas basics. If students are lacking engagement, you may opt to pause to play the game and return to the slides.
4. Divide students into teams with the educator's help. Send the teams to their relay stations. Explain that they are going to play a game using the following prompt:

   The object of this game, Navigating Natural Gas, is for each team to correctly identify as many items as possible that are made from natural gas. This box [demonstrate box] contains items made from natural gas and a few items that are not made from natural gas. In relay fashion, each team member will come to the box, one at a time without the pencil or paper. They will visually navigate the box, and notice the items inside, without touching. They should aim to stay at the box for around 5 seconds and return back to the station. The player will tag the next player in line and write down as many items that they can remember from the box that are made from natural gas without talking. The second player will head to the box, navigate, and return, tagging the next player in line. They will then take the pencil and silently write down the items they remember, or cross off items they disagree with. The relay will continue until I say stop. Team members may not talk to each other and must stay in their relay line, but team members may look at the list so they can try and look for new items when it is their turn. Once all players have navigated past the box, they may continue adding or crossing off items. Players may only visit the box and use the pencil when it is their turn in line. The team with the most correct items will be the winner, but items will not earn points if listed twice. Be careful, there are items in the box that are NOT made from natural gas!

CONTINUED ON NEXT PAGE

5. Alert the class how much time you will allow. Make sure each team is in a single file line, and they know their order. Review the rules if needed.

   NOTE: younger students may require more time. The amount of time needed will depend on the number of items in your box and the number of students per team. A smaller number of items in the box will require less time. Smaller groups will also require less time but ensure enough time that all group members have a chance to proceed at least once.

6. Give the teams the cue to begin and monitor for adherence to rules. Provide reminders of how much time remains, and help students monitor their five seconds at the box. You can artificially shorten or extend the time remaining as needed, if you notice teams need less or more time than allowed.
7. Ask the teams to write their names on their paper and review the lists for scores. Provide one point for each item but be careful to look for duplicates like "pencil and writing utensil." Deduct 5 points for any incorrect item that is NOT made from natural gas.
8. Share the winning team and then go through the box contents together. Give students an opportunity to "thumbs up or thumbs down" if an item is made from natural gas. Discuss any questions or contentions. Are there any items that are NOT made from natural gas that may still have natural gas involved somehow in their creation or use? Award prizes if allowable.
9. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What are the ways we use natural gas?
- What is something that wasn't included in game (or slides) that might be made from natural gas?
- What would our lives be like today without natural gas? Which things could we do without?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Reduce the number of slides.
- You may take a picture of items to create a digital "Navigating Natural Gas Box" to add to your slides. This will allow you to cut down on items you need to bring with you.
- In place of the relay game, show the box (or slide detailed above) and ask students to discuss the contents.

Amplify the Content

- Have students score their own team list.
- Discuss or show items that they don't see in the box. Where do these items fall on the list – made from natural gas or not?
- Incorporate safety and other show and tell items to make the natural gas connections more robust.
- Ask students to write or discuss what their day would be like without the items made from natural gas.

Additional Resources

- The INGAA Foundation Issues, Economics: **www.ingaa.org/issue/economics/**
- U.S. Department of Energy, Energy Information Administration Kids Page: **www.eia.gov/kids/energy-sources/natural-gas/**
- U.S. Department of Energy, Natural Gas Products Infographic: **www.energy.gov/sites/prod/files/2019/11/f68/Products%20Made%20From%20Oil%20and%20Natural%20Gas%20Infographic.pdf**
- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- Spectra Energy, What Products Are Made with Natural Gas Video: **https://youtu.be/nfiubLS4Gpg?si=mM1tpEefyNf3x-b3**

RENEWABLE NATURAL GAS IN A BAG

Check out this training and informational video!

Topic

Energy Sources & Natural Gas Basics, Future of Natural Gas

Grade Level

Elementary, grades K-5
Middle, grades 6-8
High School, grades 9-12

Time

30-60 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is most often a nonrenewable fossil fuel, but natural gas can also be produced from renewable sources.
- Renewable natural gas is formed from waste decay processes when oxygen is not present (fermentation, landfills, digesters, etc).
- The biogas that is created from waste decay processes can be treated to have similar methane content and characteristics of fossil fuel natural gas. This renewable natural gas is fully interchangeable with fossil fuel natural gas and can be moved through the pipeline system.
- Natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas can be used to create many products.

Materials

- Sugar
- Baker's yeast
- Resealable plastic bags
- Warm water or electric tea kettle
- Safety glasses
- Plastic spoons, teaspoon size
- Permanent markers or sticky labels
- Camera *(optional)*
- Yard waste, compostable food scraps [non-meat, non-dairy] *(optional)*

Relevant Slides

- Sandy's Deep Dive Adventure

OR

- Let's Talk About Natural Gas, slides 1-18

OR

- Our Future with Natural Gas, slides 1-28

Background Information

Renewable natural gas (RNG) is natural gas that is produced from biomass instead of fossilized plant and animal remains. Biomass is energy that comes from living or once living (organic) sources. Wood, garbage, animal waste, crops, and even sewage all count as biomass. They can give off their energy once they are fermented, decayed, and/or burned. Biogas is the gas that is produced from decaying biomass. Biogas can be cleaned and turned into RNG that is fully interchangeable with pipeline quality natural gas. Students will make biogas through fermentation – the use of a microorganism (yeast) to break down material.

Basic Steps

1. Preview the student worksheet.
2. Gather the supplies and decide if you will prepare a sample using yard waste or food scraps. If creating a sample using these items, prepare this a few days in advance.
3. Prepare copies of the student worksheet or make a digital copy to insert into your slides.
4. Set up assembly stations for the students and make sure there is a windowsill or flat space to allow the students to place their bags. It will help if this is a warm spot, like a sunny window area or near a heat register, as it will expedite the process.
5. Prepare a source of warm water to help dissolve the sugar and activate the yeast. Water that is around 40˚C/100˚F will work best.
6. Introduce yourself to students and briefly introduce natural gas with your slides. Pause before getting into too much detail on natural gas, as it is a great time to interrupt and set up the bags to increase engagement in the concept.
7. For younger students, explain that you will be mimicking the creation of a gas, like natural gas. For older students, you can avoid making the connection until the end, in favor of allowing them to make the connection. Ask students if they know how to tell if a gas is present [bubbles appear], if they have heard of the process of fermentation, and if they can describe anything they know about it.
8. Review the activity instructions and demonstrate the activity setup. Provide students with time to assemble their bags and label them with a permanent marker or label with their name, date, and contents. Help students arrange them on a windowsill or area that will be warmer.
9. Ask students to complete their worksheets and make predictions.
10. Discuss predictions and the plan for observing their bags and recording data.
11. Clean up and for older students, continue the slide presentation while the "natural gas" is forming in their bags. For younger students, consider coupling this activity with a coloring sheet or showing a video clip.

CONTINUED ON NEXT PAGE

12. After you finish with the slides, allow students time to go retrieve their bags and make observations. Discuss what students are seeing, how their bags compare to the bags of others, and how they know a gas is present. They should be seeing bubbles and if they open their bags, they should know by smell that fermentation has occurred.
13. Explain that natural gas can be made from biomass, or organic matter like sugar or other plant matter, garbage, animal waste, and even sewage. As the organic matter decays or ferments over time, gas is produced. This gas is called biogas and often contains methane, the same gas we use as natural gas! Explain or review that decaying or fermentation are chemical changes, and gas bubbles are a sign that a chemical change has occurred. Bacteria or other tiny organisms, like yeast in the bags, help the decaying or fermenting to happen.
14. For younger students, explain how the bag models a part of the renewable natural gas process. For older students, ask them to make connections and discuss together.
15. Highlight that "biogases", like that created in your bag, will be further processed or treated in order to be called Renewable Natural Gas or RNG. This involves removing water and contaminants and increases the methane content so it can be used just like any natural gas that comes into a home or business.
16. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What did you notice in the bag over time?
- What would happen if the bag were placed in a cool space?
- Could this process happen without the yeast?
- How is your bag similar to a landfill or biogas digester that creates methane gas? How is it different?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- For younger students, a table or fair, or quicker assembly, pre-measure sugar and yeast and assemble the bags ahead of time. Students can add warm water when ready.

Amplify the Content

- Allow students to adjust the amounts of sugar, yeast, amount of water, or water temperature to see what effects these variables have on creating a gas.
- Allow students to use a different feedstock than sugar, such as plant matter, food scraps, cardboard, etc. Or, allow students to tweak the set-up using a water bottle and balloon.
- Host a virtual check-in session to communicate further results with the class.

Additional Resources

- The NEED Project, Biomass Infosheet: **www.need.org/wp-content/uploads/2024/10/Biomass-SEC.pdf**
- The NEED Project, Energy Stories and More page 33: **www.issuu.com/theneedproject/docs/energystoriesandmore**
- Student Energy, Biofuels 101 Video: **https://youtu.be/ZGmwtDffc74**
- Great Lakes Bioenergy Research Center: **www.glbrc.org/outreach**

RENEWABLE NATURAL GAS IN A BAG

Question

How can you make natural gas?

Hypothesis

Materials

- Resealable plastic bag
- Sugar
- Yeast
- Warm water
- Plastic spoon (teaspoon size)
- Permanent marker or label
- Safety glasses
- Camera (optional)
- Food and yard scraps (optional)

Procedure

1. Open the plastic bag. Use the spoon to add about 1 teaspoon of sugar to the bag.
2. Add about 1 teaspoon of yeast to the bag.
3. If you are using plant and food scraps, crunch or smash them up well and add them to the bag. Add 1 teaspoon extra of yeast.
4. Add about 10-12 teaspoons of warm water to the bag.
5. Make sure your bag has empty space, too.
6. Force as much air out of your bag as possible before you seal it.
7. Once your bag is sealed, carefully label it with your name, the date, and the contents of the bag. Take a picture of the bag if a camera is available.
8. Place the bag in a warm place, like a windowsill, and allow it to stay there for several days. Observe and take notes on the conditions of your bag each day, or as time allows.
9. Dispose of your bag as your teacher directs.

Observations

Draw and describe what you see happening each day to the contents of your bag.

Conclusions

1. What did you notice happening to the contents of the bag over time?

2. What happened to the empty space in the bag over time?

3. How did you know a gas was produced?

4. What would happen if the bag was in a cool space with no warmth or light?

5. Could you create the gas without the yeast? What do you think would happen?

A NATURAL GAS STORY

Check out this training and informational video!

Topic

Energy Sources & Natural Gas Basics, Natural Gas in Depth

Grade Level

Elementary, grades K-5
Middle, grades 6-8

Time

30-60 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is most often a nonrenewable fossil fuel, but natural gas can also be produced from renewable sources.
- Natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Renewable natural gas is formed from waste decay processes when oxygen is not present (fermentation, landfills, digesters, etc).
- The biogas that is created from waste decay processes can be treated to have similar methane content and characteristics of fossil fuel natural gas. This renewable natural gas is fully interchangeable with fossil fuel natural gas and can be moved through the pipeline system.
- Natural gas can be used to create many products.
- Energy is the ability to do work or make change.
- Energy is never created or destroyed; it simply changes form.
- Energy transformations allow us to harness energy from energy sources in the natural world.

Materials

- Scissors
- ***A Natural Gas Story***, page 43
- ***A Natural Gas Story Picture Cards and Answer Key***, pages 44-45
- ***Forms of Energy,*** page 46
- ***A Natural Gas Story Pantomime & Cheat Sheet***, page 47-48 *(optional)*
- Art supplies or props as listed *(optional)*

Relevant Slides

- Let's Talk About Energy, slides 1-23

OR

- Our Future with Natural Gas, slides 1-35

Background

When students think of energy, they most often think of electricity. A significant proportion of our total energy is supplied by natural gas. The purpose of this activity is to help students understand how natural gas is used in the energy industry and how we use it as consumers. Students will also identify the energy transformations of natural gas from formation to end use. This activity is a great activity for making connections to educational standards in school curricula and can be used for any age group. However, if catering to an older audience, you may wish to use the next activity, ***The Natural Gas Pipeline***.

Basic Steps

1. Make copies of the story or prepare a digital copy to put into your presentation for reading aloud.
2. Decide if you will have students simply arrange the picture cards during the story or if you wish for them to quickly make props out of art supplies and act out the story.

- If opting to use the picture cards, print color copies of the cards for students or small groups and have an answer key for yourself. The cards are NOT in order and have been pre-shuffled on the page. Refer to the answer key on **page 45**.
  a. If opting to act out the story, make copies of the pantomime/cheat sheet for each student, and prepare art supplies or a prop box ahead of time.

3. Introduce yourself to students and briefly introduce natural gas with the introductory slides. Pause before getting into too much detail on natural gas, as it is a great time to interrupt and introduce the story as a way to showcase natural gas information without the slides. Younger students may skip slides entirely.
4. Explain that energy, like the energy in natural gas, is always changing – from one form of energy to another. These energy transformations allow us to use our energy sources for electricity, to power vehicles, and to heat and cook. Tell the students that you will be reading (or acting out) a story that talks through the energy transformations involved in natural gas as it is formed and used.
   a. If using the picture cards as props, ask students to cut out their picture cards.
   b. If you are asking the students to make their own props, assign roles using the pantomime/cheat sheet and provide time for the students to assemble their props. Any students that do not have assigned roles should team up with another student constructing props, or can assist in reading the story aloud.
5. Project and read the story aloud. As students hear each line of the story, they should act out their role in the front of the room OR lay the correct picture card out in line on their table. Prompt students who are unaware with a hint as needed.

CONTINUED ON NEXT PAGE

6. Review the flow of natural gas from beginning to end. Highlight how energy transformations are involved, the various uses, and the role of pipelines for transportation.
7. Collect cards or props and clean up.
8. Finish any slides and connect the information to the story. Ask students if they have any questions.
9. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- How is natural gas formed?
- How is natural gas used?
- How is natural gas transported?
- How does natural gas transform to give us energy?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Use large picture cards to demonstrate the story. Download the cards at **www.need.org/wp-content/uploads/2023/12/NaturalGasStory_Props.pdf**.
- Ask the teacher to review and/or introduce forms of energy and energy transformations prior to your visit.
- Skip most of the slides and simply do the story. Use the slides as backup for any Q&A after the story.

Amplify the Content

- Introduce forms of energy and energy transformations using the additional resources.
- Create a "prop box" of props for each role in the story. Pass them out to students to act out as you read. (see step 2 in Basic Steps)
- Have students create their own props out of art supplies to go with their assigned role. Students will act out their role as you read. (see step 2 in Basic Steps)
- Ask what else could be included in the story and encourage students to write an amendment that includes a role and suggested prop(s) for their additions.

Additional Resources

- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- U.S. Department of Energy, Energy Information Administration, Kids Page: **www.eia.gov/kids/energy-sources/natural-gas/**
- U.S. Department of Energy, Energy Information Administration, Natural Gas explained - Pipelines: **www.eia.gov/energyexplained/natural-gas/natural-gas-pipelines.php**
- Student Energy, Natural Gas 101 Video: **https://youtube.com/watch?v=-njmj0diWu8**
- Williams, Energy Insights: **www.williams.com/energy-insights/how-does-natural-gas-become-electricity/**

A NATURAL GAS STORY

Natural gas is an important energy source. We burn it in furnaces to heat our homes. We burn it in stoves and ovens to cook our food. Power plants, factories, and landfills burn and use the heat to make electricity. Some vehicles even burn natural gas instead of gasoline. But where does this important energy source come from?

The sun produces lots of light from a process called nuclear fusion. The sun's radiant energy travels to Earth and is changed into chemical energy by plants. Hundreds of millions of years ago, before dinosaurs lived, oceans covered most of the earth. Tiny plants and animals lived in these oceans. They stored the sun's energy in their bodies as chemical energy. The animals ate the plants, and both the plants and animals stored the sun's energy in their bodies as chemical energy.

As the plants and animals died, the organisms sank to the ocean floor. As more and more plants and animals died, they sank and made a thick layer deep under the water. Over time, more layers of rock, sand, and other dead plants and animals built up. As the layers built up, they pressed down hard on the layers beneath.

Over time, those layers of sediment were compacted until they turned into rock. Oxygen and other elements were pushed out, and carbon, hydrogen, and a little bit of sulfur remained. The carbon and hydrogen made molecules of all different sizes, called hydrocarbons. The smallest molecules are what we call natural gas.

Geologists look for natural gas using special equipment. Using their knowledge of the Earth and its processes, geologists are able to create a picture of the layers underneath the surface. They use data from scientific instruments and tests to tell them which layers likely have natural gas. Engineers then make a plan to drill a hole, called a well, in the ground and get the natural gas.

From the well, natural gas flows through a pipeline to a processing plant. There it is cleaned, and water is removed. Natural gas found underground and processed this way is a nonrenewable energy source. This means that we cannot make more natural gas this way in a short amount of time. But this is not the only source of natural gas.

Renewable natural gas comes from places you might not expect, landfills full of garbage and farms. What do these places have in common? Decomposition.

Decomposition is the word for what happens when things break down over time, such as a fallen tree softening and sinking into the forest floor. Slugs, pill bugs, bacteria, fungi, and other organisms get food from dead plants, dead animals, and even garbage. Sometimes, decomposition happens where there is not a lot of oxygen. This is also called anaerobic respiration, and produces a compound called methane, the main component of natural gas. Anaerobic decomposition happens in landfills where everything is buried, on farms where wastes are piled up, and special systems called digesters.

Landfills have pipes sticking out of them to vent the methane out, so it doesn't build up too much pressure. This methane is burned or flared off or it can be captured and burned in a generator turning chemical energy into electrical energy. They can also collect and sell the natural gas, sending it out to customers on a pipeline. Large farms with many hundreds of animals capture methane from the waste animals leave behind. They can use it to heat their barns, power their facilities, and sell it to gas utility companies.

What is the difference between natural gas from landfills and farms and that found underground? Absolutely nothing! The burners in furnaces, stoves, and power plants don't know the difference. Methane is methane, regardless of where it comes from.

As you may have been able to tell, methane is very flammable. This means it catches fire easily. And, because it has no odor or color, you would not be able to see if a pipe is leaking. Processing and utility companies solve this problem by adding a stinky chemical to natural gas. Now, everyone knows when a pipe is leaking! If you smell natural gas, leave the area and call 911!

Now you know where natural gas comes from – underground, landfills, and farms – and you know how it gets to where it's needed, by pipeline. Then what?

Homes and businesses may use a number of different kinds of natural gas appliances, including furnaces, stoves and dryers. When natural gas burns, it produces carbon dioxide and water vapor. Sometimes carbon monoxide is produced, too. Appliances can be safely and reliably used with proper, professional installation and plenty of air circulation and ventilation.

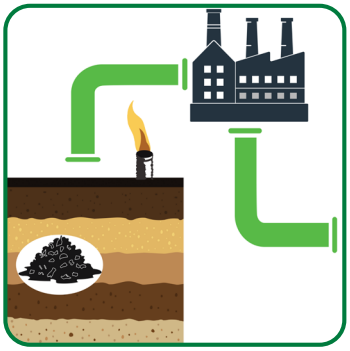
Factories use natural gas as a heat source to make lots of different products. They might melt plastic to shape it, they might cook foods or process canned goods, and they might make glass, paper, and cement. Natural gas molecules are also used to make products, such as paint, glue, fertilizer, plastic, medicine, laundry detergent, insect repellent, and many more!

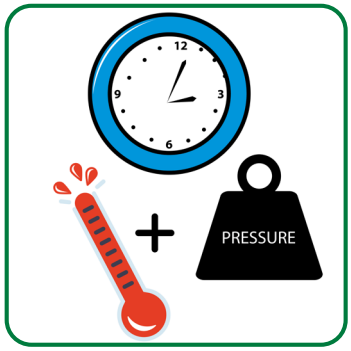
Some cars, trucks, delivery vans, and buses also burn natural gas. Parks and cities often have buses powered by natural gas because it is a cleaner-burning fuel than gasoline or diesel fuel.

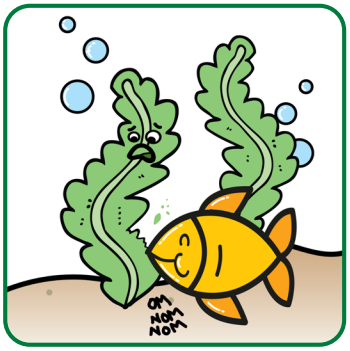
Electric power plants burn natural gas to generate electricity. The natural gas comes in through a pipe and enters a giant furnace. The burning natural gas releases a lot of heat energy that is used to boil water. The water becomes steam, which travels through pipes and pushes on a machine called a turbine. The turbine is attached to a generator, and electricity is the result.

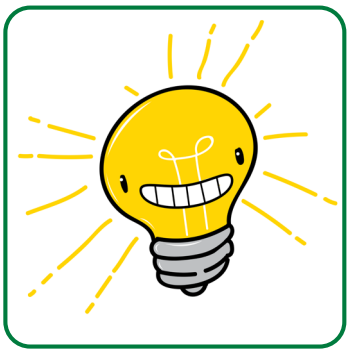
Natural gas is a valuable energy source that is both nonrenewable and renewable. While most natural gas we use is nonrenewable, more and more renewable natural gas is being used. Aren't you glad we have natural gas for heating, cooking, and making electricity?

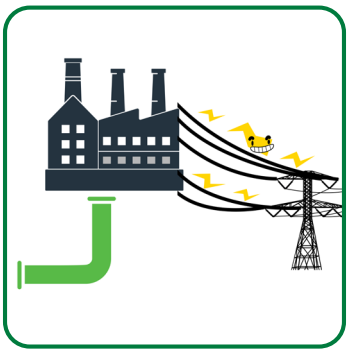
A NATURAL GAS STORY PICTURE CARDS

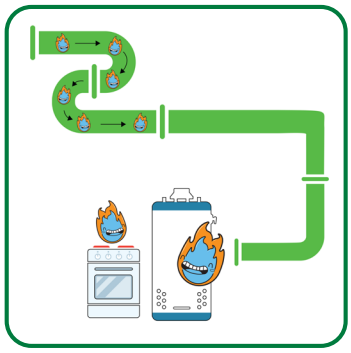


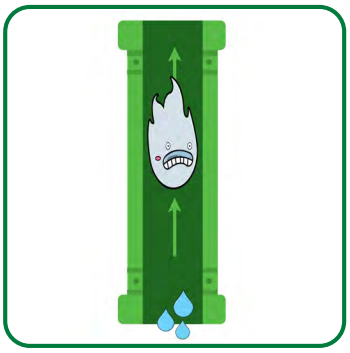


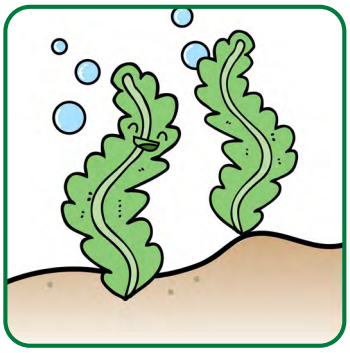


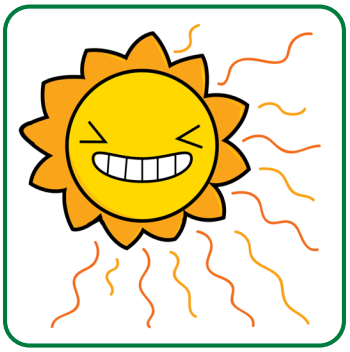


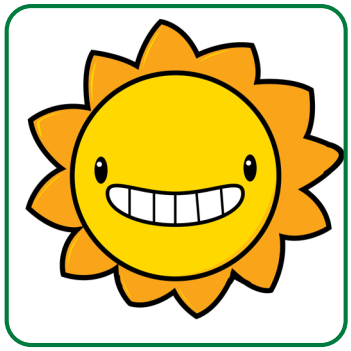


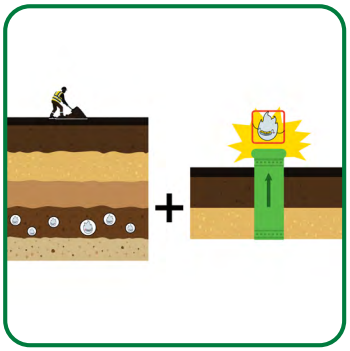












A NATURAL GAS STORY ANSWER KEY

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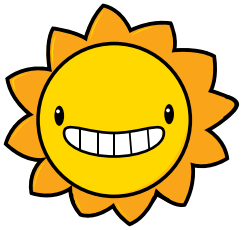

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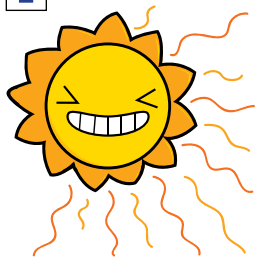

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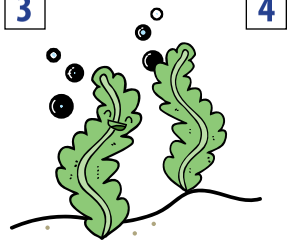

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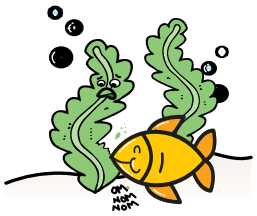

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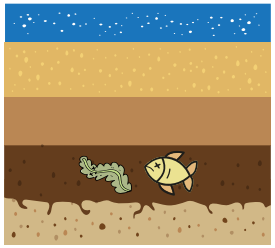

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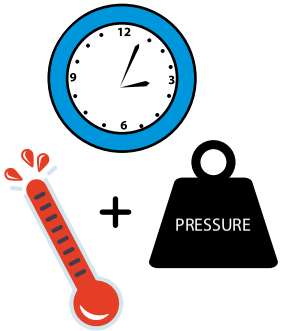

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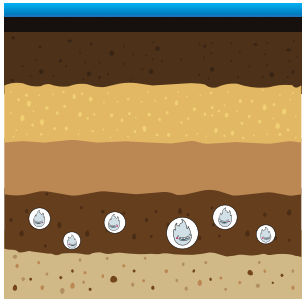

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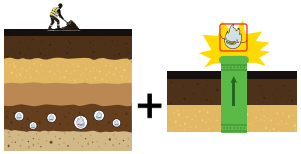

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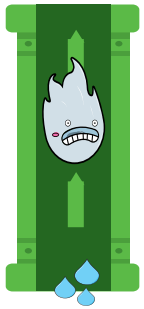

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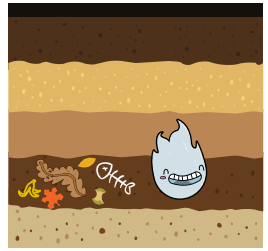

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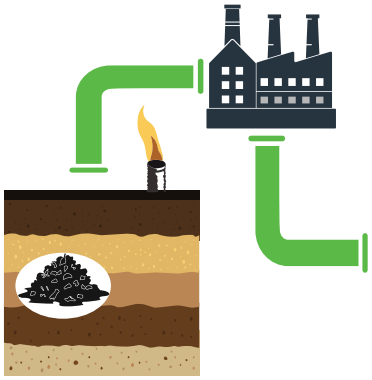

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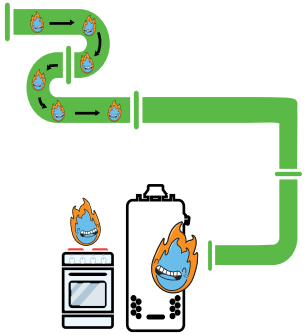

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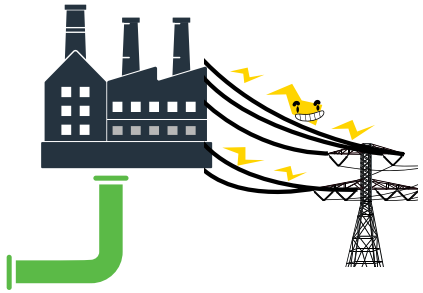

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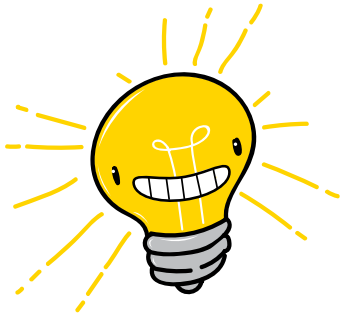


FORMS OF ENERGY

ALL FORMS OF ENERGY FALL UNDER TWO CATEGORIES:

POTENTIAL

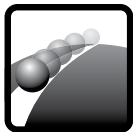
Stored energy and the energy of position (gravitational).

CHEMICAL ENERGY is the energy stored in the bonds between atoms in molecules. Gasoline and a piece of pizza are examples.

NUCLEAR ENERGY is the energy stored in the nucleus or center of an atom – the energy that holds the nucleus together. The energy in the nucleus of a plutonium atom is an example.

ELASTIC ENERGY is energy stored in objects by the application of force. Compressed springs and stretched rubber bands are examples.

GRAVITATIONAL POTENTIAL ENERGY is the energy of place or position. A child at the top of a slide is an example.



KINETIC

The motion of waves, electrons, atoms, molecules, and substances.

RADIANT ENERGY is electromagnetic energy that travels in transverse waves. Light and x-rays are examples.

THERMAL ENERGY or "heat" is the internal energy in substances – the vibration or movement of atoms and molecules in substances. The heat from a fire is an example.

MOTION ENERGY is the energy of the movement of a substance from one place to another. Wind and moving water are examples.

SOUND ENERGY is the movement of energy through substances in longitudinal waves. Echoes and music are examples.

ELECTRICAL ENERGY is the movement of electrons. Lightning and electricity are examples.

A NATURAL GAS STORY PANTOMIME

Students will demonstrate the flow of energy to heat homes using props. Depending on the audience, signs with the different forms of energy can be used by the students to identify the energy transformations. This activity with different props can also be used to demonstrate other energy flows, like coal to electricity, biodiesel, ethanol, etc.

Role	Prop	Action	Text
Sun – Nuclear Energy	Yellow ball	Hold up the yellow ball and move fingers to suggest nuclear fusion producing energy	The sun produces lots of light from nuclear fusion.
Sun – Radiant Energy	Yellow ribbons	Wave the ribbons in the air	Radiant energy from the sun travels to Earth in waves
Plants and Animals – Chemical Energy	Green leaves and sugar cubes	Green leaves are pushed upward (growth) and then "produce" sugar cubes	Tiny, prehistoric plants and animals absorbed the radiant energy and stored it as chemical energy in their bodies. Animals eat the plants and get the stored energy for themselves.
Chemical Energy Changing to Nonrenewable Natural Gas	Brown leaves, cardboard, brown paper, black paper	Brown leaves fall to the floor.	Plants and animals died
		They are buried by layers of paper and cardboard.	Plants and animals were buried under layer upon layer of sand and dirt and stayed there for hundreds of millions of years.
	Clock	Stand on the paper and cardboard, hold a clock	Over time they changed into natural gas. The natural gas is called nonrenewable natural gas.
Natural Gas Production	Shovel	Walk over to where the "plants" were "buried" and pretend to dig	Geologists look for natural gas and dig a hole called a well to get it out of the ground.
Natural Gas Processing	Length of hose or rope	Stick the hose into the "well"	The natural gas from the ground is processed and sent into a pipeline. This nonrenewable natural gas is not the only kind we use.
Waste – Chemical Energy	Clean "trash" and a bucket – on the other side of the room	Drop the trash into the bucket	When we throw things away, it is collected by waste removal companies in big garbage trucks.
Waste – Chemical Energy on the Move	Bucket of trash and a large box	Empty the bucket into the box	The garbage trucks carry the trash to a place called a landfill.
Waste – Chemical Energy Turning into Natural Gas	Box of trash and several pieces of cardboard	Drop the cardboard on top of the trash in the box, covering it	When a landfill is full, it is covered by dirt and the trash is buried where it is decomposed and creates methane (natural gas).
Natural Gas – Chemical Energy	Pieces of tube or pipe, orange and red construction paper	Stick the pipe in the box, "pretend" to light the flared natural gas	Pipes are added to vent the natural gas that forms in the landfill, this gas is often flared or burned, OR turned into energy on site.

CONTINUED ON NEXT PAGE

Role	Prop	Action	Text
Natural Gas Transportation	Another hose or rope	Attach the garden hose to the pipe	The natural gas that forms in the landfill can be into a pipeline. Farms can also capture natural gas from wastes and send it into a pipeline. These two sources are called renewable natural gas.
Natural Gas Processing	Third length of hose or rope	The first two hoses, from the landfill and the well, are held up to the third so they feed into it	Natural gas from many sources is collected in a pipeline and sent to homes, businesses, factories, and electric power plants.
Natural Gas – Chemical to Thermal	Red and orange construction paper	Demonstrate fire with construction paper	Natural gas enters homes and businesses through a smaller pipe and is used to heat buildings. It is also used in stoves to cook food.
Natural Gas Chemical to Electrical	Pipe or rope, Coil of wire and magnets; spinning desk chair, extension cord	Have the pipe or rope push the coil of wire on the spinning char near the magnets, the magnets hold an extension cord to show electricity generated and moved	Natural gas is also used in power plants to turn a generator. The generator produces electricity.
Electrical Energy	Battery operated flashlight or bulb	Turn on light	Wires carry the electricity to buildings, where it is used to power devices.

THE NATURAL GAS PIPELINE

Check out this training and informational video!

Topic

Natural Gas in Depth

Grade Level

Middle, grades 6-8
High School, grades 9-12

Time

45-60 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is most often a nonrenewable fossil fuel, but natural gas can also be produced from renewable sources.
- Natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Natural gas can be used to create many products.
- The natural gas system relies on producers, consumers, and infrastructure across the globe. The system can be impacted by a weak link in the chain.

Materials

- ***Natural Gas Pipeline System Hangtags***, pages 51-52
- Balls of yarn or string
- Scissors
- Hole punch
- ***Natural Gas Production to Market graphic***, page 53 *(optional)*
- ***Natural Gas System worksheet***, page 54 *(optional)*

Relevant Slides

- Let's Talk About Energy, slides 1-23

OR

- Our Future with Natural Gas, slides 1-35

Background

When students think of energy, they most often think of electricity. A significant proportion of our total energy is supplied by natural gas. The purpose of this activity is to help students understand how natural gas is brought to market, how all the parts of the natural gas industry operate as a system, and how each of the parts can impact the other. This activity is better suited for older students in comparison to the previous story activity, which could be used for younger students. In this activity, the word "pipeline" is used creatively to describe the natural gas system as connected parts, like a pipeline system. However, natural gas transport is heavily emphasized as well.

Basic Steps

1. Make copies of hangtags so you can have several sets. There are ten tags in the system, and you may need a few "system" sets for each student to be engaged in the activity. Assemble the hangtags as necklaces by cutting and folding each on the dotted line. Punch a hole through the folded card and attach a string to each as a necklace.
2. Decide if you wish to share the graphic and the worksheet during the activity. If you plan to use them, you may opt to project for the class, or hand out individually. Make copies or add to your slide deck, as needed.
3. Introduce yourself to students and briefly introduce natural gas with the introductory slides. Pause before getting into too much detail on natural gas, as it is a great time to interrupt and introduce the activity showcase natural gas information without the slides.
4. Ask students what they think happens when a resource is found far from cities or industries that use the resource. Is it helpful to customers?
5. Ask students for an example of a time they've heard or used the word "pipeline." Students may describe oil or a fluid moving in a pipeline, but they may also describe hearing people say something is "in the pipeline," or "moving through the pipeline" as a way to describe things are in motion or moving through a system. Explain that a pipeline can describe a system of things that works together. Pipelines allow things to move and flow – connecting us to something else. In the natural gas world, pipelines are exactly that and are essential to being able to use natural gas, bringing stranded resources to marketable locations, and bringing processed products to consumers. For the system to work as it is intended, all parts need to be working together. In this activity, you will explore the parts of a natural gas system and how they work together, and ultimately what can happen if one part of the system is not functioning as intended.
6. Assign roles to the students by passing out hangtags to ten students. If assembling multiple "systems," make sure to keep each group of ten separate, and send each to a different part of the room as a group of ten.
7. Share the Production to Market graphic, if desired. Highlight all the spots on the graphic where each of the system hangtags might be found. Alternatively, you can ask students to read their hangtags and determine where they might fall on the graphic in their group of ten. For example – production would be at the "natural gas well."
8. Ask students to read the backs of their tags and allow time for questions about their roles or how they are involved in the system or process of bringing natural gas to market. Have each group put on their hangtags and stand in a circle with one student holding the ball of yarn.
9. Explain that the first students should look around the circle and identify a part of the system that relates to their component. Have the first student hold onto one end of the yarn, say the name of the related component, and toss the ball of yard to that student. The first student then explains how their parts are related.

CONTINUED ON NEXT PAGE

10. Have the groups repeat the process until all students have caught and tossed the ball of yarn. In the end, there will be a web of yarn connecting all students in the group. In some cases, students may need to catch the ball of yarn twice.
11. Have one student give a tug on the string. Ask the students that felt the tug to explain how a stress on one component affected their role card. For example, a Production tug might cause an attached Processing tag to say, "If production of natural gas falls, the processing facility cannot distribute enough natural gas to residences to keep them warm."
12. Continue this process with each student tugging and suggesting different ways the system could be affected. Students should be able to explain various ways a change in one part of the system might affect other parts of the system. Ask students to consider if there is another way to assemble their chain to avoid this hangup, and why.
13. Collect hangtags and string and return to seats.
14. Finish the slides you wish to showcase, or as time allows, and connect the information to activity. Ask students if they have any questions about any parts of the natural gas industry system.
15. If time allows project or distribute the ***Natural Gas System*** worksheet. In small groups or as a class, students should select one step in the natural gas system (the hangtag vocabulary) and place it in the center circle, filling in the outer circles with the remaining steps. Discuss and write inside the arrows a way the inner component affects the outer components and so on. Can students relate these impacts or cause/effect incidences to real-world scenarios? If you are comfortable, describe some issues that have occurred and how those industry players, communities, or countries navigated the impacts.
16. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- How is natural gas formed?
- How is natural gas used?
- How is natural gas transported?
- What is an example of an impact to the natural gas system and how will it impact other parts of the system?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Ask the educator to review the vocabulary and graphics prior to your visit.
- Skip most of the slides and simply do the activity. Use the slides as backup for any Q&A after.
- Instead of several, concurrent "systems," select ten students and run the activity as a demonstration with those ten individuals in the center of the room and the class providing input.

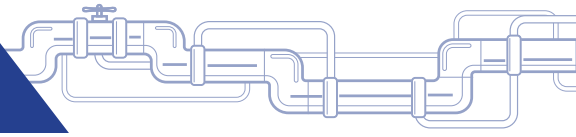
Amplify the Content

- Have students create additional cards to incorporate more complexity into the system – i.e. renewable natural gas, export, etc.
- Discuss LNG in more depth by conducting the volume simulation activity.

Additional Resources

- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- U.S. Department of Energy, Energy Information Administration Kids Page: **www.eia.gov/kids/energy-sources/natural-gas/**
- U.S. Department of Energy, Natural Gas explained - Pipelines **www.eia.gov/energyexplained/natural-gas/natural-gas-pipelines.php**
- Student Energy, Natural Gas 101 Video **https://youtu.be/-njmj0diWu8**
- U.S. Department of Energy, Natural Gas explained – Delivery and Storage: **www.eia.gov/energyexplained/natural-gas/delivery-and-storage.php**
- Williams, Energy Insights: **www.williams.com/energy-insights/how-does-natural-gas-become-electricity/**

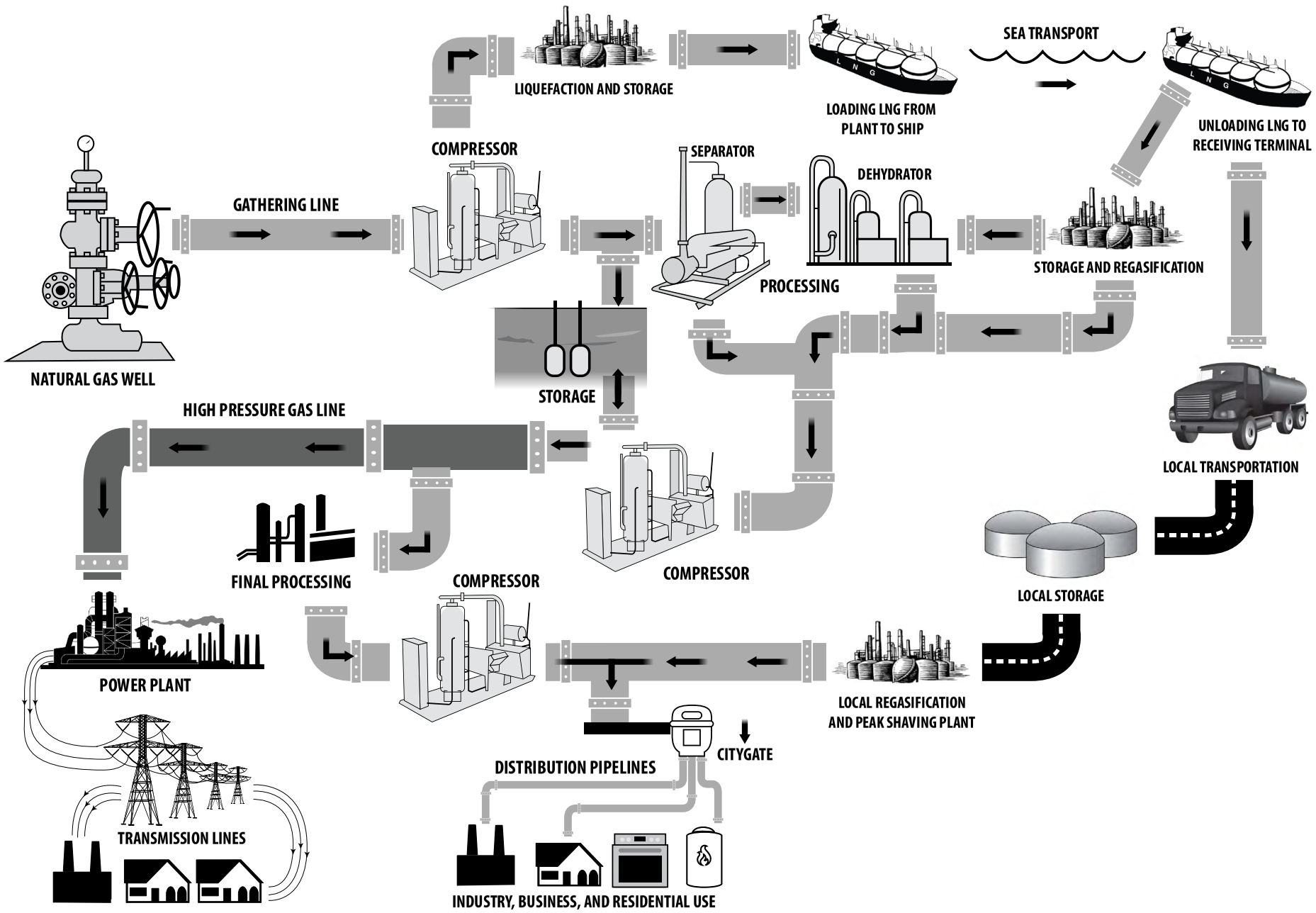
NATURAL GAS PIPELINE SYSTEM HANGTAGS



Exploration	**The process of finding natural gas deposits.**
Production	**The process of drilling wells and bringing hydrocarbons to the surface.**
Separation and Dehydration	**The process of removing water vapor and liquid aerosols from natural gas so it is of a good quality for pipeline transportation.**
Storage	**Underground formations can be used to store natural gas at low demand times, so it is available at peak demand times. LNG can be stored in insulated tanks until needed.**
Liquefaction	**The process by which natural gas is converted into a liquid.**

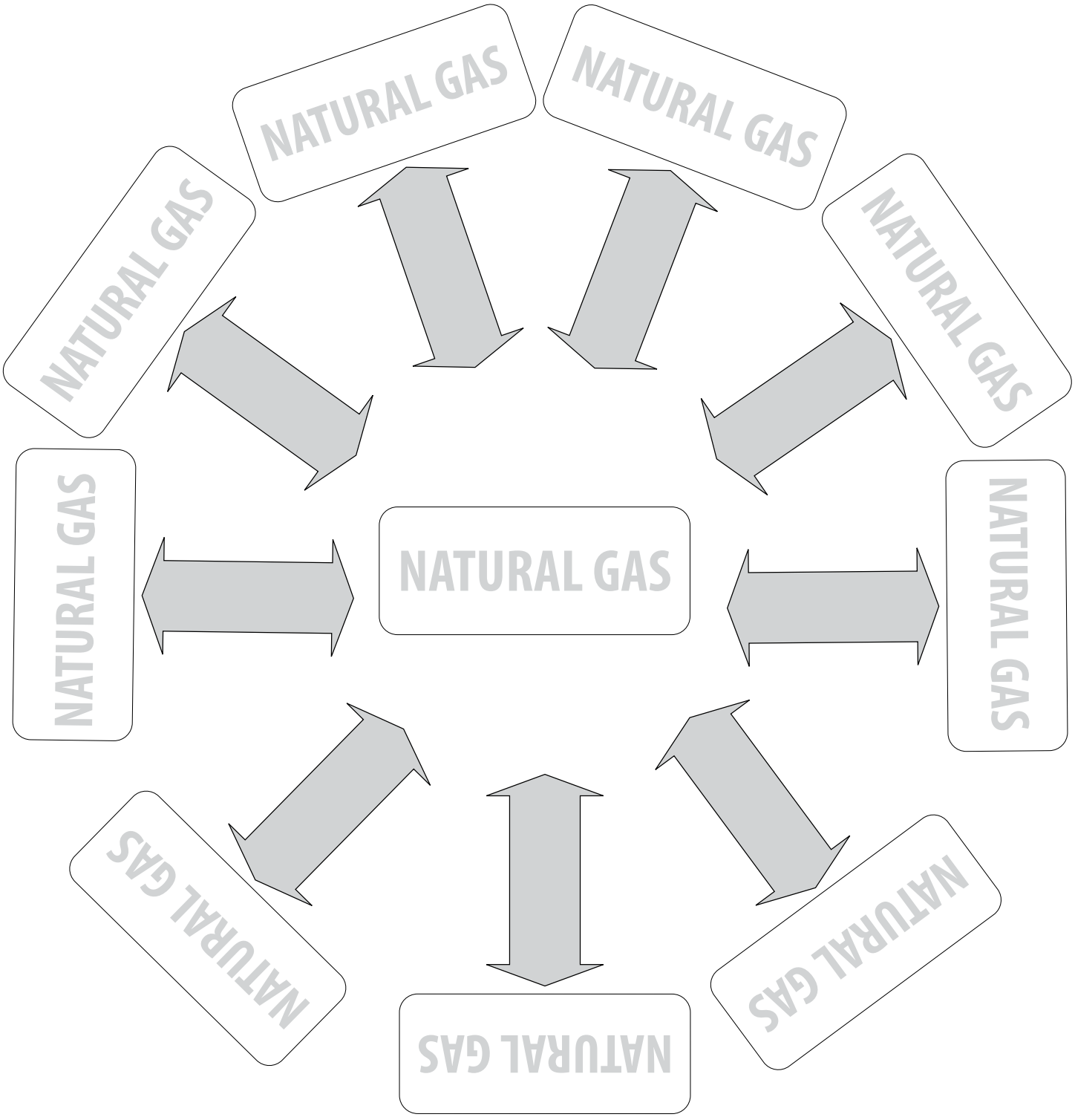
Transportation	**Natural gas is moved through an extensive network of interstate and intrastate pipelines or by tanker or truck as LNG.**
Compression	**Increasing the pressure of natural gas at compressor stations every 50-100 miles along the pipeline system.**
Distribution	**Utility companies deliver natural gas to consumers through a network of pipelines and a citygate.**
End Use	**Industry, businesses, and residential users all need natural gas for heating, cooking, manufacturing products, and generating electricity.**
Regasification	**The process by which LNG is heated, converting it into its gaseous state.**

NATURAL GAS PRODUCTION TO MARKET



THE NATURAL GAS SYSTEM

Choose one step in the NG chain and write it in the center box. Label the outside boxes with the nine remaining steps. In the arrows connecting the NG steps, write a way the center step affects the outside step as well as a way the outside step affects the inside one.



BUILD A PIPELINE

Topic

Natural Gas in Depth

Grade Level

Elementary, grades K-5
Middle, grades 6-8

Time

60 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is pumped under pressure through a pipeline to its point of use.
- Compression is used to help maintain pressure of the natural gas in the pipeline, allowing it to continue flowing over long distances, change elevation, and overcome friction.

Materials

- Cardboard paper towel tubes
- Flexible straws
- Liquid to "drink" (water, juice, chocolate milk, etc.)
- Cups or containers for liquid
- Masking tape
- Scissors
- Small corks
- Wooden beads
- Small buttons
- Marbles
- Pennies
- Bouncy balls
- Small binder clips
- Grapes *(optional)*

Relevant Slides

- Sandy's Deep Dive Adventure

OR

- Let's Talk About Energy, slides 1-23

Check out this training and informational video!

Background

Pipelines are an efficient and safe transportation system that enables to movement of large volumes of energy products every day to industry and consumers. Many people, students included, will be unaware of how much of our energy is transported via pipeline. This activity contains two parts that aim help students understand the basics of how fluids move through pipelines, and why compression is an important element of pipelines for moving products over longer distances.

For simplicity of modeling, this activity set will focus on "fluids" moving through a pipeline, rather than focusing strictly on gases. Part one involves building a simple pipeline out of straws and sipping liquid; part two involves constructing a pipeline and pushing objects of various sizes through using air to demonstrate the role of compressors. You can conduct these sequentially, with all students working on part one followed by part two. Alternatively, you can set these up in stations, where some students work on part one while others work on part two, with an option to switch or share what they learned. Younger students may benefit more from the sequential model. This activity is fun for all ages but is a better fit for younger students up through middle school. This activity can easily be split into small parts that could be used quickly for a fair/table setting.

Safety Note:
It may be best to purchase wrapped straws for simple distribution of straws. To ensure germs are minimized, make sure no students share straws. Only one person should be the "drinker" of fluids in part one.

Basic Steps

1. Read the procedure and student activity pages. Decide if you will do both parts of the activity. Gather materials for the part or parts of the activity you will do. Consider how many students there will be and how many sets of supplies for each part will be needed.
2. Make copies of the handout or prepare a copy to project within your slides.
3. Set up the pipeline activity materials ahead of time in stations or for sequential delivery. If doing stations, make sure all materials are placed in the locations you have designated for each of the stations. Pour liquid in the cups to act as "pipeline fluid."
4. Introduce yourself to students and briefly introduce natural gas with the introductory slides. Pause for questions, and then continue with remaining slides as desired, discussing natural gas use and transportation via pipelines. Make sure to emphasize elements that are relevant to your pipeline activities, i.e. compressor, gate, etc.
5. Explain that you will be modeling pipelines in your activities. If working in stations, separate students and send them to the stations. Pass out the student handout or project it for all to see.

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6. Model the instructions for part one of the activity if working sequentially. Give students time to work and assist them with the hands-on pieces as necessary. Repeat for part two. If working in stations, model instructions for both parts and provide students with a set amount of time to work before they move to the other part of the activity.
7. Give students an opportunity to share what they have observed in each part of the activity. Demonstrate and answer questions as needed to help make connections to the content of your slides, your career, and the natural gas industry. Remind students these were models, and explain how these models might differ from natural gas pipelines and correct any misconceptions.
8. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What are the challenges we face when trying to move things long distances in a pipeline?
- How does compression work to help move fluids in a pipeline?
- What is important to consider in constructing a pipeline?
- Where would you need to place compressor stations to make a pipeline work?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Conduct only one part of the activity. For younger students conduct only the straw/liquid portion.
- For a simpler set-up of part two, with less supplies, create one station for each item students push through the pipeline. Students can bring their own straw to each pipeline and attempt each one.

Amplify the Content

- Bring in some tools or technology to demonstrate as a "show and tell" related to pipelines.
- Discuss pipeline safety with students.
- Discuss the differences between natural gas pipelines and pipelines for other hydrocarbons.
- Have students create a bar graph of the data for part two of the activity, showcasing relative "pressure" needed to move items.
- Have students test their pipelines by moving around obstacles and changing "elevations."
- Incorporate a scale or balance and density calculations for older students.
- Show students a map of pipeline infrastructure in their region or local community.

Additional Resources

- The INGAA Foundation: **www.ingaa.org/stay-current/what-is-a-natural-gas-compressor-station/**
- Penn State University Extension Office: **https://extension.psu.edu/understanding-natural-gas-compressor-stations**
- U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration: **www.phmsa.dot.gov/faqs/general-pipeline-faqs**
- Student Energy, Natural Gas 101: **https://youtu.be/-njmj0diWu8?si=b_Q7uUQFUqDnyejV**

BUILD A PIPELINE

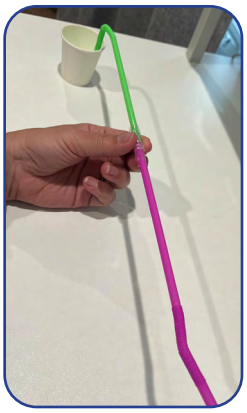
Question

How does a pipeline work?

Part One Materials – Moving Fluid

- Flexible straws
- Cup of pipeline fluid
- Masking tape
- Scissors
- Ruler

Procedure



1. Designate one person to be the fluids drinker. This is the only person who should handle the drinking end of the pipeline.
2. Put one straw into the cup of pipeline fluid so that the shorter end is in the cup and the longer end is sticking out. The drinker should bend the flexible part of the straw so the long end is horizontal (parallel to the table) and take a sip from the long end. Record your observations in the chart below.
3. Attach more pipeline length. Using your scissors, make a 1 cm or less cut in the long end of your first straw. Insert this end into the end of a new straw. Two straws should be connected and oriented so that the short end is still in the cup, and the long end of the straw is parallel to the table. Add another bend if you'd like to make your pipeline change direction.
4. Have the drinker take another sip of the pipeline fluid using the longer pipeline. Record your observations.
5. Now use a piece of masking tape and wrap it around or over the seam where the two pipelines are connected. Sip again and record.
6. Add a third, fourth, and fifth straw. Record your observations in the chart.

Observations

Number of Straws	Notes
1	
2	
3	
4	
5	

Conclusions

1. How did "sipping " change when the pipeline got longer and longer?

2. How did adding tape impact your "sipping?"

3. How would your "sipping" change if the straws are bigger around or smaller? (more or less diameter) How did the "sipping" change if you added another bend in your straws, changing directions?

Part Two Materials – Pump and Push

- Cardboard paper towel tube
- Small flexible straw
- Masking tape
- Small cork
- Wooden bead
- Small button
- Marble
- Penny
- Bouncy ball
- Small binder clip
- Grape (optional)

Procedure

1. Practice taking short breaths and blowing air into your straw. Each breath should last one second.
2. Lay your paper towel tube on the table with the opening facing you. This is your pipeline.
3. Place the button inside the paper towel tube pipeline. Line up the edge of the button with the edge of the opening.
4. Using your flexible straw, take short breaths and try to push the button through the pipeline. Count how many breaths it takes to push the button the entire length of the pipeline. Record your data in the table below with any notes and observations.
5. Repeat steps 3 and 4 for each of the objects.

Observations

Object	Number of Breaths	Observations and Notes

Conclusions

1. Which item was the hardest to push through the pipeline? Why?

2. What would you need to change about your pipeline, straw, and breath if you needed to move objects through a pipeline that was twice as long?

PIPELINE PUSH

Check out this training and informational video!

Topic

Natural Gas in Depth
Natural Gas Careers and Future of Natural Gas

Grade Level:

Middle, grades 6-8
High School, grades 9-12

Time

45-60 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is processed to remove water, other hydrocarbons, and solid particulate matter.
- Natural gas is pumped under pressure through a pipeline to its point of use.
- Compression is used to help maintain pressure or repressurize the natural gas in the pipeline, allowing it to continue flowing over long distances, change elevation, and overcome friction.
- An odorant is added to natural gas before it enters the residential gas stream.
- There are different segments of pipeline in the natural gas system.The natural gas pipeline system involves gathering, transmission and distribution lines.

Materials *PER STATION*

- 4 Beakers, bowls, or wide mouth jars
- Flexible straws
- Index cards or labels
- 3 Basters or syringes
- Small funnel
- Coffee filter
- Bottle of food coloring
- Water
- Tape
- Scissors
- Masking tape
- Metal baking trays *(optional)*

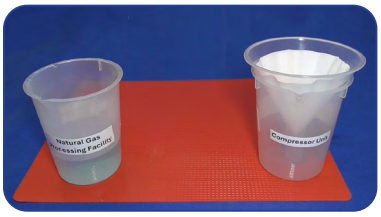
Relevant Slides

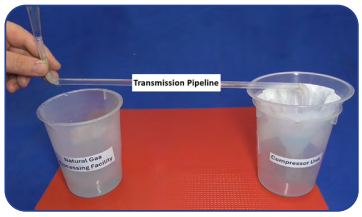
- Let's Talk About Energy, slides 1-23

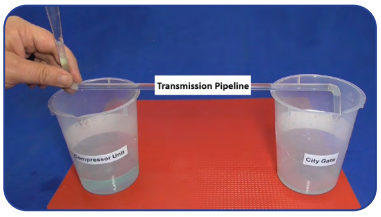
OR

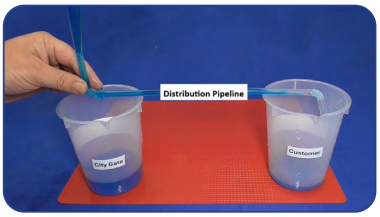
- Our Future with Natural Gas, slides 1-35

Pipeline Push Assembly









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Background

Pipelines are an efficient and safe transportation system that enables the movement of large volumes of energy products every day to industry and consumers. Many people, students included, will be unaware of how much of our energy is transported via pipeline. This activity aims to help students understand the basic elements of a natural gas pipeline system and some of the pipeline-related careers in the industry. In the activity, they will assume a career role and complete some tasks related to their role to construct a pipeline, move natural gas from a processing facility, through a transmission pipeline into a filter and compressor station, and through a city gate where it will move into a distribution line for the customer.

For simplicity, the pipeline will be moving water in this model, rather than gas. You can opt to include coffee grounds to demonstrate the use of filters for processing out condensates and solids throughout the pipeline system. The use of food coloring is to demonstrate the addition of mercaptan, an odorant, before the gas enters the residential gas stream. However, feel free to discuss how these parts and systems may be altered in different areas or scenarios. This activity is great for middle and high school students to do individually or in small groups. However, it would make an excellent demonstration for younger students or in a table/fair setting. Have the set-up completely assembled and ask students to engage with a few steps at a time.

Basic Steps

1. Read the procedure and student activity pages. Decide if you will allow students to carry out the activity instructions, or if you will conduct it as a demonstration. Gather supplies as needed for the delivery method of your choice.
2. Make copies of the handout or prepare a copy to project within your slides.
3. Set up the pipeline activity materials ahead of time in stations or for demonstration. If doing stations, make sure all materials are placed in the locations you have designated for each of the stations. It may be helpful to set up supplies on metal trays so that "pipeline messes" are contained.
4. Introduce yourself to students and briefly introduce natural gas with slides 1-18, or a selection of these as needed. Pause for questions, and then continue with any slides you wish on pipelines, safety, or natural gas in-depth as time and attention permits. Make sure to emphasize elements that will appear in your pipeline activity.
5. Explain that you will be modeling a gas pipeline system for this activity. If working in stations with small groups, separate students and send them to the stations. Pass out the student handout or project it for all to see.
6. Model or clarify any of the instructions in the activity if allowing students to work in small group stations. Give students time to work and assist them with the hands-on pieces as necessary. If conducting the activity as a demonstration, model instructions and ask student volunteers to assist with the various careers and steps.
7. Give students an opportunity to share what they have observed in the activity. Demonstrate and answer questions as needed to help make connections to the content of your slides, your career, and the natural gas industry. Remind students this is a model and explain how this model differs from actual natural gas pipelines and correct any misconceptions.
8. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What are some advantages and challenges of moving natural gas via pipeline?
- How might natural gas pipelines differ from pipelines carrying liquid hydrocarbons?
- What safety benefits and concerns exist with natural gas pipelines?
- How much energy does it take to move energy?

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Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson	Amplify the Content
▪ Conduct the activity as a model demonstration instead of allowing students to complete in small groups. If doing so, make sure to select a new pipeline operator each time, and add in additional volunteers for other careers as needed. ▪ Omit some of the introductory slides covering energy basics, and simply focus on natural gas and pipelines.	▪ Bring in some tools or technology to demonstrate as a "show and tell" related to pipelines. ▪ Discuss the differences between natural gas pipelines and pipelines used for other hydrocarbons. ▪ Show students a map of pipeline infrastructure in their region or local community. ▪ Assign enough students to the activity to make sure the simulation runs continuously. Discuss any pinch points and how they compare to realistic supply and distribution issues that arise. ▪ Ask older students to modify their model system to incorporate smaller diameter gathering lines and service lines, as well as storage facilities, and LNG import or export. ▪ Discuss pipeline safety with students. ▪ Discuss the energy it takes to move energy sources and how the natural gas industry manages this challenge.

Additional Resources

- The INGAA Foundation:
  - **www.ingaa.org/pipeline-infrastructure-showcase-repository/**
  - **www.ingaa.org/issue/construction/**
  - **www.ingaa.org/issue/operations/**
- Penn State University Extension Office: **extension.psu.edu/understanding-natural-gas-compressor-stations**
- U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration:
  - **https://primis.phmsa.dot.gov/comm/NaturalGasPipelineSystems.htm**
  - **www.phmsa.dot.gov/faqs/general-pipeline-faqs**
- Range Resources, Natural Gas Pipeline video:
  https://youtu.be/WqZd1lPh-Fk?si=v-6tF54n9u0ygxWM
- Student Energy, Natural Gas 101:
  https://youtu.be/-njmj0diWu8?si=b_Q7uUQFUqDnyejV

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PIPELINE PUSH - NATURAL GAS

Question

How do natural gas pipelines move natural gas to consumers?

Hypothesis

Materials

- Flexible straws
- Scissors
- Index cards
- Container labeled "Natural Gas Processing Facility," filled with water
- Container labeled "Compressor Unit"
- Container labeled "City Gate"
- Container labeled "Customer"
- 3 Basters
- Coffee filter
- Funnel
- Food coloring
- Masking tape
- Metal trays *(optional)*

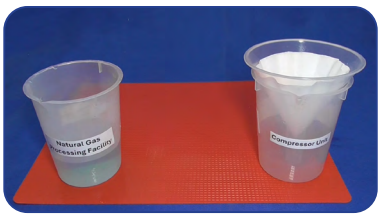
Procedure

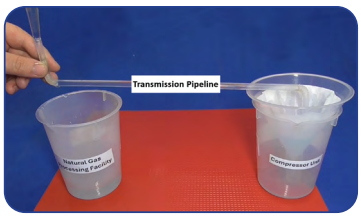
CHOOSE YOUR ROLE

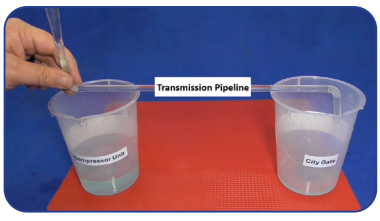
1. There are many different occupations in the pipeline industry. These workers are all about efficient and safe delivery of natural gas. They need to be excellent troubleshooters when things go wrong. Many need to be comfortable working outdoors in the elements. Some pipeline jobs require a high school diploma, while others require apprenticeships, certifications, and/or college degrees. Read the job descriptions below.
2. Write each person's name next to their assigned role.
3. Read through the entire activity so you know the materials you need, what your job responsibilities are, and when you are expected to do them.

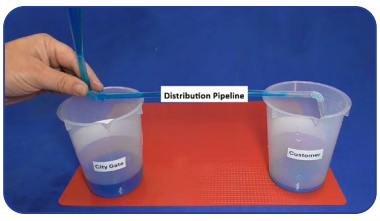
PIPELINE OPERATOR/CONTROLLER (2) Tend, control, or operate pumps or pipeline systems to transfer gases efficiently and maintain flow.	**WELDER** Use hand-welding, flame cutting, soldering, or brazing equipment to weld or join pipeline components permanently, filling holes and indentations, and connecting seams. Work with pipefitters to ensure integrity of structure.	**GAS COMPRESSOR OPERATOR** Operate steam, gas, electric, or combustion-driven compressors. Transmit and compress natural gas to maintain efficient flow.
PIPEFITTER Installs, inspects, maintains, repairs, and replaces pipelines and related equipment. May work with different types of pipes and use different joining methods to ensure no leaks occur. Work with welders to create the complete system.	**REFINERY OPERATOR** Operate or control refining or processing units. Specializes in controlling pipe systems and pumping systems, regulating flow of natural gas from refinery into the pipeline system.	**NATURAL GAS SUPERVISING ENGINEER** Oversees the safe and efficient supply and distribution of natural gas in the natural gas systems. Supervise design and construction of systems, review service requests, manage supply issues, and prepares report on consumption.

Pipeline Push Assembly









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PART 1: PREPARE THE PIPELINE

1. **PIPEFITTER** - Lay two straws on the table, long end to long end, (flexible ends facing out). Use scissors to cut a slit into the long portion of one straw so it slides and fits into the other straw. On an index card, make a label that says, "Transmission Pipeline." Pass the pipeline and label to the welder.
2. **WELDER** – When you receive the pipeline from the Pipefitter, use tape to securely weld the joint of the straw. Tape it so that the flexible ends are out. Weld the "Transmission Pipeline" label onto the straw where it's easily visible and not close to either end of the pipe.
3. **PIPEFITTER** and **WELDER** - Repeat steps 1 & 2 to make and weld another section of transmission pipeline. Do not connect the two sections.
4. **PIPEFITTER** and **WELDER** - Repeat steps 1 & 2 to make and weld another section of pipeline, and label this section of pipeline as "Distribution Pipeline".
5. **PIPEFITTER** – Inspect all sections of pipe and welding to ensure the system is safe and will not leak. Certify the pipelines are ready for installation by notifying your supervising engineer that you are ready to use the pipeline.
6. **REFINERY OPERATOR** - Label one baster as the Transmission Pipeline Baster.
7. **GAS COMPRESSOR OPERATOR** - Label one baster as the Compressor Baster.
8. **PIPELINE OPERATOR** - Label one baster as the City Gate Baster.

PART 2: MODEL THE PIPELINE SYSTEM

NOTE: During Part 2, the **Pipefitters** and **Welders** may not have a prescribed step to complete. However, they must be ready and available to repair any sections of pipeline that the engineers and operators feel need attention to improve flow and assist with cleanup.

1. **SUPERVISING ENGINEER** - Arrange the fixed components in the pipeline system. Place the containers in order, left to right: Natural Gas Processing Facility, Compressor Unit, City Gate, and Customer. Make sure they are all roughly a pipeline length apart. Sketch the design of the system before moving on to step 2. Record your sketch in the Data section.
2. **PIPELINE OPERATOR (1)** – Hold the Transmission Pipeline over the container labeled Natural Gas Processing Facility with one flexible end pointing up, and the other flexible end pointing down over the container labeled Compressor Unit. Put the coffee filter inside the funnel and place the funnel with filter inside the compressor container. The pipeline contents should flow into the filter before the container, but do not cover the whole container so you can see inside. The Natural Gas Processing Facility should be filled with water to represent gas that will flow into your pipeline.
3. **REFINERY OPERATOR** – Fill your baster pump with some natural gas from the processing facility and pump it through the Transmission Pipeline until it flows into the Compressor Unit. Continue pumping until a good amount of liquid is in the Compressor Unit and the Supervising Engineer has instructed you to stop.
4. **SUPERVISING ENGINEER** - Monitor the flow of gas coming into the pipeline system and moving through the filter into the compressor. Instruct the Refinery Operator to speed up, slow down, or pause operations as needed.
5. **PIPELINE OPERATOR (2)** - Take the second section of Transmission Pipeline and hold it above the Compressor Unit with one flexible end pointing up, and the other flexible end pointing down over the container labeled City Gate.
6. **GAS COMPRESSOR OPERATOR** – Fill your baster pump with natural gas that has been "compressed" in the Compressor Unit. Pump the gas into the Transmission Pipeline into the City Gate. Continue pumping until a good amount of liquid in the City Gate and the Supervising Engineer has instructed you to stop.
7. **SUPERVISING ENGINEER** - Monitor the flow of gas in the pipeline system moving from the compressor to City Gate. Instruct the Compressor Operator to speed up, slow down, or pause operations as needed. Drop a few drops of food coloring (odorant) to represent mercaptan at the City Gate.
8. **PIPELINE OPERATOR (1)** – Hold the Distribution Pipeline above the City Gate with one flexible end pointing up, and the other flexible end pointing down over the container labeled Customer.
9. **PIPELINE OPERATOR (2)** – Fill your baster pump with odorized natural gas from the City Gate. Pump the gas into the Distribution Line until it flows to the Customer.
10. **ALL** – Dump the natural gas and clean up the model station following instructions.

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Data and Observations

Sketch a drawing of your pipeline system. Label all of the parts.

Conclusions

1. Why do you think pipelines are considered modes of transportation?

2. What are some advantages and challenges to moving gases through pipelines?

3. Describe something you would do to improve this model.

4. What might be different in a pipeline system that moves a liquid like oil?

SEPARATOR SIMULATION

Check out this training and informational video!

Topic

Natural Gas in Depth

Grade Level

Elementary, grades K-5
Middle, grades 6-8
High School, grades 9-12

Time

20 - 30 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Natural gas is often found and recovered in combination with other materials such as water, hydrocarbons, mud, etc.
- Time and specific gravity or density can help naturally separate gas from liquids and other materials. Separators, scrubbers, and filters can be used to help separate products physically.
- Separation is helpful for value and safety.
- Mixtures can be separated based upon their physical properties.

Materials

- Mason jar or similar with lid
- Oil (cooking oil)
- Soil (small amount)
- Sand (small amount)
- Water
- Bottle of Italian salad dressing, label removed

Relevant Slides

- Let's Talk About Energy, slides 1-18

OR

- Our Future with Natural Gas, slides 10-19+

Background

Separation is an important part of the processing of natural gas. Natural gas does not always come to the surface ready for use. It is more commonly brought to the surface as an emulsion, or mixture, of oil, gas, water, and/or solids. Natural gas is often a mix of dry gas (methane) and wet gases like ethane, butane, or propane, and not necessarily water. Wet gas must be separated or removed from the dry gas before it is sent into the pipeline system. Filters and compressors help remove condensate and solids that may remain. Typically, the separation of wet and dry gas is achieved through cooling and chemical processes. If separating liquids, like oil and water first from natural gas, density, gravity, heat, physical barriers, and retention time will be used. This activity will model separation using non-gaseous items for simplicity of demonstration. It is a great, quick demonstration, and connects well with classroom science standards related to mixtures, physical properties, and density in elementary through high school.

Basic Steps

1. Assemble your separator demonstration by filling a transparent jar or container with mostly water, about one inch of oil (for visuals), some potting soil, and a bit of sand. Place the lid on tightly. Shake up to "emulsify" and allow density to do its job. The oil should separate out and form a layer on top of the water. Sand will sink to the bottom, and organic matter, like potting soil, will float on top. You can opt for making a second set-up with differing amounts of the mixture inside to show that it will always separate the same. Use a container of Italian salad dressing (with zesty "bits") as a quick supplemental or alternative to demonstrate the concept more simply.
2. Introduce yourself to students and briefly introduce natural gas with the introductory slides. Pause for questions, and then continue with the remaining slides as desired, discussing transportation of natural gas and the natural gas industry as a whole. Be sure to highlight content about processing and characteristics of pipeline quality natural gas that relate to your demonstration.
3. Use your jar and/or bottle of salad dressing to demonstrate a separator. Explain that natural gas is often found with other components, and explain the difference between wet and dry gas, if appropriate. Explain that separation is used in the oil and natural gas industry to separate natural gas from other products, and to separate out different gases from methane. Depending on the age of the students you can discuss the various types of separation and how they work, and where in the natural gas stream separation is necessary.
4. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What is an example of something in the world around you that separates over time?
- How is a separator or separation used in the natural gas industry.
- How is compression helpful for separation?

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Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- This lesson is simple in its nature and demonstration. Use only the container of Italian dressing for a simpler set-up and demo.

Amplify the Content

- Consider adding heat to show how heating may change the viscosity of fluids and aid in separation.
- Discuss safety and quality control in natural gas and what happens if condensate is found in a pipeline.
- Consider coupling this demonstration with the "Pipeline Push" activity.
- Show an industry video or photo of pipeline gases or bring in example tools or equipment that are used to aid in natural gas processing. Students may also enjoy seeing how things are fixed when something has gone wrong.

Additional Resources

- The INGAA Foundation: **www.ingaa.org/issue/operations/**
- Kimray, Inc., Oil and Gas Basics – Separation video: **https://youtu.be/-xWQMWJD8hg?si=1G9-tr5_I8qw98SY**
- Penn State University Extension Office: **https://extension.psu.edu/understanding-natural-gas-compressor-stations**
- Student Energy, Natural Gas 101: **https://youtu.be/-njmj0diWu8?si=b_Q7uUQFUqDnyejV**

VOLUME DEMONSTRATION

Check out this training and informational video!

Topic

Natural Gas in Depth

Grade Level

High School, grades 9-12

Time

10-20 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Liquefied Natural Gas (LNG) is natural gas that has been cooled to a liquid state, approximately -260º Fahrenheit, and has a volume that is about 600 times smaller than its volume in gaseous state.
- In its natural state, methane is a gas, which can make it difficult to store or ship in large volumes.
- When temperature is held constant, the volume of a gas is inversely proportional to its pressure – increasing pressure at low constant temperature allows for condensation of natural gas to a liquid.
- Volume of gas is directly proportional to the temperature of gas, if pressure is held constant – when LNG is heated its volume increases, allowing for regasification.
- LNG can be stored or exported to places pipelines do not reach. Specialized ships and storage facilities are used to keep gas at the pressure and temperature required.
- LNG must be regasified before re-entering the pipeline system.

Materials

- Beach ball
- Ping pong ball
- Set of 600 counting units (or any items, such as cotton balls)
- 1 800-1,000 mL Beaker
- Water
- Marker

Relevant Slides

- Our Future with Natural Gas, slides 14-19+

Background

After oil and natural gas are separated, they are transported for further processing and use. If natural gas must travel a long distance, it can be liquefied from its gaseous state. When it is cooled to become a liquid, it takes up less space, making it easier to transport larger amounts over long distances.

Basic Steps

1. Gather the materials listed for the demonstration.
2. Set up the supplies for easy demonstration and class viewing. Fill the beaker with only 1 mL of water.
3. Introduce yourself to students and briefly introduce natural gas with the introductory slides. Pause for questions, and then continue with any remaining slides if desired, discussing transportation of natural gas and the natural gas industry. Be sure to highlight LNG and the components of the natural gas system that relate to exporting or using LNG.
4. Show the students the beach ball and the ping pong ball. Ask them which ball they think represents natural gas and which represents LNG. (The beach ball represents a gaseous state [natural gas] while the ping pong ball represents the liquid state [LNG].)
5. Explain to the students that natural gas is typically found in a gaseous state. Explain that natural gas can be changed into a liquid (LNG) by making it very cold (-260°F or -162.2°C).
6. Ask the students what happens to the volume of a gas when it becomes a liquid. (The volume of a gas is reduced when it is a liquid.) Revisit the ping pong ball and beach ball. Ask students to consider their answers from before.
7. Show the class your 600-unit set of items, without specifying how many are in the set. Ask the students to predict the volume of natural gas in a liquid state (LNG) if the whole set represents a gaseous state. Have students provide predictions and write them on the board.
8. Explain to the students that LNG is 1/600th of the volume of natural gas in a gaseous state. Separate out one unit from your 600-unit set.
9. Now, show the beaker with 1 mL of water to the class. Have the students predict and draw lines on the beaker (with pencil or marker) to show how much water would represent natural gas in a gaseous state, if the amount of water presently in the beaker represents LNG. (600 mL)
10. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What are the advantages and disadvantages of natural gas in both gaseous and liquid states?
- Why is regasification necessary? What would it require to transport LNG differently?

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Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- This lesson is simple in its nature and demonstration. Use only one of the items (600-item set or beaker/water) for a simpler set-up and demonstration.

Amplify the Content

- Provide small groups with their own 600-unit counting sets and beakers of water and conduct the activity with more small group discussion.
- Ask students to brainstorm other visual representations of the volume of natural gas compared to LNG.
- Combine this activity with a pipeline or separator activity for a more robust showcase of the industry.
- Discuss peakshaver facilities.
- Discuss or reinforce the gas laws with older students (those who have taken chemistry) and relate them to LNG. See the science concepts for more information.
- Show a video or imagery of LNG infrastructure, including maps or aerial photos of import/export terminals and storage facilities.

Additional Resources

- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- U.S. Department of Energy, LNG: **www.energy.gov/fecm/liquefied-natural-gas-lng**
- U.S. Department of Energy, Energy Information Administration, Natural Gas explained – Liquefied Natural Gas: **www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php**
- U.S. Federal Energy Regulatory Commission, LNG Existing and Proposed Terminals: **https://www.ferc.gov/natural-gas/lng**
- U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration: **https://primis.phmsa.dot.gov/comm NaturalGasPipelineSystems.htm**
- Student Energy, Natural Gas 101: **https://youtu.be/-njmj0diWu8?si=b_Q7uUQFUqDnyejV**

NATURAL GAS CAREER ROUNDUP

Check out this training and informational video!

Topic

Natural Gas Careers and Future of Natural Gas

Grade Level

Elementary, grades K-5
Middle, grades 6-8
High School, grades 9-12

Time

30-40 minutes

Science Content

- Natural gas is a clear, colorless, odorless gas made mostly of methane.
- Natural gas is most often a nonrenewable fossil fuel, but natural gas can also be produced from renewable sources.
- Natural gas can be used as a heat source for industry, residential and commercial energy, as a feedstock for industry, as a transportation fuel, and as a fuel for electricity in power plants.
- Natural gas is found deep underground, brought to the surface, and pumped under pressure through a pipeline to its point of use.
- Natural gas can be used to create many products.
- There are many careers available in the natural gas industry. Some of these careers require a specific educational background and post-secondary schooling or certifications, while others require a high school diploma and on-the-job training.

Materials

- Natural Gas Roundup Posters
- ***Natural Gas Roundup Cards***, page 70, copied and cut
- Construction or colored paper

Relevant Slides

- Let's Talk about Energy, slides 1-4, 10-14, 23-33

OR

- Our Future with Natural Gas, slides 1-28

Background

This is a good activity to introduce careers in the industry. This activity divides a large group into small groups. For Elementary and younger students, you may need to skip to step 8 in the procedure, as they may be less familiar with the careers vocabulary and descriptions.

Basic Steps

1. Print the Natural Gas Careers cards so that you have one slip per student and an equal number for each career. Cut out the cards and laminate, if necessary.
2. Download and print the posters from **www.need.org/wp-content/uploads/2025/07/Natural-Gas-Career-RoundUp-Posters.pdf**. Cut a strip of colored paper for each poster to create a flap that conceals the job title. Tape the strip down so the title for each is hidden appropriately.
3. Mount the posters around the walls of the room. Space the posters equally apart and set up chairs for each station, if desired. Place a piece of paper and a pencil with each poster station. The players will use these toward the end of the game.
4. Introduce yourself to students and briefly introduce natural gas with introductory slides. Pause for questions. Continue with career slides and any slides about natural gas and the industry as time allows. Be sure to highlight careers and skills used in the industry.
5. Assign players to groups using the careers cards you cut out. Let the players draw these out of a hat or pass them out randomly. (You can assign players to fewer than groups by eliminating one or more energy sources from the hat. Even if you have fewer groups, keep all the posters on the walls.) Make sure each career you will use is represented by at least one student. Instruct students NOT to share what career they have picked.
6. Give instructions for game play as follows:

   You have all been assigned to a career group. In a minute, you'll be getting into these groups. You must follow these instructions.

   You cannot speak or communicate with anyone during the first phase of the game.

   When I say go, walk to the closest poster and read the clues that describe the career. If you think these clues describe your career, remain beside that poster. If the clues don't describe your career, move on to another poster. Repeat the process until you think you've found your career.

   You'll have three minutes to find your career. Remember, no talking or communicating is allowed. Does anyone have any questions? Ready? The first round lasts five minutes. Go!

   Your five minutes are up, and everyone must be at their poster. Remember, remain silent. Now, will the person closest to each poster lift the flap of the poster so that only the people in your group can see which career the clues describe. (Players lift flaps to reveal career titles.)

   Please close the flap. If you're in the correct group, remain at your poster. If you're not, look for your career again. This time you have three minutes. No talking or communicating. Go!

7. Play the first round for five minutes and the second for three minutes. You can continue rounds until everyone has found his or her career. Subsequent rounds last 30 seconds to one minute each.

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8. After all the rounds are finished, give the groups these instructions:

   You will be allowed to talk during this part of the game. The members of your group must now decide which of the clues reveal the least about your career. Keep the least revealing clues and eliminate the two clues that reveal the most. I'll give you two minutes to do this, and then I'll ask three people in your group to each read a clue one at a time. After the second clue has been read, everyone in your group will say in unison, "What are we?"

   Now, one person in your group should take the pencil and paper at your station and write numbers one through twelve down the side of the paper. After a group says, "What are we," the other groups will have 15 seconds to write down the name of the career. Since every source has a number, just write the group's name by the corresponding number on your piece of paper.

   The group that correctly identifies the most career fields wins.

9. Play the game answer any questions students have regarding the careers in your field.
10. Pass out an ***Exit Ticket*** for the appropriate grade level or share the link with the educator to have the students complete the exit ticket on a device. Share the evaluation with the educator. Submit evaluation responses to **foundation@ingaa.org**.

Discussion Questions

- What career opportunities interest you?
- What is required for careers in the natural gas industry?
- In what ways to careers in the natural gas industry overlap with others?

Simplify/Amplify

Simplifying the lesson can be helpful for younger students or in scenarios where less time is available. Amplify the content for older students, those more familiar with the topic, or when more time is available for exploration.

Simplify the Lesson

- Play the game without the written portion in step eight. Simply ask the students at each poster to verbally share their clues and have the class guess their poster identity out loud.

Amplify the Content

- Combine this activity with another activity in the set, such as *Pipeline Push*. Discuss the careers in that activity and add others to this poster game.

Additional Resources

- The NEED Project, Natural Gas Materials: **www.need.org/resources/oil-natural-gas-materials/**
- Student Energy, Natural Gas 101: **https://youtu.be/-njmj0diWu8?si=b_Q7uUQFUqDnyejV**
- Center for Energy Workforce Development, Get Into Energy: **https://getintoenergy.org/careers-in-natural-gas/**
- American Petroleum Institute, Career Opportunities in the Natural Gas and Oil Industry: **www.api.org/-/media/files/policy/jobs/oil-and-gas-career-guide.pdf**
- U.S. Bureau of Labor Statistics, Career Resource Guide: **www.bls.gov/k12/students/careers/how-can-bls-help-me-explore-careers.htm**

CIVIL ENGINEER	WELDER
SUPPLY CHAIN MANAGER	NATURAL GAS TECHNICIAN
GIS ANALYST	PETROLEUM & NATURAL GAS ENGINEER
ATTORNEY	ENVIRONMENTAL ENGINEERING & PROTECTION TECHNICIANS
OCCUPATIONAL HEALTH & SAFETY SPECIALISTS	DATA SCIENTIST
PIPEFITTER	CHEMIST

EVALUATION

Elementary Student Exit Ticket

1. What was your favorite part of today's classroom visit?

2. Draw a picture of or write 1 thing you learned today:

3. What is 1 thing you would ask your presenter after today's activities?

EVALUATION

Middle School Student Exit Ticket

1. What was your favorite part of today's classroom visit?

2. What is one thing that stuck with you from today's activities?

3. True or False: I learned something new today.

4. What is one thing you would ask your presenter after today's activities?

High School Student Exit Ticket

1. What are three (3) key takeaways from today's activities/visit?

2. True or False: I learned something new today.

3. True or False: I would consider a career in the natural gas industry.

4. What is one thing that stuck with you from today's activities?

EVALUATION - TEACHER/EDUCATOR/ORGANIZER

PLEASE ANSWER THE FOLLOWING QUESTIONS USING THE RATING BELOW.

1. The INGAA Foundation member communicated well with me to organize and prepare for the visit.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

2. I fully understood the content and activities that were going to be covered.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

3. My students were engaged in today's activities.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

4. The activity selected was a good fit for my students and/or the content we cover.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

5. I would host another visit for my school/classroom in the future.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

6. I would like more resources for my students.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

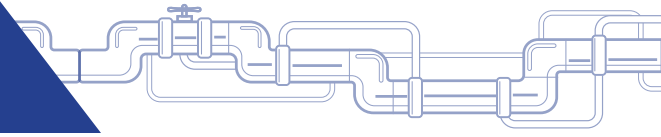
7. I learned something new today about natural gas and the industry.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

Please list any suggestions for future visits.

Please list any questions you have that were not covered.

EVALUATION - INGAA FOUNDATION MEMBER



PLEASE ANSWER THE FOLLOWING QUESTIONS USING THE RATING BELOW.

1. The classroom teacher/community member and I had good communication.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

2. I felt prepared for the session.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

3. The activity instructions and supplies were adequate and appropriate for the session.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

4. I completed the activity as written with no modifications.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

5. The students were engaged in today's activities.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

6. The activity selected was a good fit for the time allowed.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

7. The activity was a good fit for the students and their abilities/attention/attitude.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

8. I would feel comfortable doing this activity again.

   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

9. I would visit this classroom/community site again.

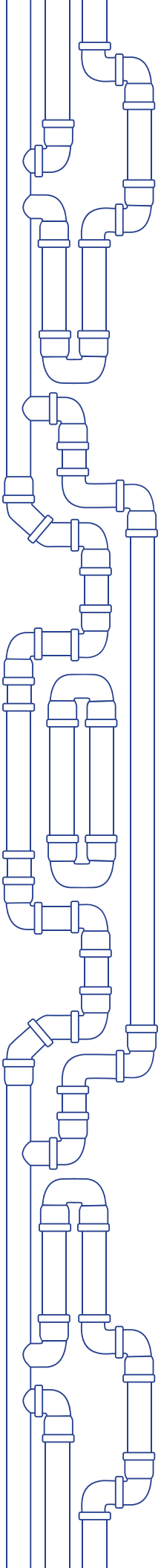
   ☐ do not agree ☐ somewhat disagree ☐ neutral ☐ somewhat agree ☐ absolutely agree

Please list any challenges you had during the impact outing:

Please list any successful moments or points of pride that are worth sharing from your outing:

Please list and describe any updates, errors, or instructions you would modify in the support materials.

Please share any pictures or further feedback.



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