Natural Gas

CAES Energy Efficiency Research Institute
Boise State University
Natural Gas Lesson Plan

Components

- Buoyancy and Pressure Demonstration or Lab Experiment
- “It’s a Gas” lab experiment
- Scientific reading from NEED’s Liquefied Natural Gas: LNG Booklet
- Other scientific reading/research encouraged, but not included in this lesson plan explicitly
- Dramatic activity demonstrating the lifecycle of natural gas
- Lots of discussion throughout
What is natural gas?
What is natural gas?

- Colorless, odorless, found naturally in gaseous form
- 90% methane, traces of butane and propane
- US has large natural gas reserves
- Often found with petroleum (crude oil) or coal
- “Raw egg” smell added to alert users of a leak
- Natural gas is not renewable
- Natural gas is a fossil fuel
Why do we care about natural gas?
Why do we care about natural gas?

- Second most popular form of energy in the US (after petroleum) providing ~25% of our total energy demand
Why do we care about natural gas?

Jon Stewart Video: An Energy Independent Future


Note: Video may be inappropriate for some audiences. Please preview before showing students.
What do you think?
What do you think?

- This is not a new problem or solution.
- We are moving closer to energy independence and natural gas has played a significant roll in this.
- Even if we were completely energy independent, this does not make us immune to price and security fluctuations.
- How dependent is energy policy on congress?
- What are our options?
How important is natural gas?

Many uses:
- Industry ~33%
  - Mostly heat, also as ingredients
- Electricity ~30%
  - Second largest electricity producer after coal
  - 24% of US electricity comes from natural gas
- Residential (~20%) and Commercial (~13%) ~33% total
  - heating, cooking, appliances
- “Other” uses ~3%
  - Transportation
  - Alternative to propane
  - Distributed energy

[Diagram: U.S. Natural Gas Consumption by Sector, 2010]

Data: Energy Information Administration
Natural gas is found and obtained in a gaseous state. It goes to processing plant where it is cleaned and separated. Liquefied natural gas (LNG) is natural gas that has been cooled to -260 deg F. This reduces its volume 600 times.

- Used primarily for transport overseas or in areas with no pipelines
- Kept “on-tap” for high-demand
- Special tanks, ships and trucks required

Compressed natural gas (CNG) is still a gas, but it has been compressed (i.e. pressure increased) to take up less space:

- transported by pipeline to the gas utility
- Gas utility reduce pressure, add odorant and pipe to homes and businesses
Confusion behind natural gas
Part II

- Natural gas used to heat your home and run your gas appliances (range, clothes dryer, water heater)
  - Piped to gas utility first
  - Piped directly to your house and burned

- Natural gas used to generate electricity
  - Piped to a combined cycle power plant
  - Electricity is generated and provided to homes, businesses, etc.
How do natural gas appliances work?

- Natural gas is “clean burning” so it is safe for use in residences
- Gas is supplied to appliance and burned for heat
Gas Clothes Dryer

http://www.youtube.com/watch?v=mcipN8bypa0
Gas Water Heater

Poll #1

How are we doing?

- Clear as petroleum or coal (i.e. I’m so confused)
  - Give a red X
- Clear as natural gas (i.e. I think I get it)
  - Give a green check
Pressure and Buoyancy

- Demonstration on page 2 of “It’s a Gas” lab experiment

- Opening a soda pop bottle. Ohhh…. Ahhh…. 
Pressure and Buoyancy

What’s happening here?

- As the bottle is squeezed, the inside of the bottle experiences high pressure, which compresses the air inside the condiment packet.
- The air compression increases the density of the packet, causing it to sink.
- When the bottle is released, the pressure inside of the bottle is reduced and the air inside of the condiment packet expands.
- This lowers the density and increases the buoyancy so the packet floats once again.
Pressure and Buoyancy

- Opening a soda pop bottle. Ohhh.... Ahhh....
Pressure and Buoyancy
What’s happening here?

- The pressure in the bottle is very high and the gas and soda are mixed together.
- When the bottle is opened, the pressure is released and some of the gas separates from the liquid by fizzing to the top.
Pressure and Buoyancy?

- Why is this a good intro to natural gas?
Pressure and Buoyancy?

- Why is this a good intro to natural gas?
  - It explains how oil and natural gas are separated
  - It explains how natural gas is extracted

- Before being tapped, a natural gas well is under tremendous pressure. When it is drilled, some of the pressure is released causing the natural gas and the oil to separate.
“It’s a Gas” Lab Experiment

- What was your hypothesis?
“It’s a Gas” Lab Experiment

- What actually happened?
“It’s a Gas” Lab Experiment

- How gross was it… really?
“It’s a Gas” Lab Experiment

- What will you do differently next time?
  - Do you have an idea that might work better than the experiment directions?
  - Did you not have all of the supplies and had to “make-do”?
What happened to Tara...
Day 1
Day 2
(not much different from Day 1)
Day 6!
Day 7
It’s a Gas!
Morning of Day 8...?
What happened to Sandy…

- Procrastination… Didn’t start experiment until the afternoon of Tuesday, February 5
The supplies!
20 g eggs with shell

It would have been better to shell first, then measure.
Force into bottle while trying to photograph
Use the cheap, unhealthy lettuce
50g of (wet) sand through a funnel without disturbing the material below. Right...
25mL murky pond water. Yum.
Spill all over counter.
Pour into bottle (along sides).
Place in a warm spot.

Tuesday afternoon
Wednesday morning
No change (or photos) Wednesday afternoon or Thursday morning
Thursday early afternoon
Thursday afternoon
(2 hours later)
Friday morning
“It’s a Gas” Lab Experiment

- How is this relevant to natural gas we use every day?
It’s a Gas Lab Experiment

- How is this relevant to natural gas we use every day?
  - Natural gas is primarily methane
  - Natural gas is found in gaseous state
  - Natural gas was created by decomposing plant and animal matter
Natural Gas Lifecycle

What are three things that happen to natural gas during its lifecycle?
Natural Gas Lifecycle
(the Cliffnotes version, part I)

- Tiny sea plants and animals died, sank to the bottom of the ocean, were buried by sediment that turned into rock.
- The rock became thick over time and subjected the plant and animal remains to enormous pressure.
- Pressure and heat from the earth changed the organic matter to petroleum and natural gas.
Natural Gas Lifecycle (the Cliffnotes version, part II)

- Natural gas is now found trapped in pockets of porous rocks deep underground
Natural Gas Lifecycle
(the Cliffnotes version, part III)

- After extracted, it is cleaned and gasses are separated
- Most natural gas is compressed and transported via pipeline (CNG)
- Some natural gas is cooled to -260 deg F, stored and transported in insulated tanks (LNG)
Poll #2 And then what?

What happens next? Where is the natural gas used?

A. Mostly in industry, some in electricity
B. Roughly equally in industry, residential/commercial, electricity, with some “other uses”
C. Roughly equally between industry, residential and transportation
D. Mostly residential and commercial
Natural Gas Lifecycle
(the Cliffnotes version, part IV)

- Industry ~33%
- Residential/Commercial ~33%
- Electricity ~30%
- Other uses ~3%: transportation, distributed energy, alternative to propane
Dramatic activity

- How much have you retained about the lifecycle of natural gas? Not much.
- Get your students in action!
  - Skit
  - Song
  - Poem
  - Video
  - Timeline
  - Poster
  - Etc.