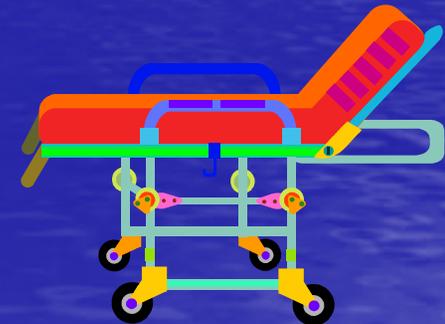




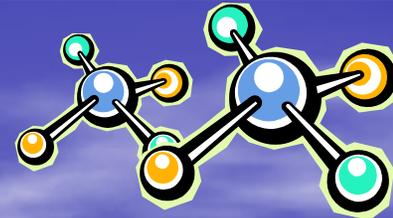
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The Mysterious Malady: INTRODUCTION

Sally was living the American Dream. She had a loving and caring husband, two wonderful children, and had just moved into her lovely new custom-built home in the foothills of the Sierra Nevada mountains. Sally was very happy...until she started getting sick.



PURPOSE



The purpose of our student research is to demonstrate evidence that supports or refutes four different claims made about the causes of Sally Citizen's illness:

1. The kinetic molecular theory explains that toxic black mold spores are being spread throughout the home by air molecules & causing Sally's allergic reactions.
2. Radon gas is seeping into the house, colliding with other air molecules. The family is getting cancer from breathing in the radon.
3. Random motion of carbon monoxide molecules has caused it to be diffused throughout the house, causing Sally's illness.
4. Freon has thermally reacted with warm air and created phosgene causing Sally to be sick.



GAS LAWS: WHAT IS KINETIC MOLECULAR THEORY?

- Kinetic Molecular Theory explains why molecules of gases are constantly moving, colliding with each other, & bouncing back and forth.
- The random motion of molecules explains the diffusion of gases
- The temperature of a substance is proportional to average kinetic energy of the moving molecules
- The higher temperature, the more rapid molecular motion, the higher the pressure will become.
- The gas laws relate pressure, temperature, & volume of any ideal or mixture of ideal gases.

OUR FORMAT

EVIDENCE: This section of each slide shows the evidence that was researched. Two types of evidence were evaluated: 1) Potential sources of the toxins, & 2) Symptoms of the toxins; ALL with the understanding that kinetic molecular theory would explain the gas being diffused throughout Sally Citizen's house.

EVIDENCE QUALITY (*****): The source of the evidence (website) was rated on a scale from 1 - 5 stars.



WHY SUPPORTING SALLY'S ILLNESS (*****): How well the evidence supported each of the four claims was rated on a scale from 1 – 5.

WHY REFUTING SALLY'S ILLNESS (*****): Tells how well the evidence refutes the claim and is rated accordingly.

DIFFUSION SPREAD MOLD TO SALLY'S LUNGS

- **EVIDENCE**: If the gas particles are subject to Brownian motion and there is no preferred direction for the random oscillations, then the particles will tend to be spread evenly throughout the medium over time.
- **EVIDENCE QUALITY (***)**: The web site by Encyclopedia Britannica clearly explains diffusion by Brownian motion.
- **WHY SUPPORTING SALLY'S ILLNESS (***)**: Because of the laws of diffusion, Sally is inhaling spores of black mold because they are traveling through the air.

http://www.britannica.com/nobel/micro/88_96.html

BLACK MOLD CAN CAUSE RESPIRATORY AILMENTS



- **EVIDENCE:** Symptoms associated with mold exposures include allergic reactions, asthma, and other respiratory complaints
- **EVIDENCE QUALITY**(*****): The U.S. Environmental Protection Agency is a respected federal agency. This is an extremely reliable source because the agency obviously does in depth research to come to this conclusion.
- **WHY SUPPORTING SALLY**(****): Some of the symptoms that come with black mold exposure are the same symptoms that Sally Citizen is experiencing: flu-like symptoms, runny nose, sniffles, headaches, skin rashes, respiratory ailments.

<http://www.epa.gov/iaq/molds/moldresources.html#Ten%20Things%20You%20Should%20Know%20About%20Mold>

RADON COMES FROM ROCK

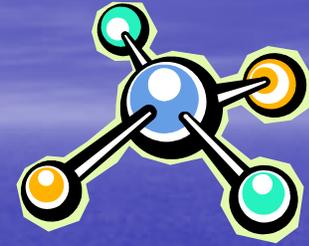
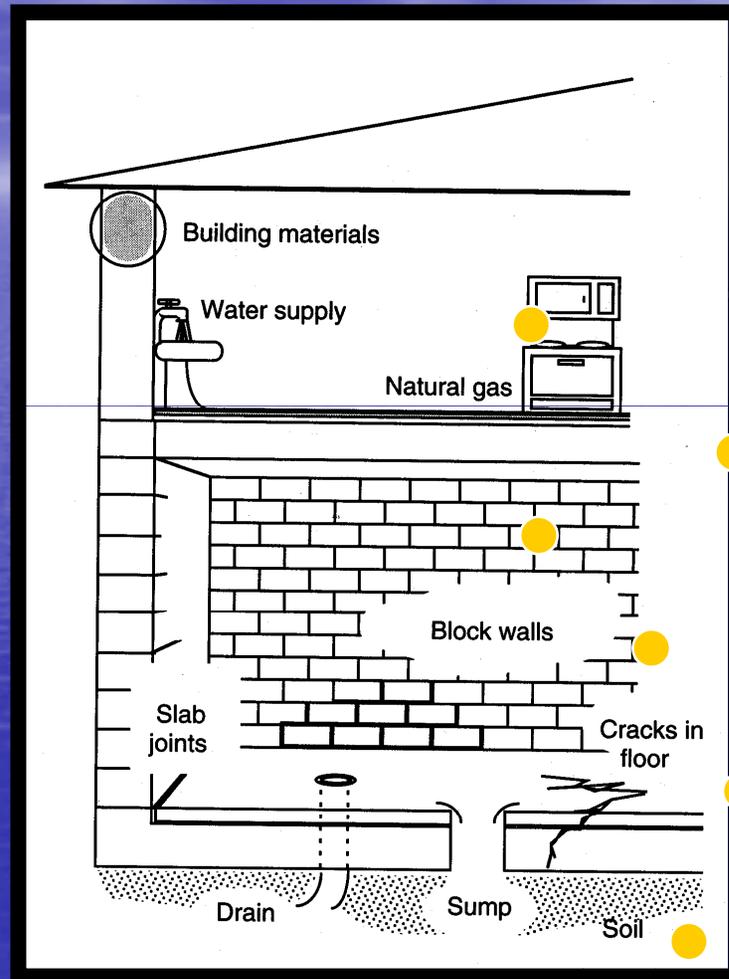
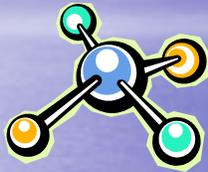
- **EVIDENCE:** Radon gas comes from radioactive decay of radium, a ubiquitous element found in rock and soil. It moves from soil into the air, emits alpha, beta particles, and gamma rays. Radiation damages cells & results in cellular transformation in the respiratory tract, which can lead to radon-induced lung diseases or cancer.



- **EVIDENCE QUALITY**(****): Agency for Toxic Substances & Disease Registry appears reputable. They work with the EPA and US Health & Human Services.
- **SUPPORT REASONING** (***): Sally's house facade is covered with rock from a local quarry. Her house is built on a hilltop. Radon could be seeping from the rocks & infiltrating the house with radon gas.

<http://www.atsdr.cdc.gov/HEC/CSEM/radon/>

RADON DIFFUSES INTO THE HOME



http://www.atsdr.cdc.gov/HEC/CSEM/radon/exposure_pathways.html#Figure%201

RADON GETS IN THROUGH CRACKS



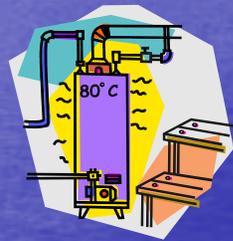
- **EVIDENCE:** Radon moves up through the ground to the air above and into your home through cracks and other holes in the foundation. Your home traps radon inside, where it can build up. Any home may have a radon problem: 1) new and old, 2) well-sealed and drafty, and with or without basements.
- **EVIDENCE QUALITY** (****): EPA is a government site.
- **WHY REFUTES SALLY** (****): Sally's hair is falling out like she has cancer BUT there is NO MENTION of chemotherapy or any other cancer treatment that would cause her hair to fall out.

<http://www.epa.gov/radon/pubs/citguide.html#howdoes>



CARBON MONOXIDE KILLS

EVIDENCE: Each year carbon monoxide gas kills 5,000 persons in the U.S. & injures over 10,000. Many of these deaths are due to faulty or defective products:



- fireplaces
- wood stoves
- hot water heaters
- furnaces
- Cooking Appliances
- Pool Heaters
- lawn mowers
- gas stoves
- snow blowers
- recreational vehicles

EVIDENCE RATING ():** This website is written by lawyers who are advertising for their business.



WHY SUPPORTING SALLY (**):** Because the Citizens live in the mountains, faulty home heating appliances such as a fireplace, wood stove, or furnace are likely sources of carbon monoxide gases in the Citizen home.

<http://www.carbon-monoxide-poisoning-injury.com/>

SYMPTOMS OF CARBON MONOXIDE



- **EVIDENCE**: CO toxicity causes headaches, dizziness, nausea and fatigue, plus flu-like symptoms. People feel a bit better outside in fresh air.
- **EVIDENCE QUALITY**(***): This website is written by lawyers who are advertising for their business.
- **WHY SUPPORTING SALLY**(****): Sally had these symptoms. She felt better when she left the house. The other family members only got sick on weekends & holidays. Shortness of breath, light-headedness, tremors, aching joints, blurred vision. Billy Bob tested positive for traces of carbon monoxide in his blood.

<http://www.carbon-monoxide-poisoning-injury.com/symptoms.htm>

FREON IS NON-TOXIC



- **EVIDENCE:** “Because Freon is non-toxic, it eliminated the danger posed by refrigerator leaks. Inventor Thomas Midgley held a demonstration of Freon by inhaling a lung-full of the wonder gas and breathing it out onto a candle flame, which was extinguished, thus showing the gas's non-toxicity and non-flammable properties.”
- **EVIDENCE QUALITY**(**): This website “About Inventors” appears reputable & informative, but Freon is NOT non-toxic to humans today.
- **WHY REFUTES SALLY** (****): Freon exposure causes MANY of the same symptoms that Sally already has. This website implies that Freon is not toxic which is not true.



<http://inventors.about.com/library/inventors/blfreon.htm>

FREON CREATES PHOSGENE

- **EVIDENCE:** Symptoms of phosgene (COCl_2) include:

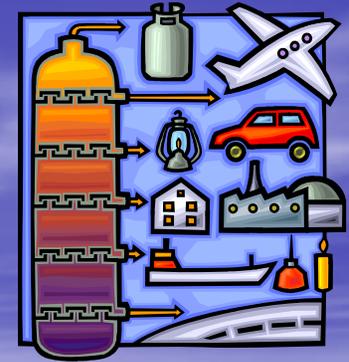
- Nausea & vomiting
- Lesions similar to frostbite or burns
- Fluid in the lungs (pulmonary edema)
- Shortness of breath
- Coughing
- Blurred vision
- Difficulty breathing
- Burning throat & watery eyes



- **EVIDENCE QUALITY**(****): CDC is the Center for Disease Control. It's a government site that we can trust because it's their job to know symptoms and sources of toxic chemicals.
- **WHY SUPPORTS SALLY** (****): All the symptoms match Sally's except the lesions (frostbite). Unfortunately, Sally also has many symptoms similar to BOTH Freon/Phosgene AND Carbon Monoxide poisoning.

<http://www.bt.cdc.gov/agent/phosgene/basics/facts.asp>

FREON/PHOSGENE EXPOSURE IS RARE



- **EVIDENCE:** Individuals are most likely to be exposed to phosgene in the workplace during its manufacture, handling, and use; from direct industrial emissions of phosgene, thermal decomposition of chlorinated hydrocarbons, and photooxidation of chloroethylenes in the air.



- **EVIDENCE QUALITY** (****): This is the EPA. We're supposed to be able to trust the EPA to do enough research to give us information..
- **WHY REFUTES SALLY** (****): Sally doesn't work in a factory or manufacturing of these chemicals.

<http://www.epa.gov/ttn/atw/hlthef/phosgene.html>



CONCLUSION



- The evidence suggests the cause of Sally Citizen's illness is a combination of two toxic chemicals: 1) Carbon Monoxide, & 2) Freon. Both toxins are highly threatening to human health. The Citizen family had experienced symptoms of high concentrations of both.
- We believe the source of carbon monoxide is from their fireplace. Since the Citizen family never used their central air & heating system, we believe that carbon monoxide was coming from incomplete combustion of fuels &/or faulty venting of the fireplace. The Freon could have come from an appliance such as the refrigerator. Together, it was a toxic soup for poor Sally!

