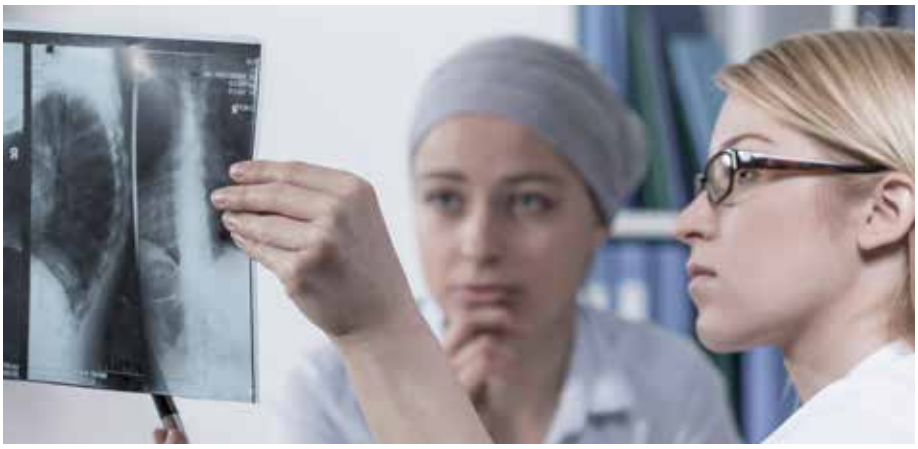
# Shale Gas Development and Cancer

ENVIRONMENTAL HEALTH PROJECT
DEFENDING PUBLIC HEALTH SINCE 2012

## HOW OUR ENVIRONMENT PLAYS A ROLE IN CANCER DEVELOPMENT

Cancer occurs when certain genetic changes happen in our bodies, altering the way cells function. Sometimes things we're exposed to in our environment damage DNA within our cells, leading to the development of cancer. These things are called carcinogens. Some well-known examples of carcinogens include tobacco smoke, UV light from the sun, and radiation.

The development of cancer is often the result of a combination of factors, including the genes you inherit from your parents, lifestyle choices – like diet, exercise, smoking, and alcohol consumption – age, and the carcinogens you're exposed to from your environment. Most environmental carcinogens require repeated exposure over time to contribute to the development of cancer. Some people are more susceptible to certain carcinogens than others. For example, while we know that tobacco smoke is a powerful carcinogen, certain life-long smokers won't develop cancer, while others will.



Most of what we know about carcinogens we've learned through animal studies or occupational exposures. It's often nearly impossible to establish what carcinogens led to the development of cancer once it occurs in an individual. Even if multiple people within a community develop the same type of cancer within a short time period, called a cluster, it's very difficult to determine if a carcinogen in their shared environment was responsible.

One reason it's hard to identify a specific carcinogen is because cancer usually develops very slowly. The latency period, or the time between exposure to a carcinogen and cancer diagnosis, is often more than ten years. Carcinogens that were present in the environment may no longer be present when the cancer emerges. Lastly, people often don't live in the same place their entire lives or work in the same type of job. Because of this, a cancer could have been caused by something they used to live near or used to use in a prior job.

## SHALE GAS DEVELOPMENT AND CANCER

Some substances introduced into our environment by shale gas development can cause cancer and, therefore, pose a risk. It's not currently known whether those substances have actually caused cancer in populations living near shale gas sites. Here is some of what scientists have discovered in the relatively short time since the rapid expansion of shale gas development:

- Yao et al. (2015) exposed human cells to wastewater from the Marcellus shale in a lab experiment. These treated cells were injected into mice, who grew tumors. Control cells that were not treated with wastewater did not induce tumor growth in mice. The authors noted that the wastewater contained high levels of barium and strontium, which they suggest may have played a role in tumor development.
- McKenzie et al. (2018) measured air emissions at various distances from shale gas development facilities in Colorado and calculated lifetime risk of cancer based on these measurements. For residents living within 152 meters (500 feet), the lifetime cancer risk exceeded the EPA's upper bound risk limit of 1 incidence in 10,000 people, actually registering at 8.3 likely incidences per 10,000 people. This risk was largely due to measured levels of benzene.

- Elliott et al. (2016) cross checked 1177 water pollutants and 143 air pollutants potentially emitted by shale gas development with the International Agency for Research on Cancer's carcinogen monographs. While over 80% of pollutants had not yet been assessed for carcinogenicity, 49 water and 20 air pollutants (55 unique compounds) were identified as known, probable, or possible carcinogens. Identified known carcinogens are listed in the table at right.
- McKenzie et al. (2017) compared incidence of acute lymphocytic leukemia (ALL) in young people to all other childhood cancers in Colorado in relationship to exposure to shale gas wells. They found that for ages 5-24, ALL cases were 4.3 times as likely to be found in the highest level of exposure to shale gas wells when compared to those diagnosed with other types of cancer. They also found that ALL incidence decreased as exposure decreased.

## CARCINOGENS OF CONCERN FROM ETHANE CRACKER PLASTICS PLANTS

Air, water, and waste stream contaminants from shale gas wells and compressor stations aren't the only aspect of this industry that introduces cancer risk. A large industrial complex called an ethane cracker heats ethane (a component of shale gas) and "cracks" it into ethylene, which is then turned into about 1.5 million tons of plastic per year. One ethane cracker plant will emit into the air that local communities breathe the following chemicals, which have been classified as possible, probable, or known carcinogens.

**CARCINOGENS FROM ETHANE CRACKER PLANTS** (Michanowicz et al., 2013)

| POLLUTANT | ANNUAL RELEASE In Pounds |
|---|---|
| Acetaldehyde | 7,018 |
| Chloroform | 1,400 |
| Ethylene Oxide | 10,024 |
| Formaldehyde | 6,020 |
| Methyl-Tert-Butyl Ether | 4,921 |

**KNOWN CARCINOGENS BY EXPOSURE PATHWAY**
(Elliott et al., 2016)

| AIR EMISSIONS | FRACKING FLUID | WASTEWATER |
|---|---|---|
| 1,3-Butadiene | 1,3-Butadiene | Radium 226 & 228 |
| Formaldehyde | Formaldehyde | Benzo(a)pyrene |
| Radon | Ethylene oxide | Beryllium |
| Diesel exhaust | Arsenic | Arsenic |
| Benzene | Benzene | Benzene |

## WHAT YOU CAN DO TO PROTECT YOURSELF FROM THESE CARCINOGENS

- Monitor your indoor and local air quality. Knowing when concentrations of pollutants spike can help you to learn when to stay indoors to avoid outdoor pollution. It can also help you to determine what areas of your home may contain high levels of pollutants.
- Keep the air you're breathing inside your home clean by using an air filter. Stay inside, close the windows, and turn on the air filter when wind is blowing from an industrial source toward your home, especially if you notice chemical odors or fumes.
- If you use well water, have your well tested yearly. If you notice any changes in taste, color, or smell, stop using the water immediately and have it tested as soon as possible. Be sure to vent your bathroom with an exhaust fan when showering.
- If you swim, fish, or recreate in streams or rivers, be aware of sewage treatment plant discharge point locations. If the sewage treatment plant accepts landfill leachate, the discharge may be a point of exposure to radioactive waste.


Elliott, E.G., Trinh, P., Ma, X., & Leaderer, B.P. (2016). Unconventional oil and gas development and risk of childhood leukemia: Assessing the evidence. *Science of the Total Environment*, 576, 138-147.

McKenzie, L.M., Allshouse, W.B., Byers, T.E., Bedrick, E.J., Serdar, B., & Adgate, J.L. (2017) Childhood hematologic cancer and residential proximity to oil and gas development. *PLoS One*, 12.

McKenzie, L.M., Blair, B., Hughes, J., Allshouse, W.B., Blake, N.J., Helmig, D., Milmoe, P., Halliday, H., Blake, D., & Adgate, J. (2018). Ambient nonmethane hydrocarbon levels along Colorado's northern front range: Acute and chronic health risk. *Environmental Science & Technology*, 52, 4514-4525.

Michanowicz, D., Ferrar, K., Malone, S., Kelso, M., Kriesky, J., & Fabisiak, J.P. (2013). *Pittsburgh Regional Environmental Threats Analysis (PRETA) Report*. PRETA Air: Hazardous Air Pollutants. University of Pittsburgh Graduate School of Public Health, Center for Healthy Environments and Communities.

Yao, Y., Chen, T., Shen, S., Niu, Y., DesMarais, T.L., Linn, R., Saunders, E., Fan, Z., Lioy, P., Kluz, T., Chen, L., Wu, Z., & Costa, M. (2015). Malignant human cell transformation of Marcellus Shale gas drilling flow back water. *Toxicology and Applied Pharmacology*, 288, 121-130.



ENVIRONMENTAL HEALTH PROJECT
DEFENDING PUBLIC HEALTH SINCE 2012

www.facebook.com/EnvironmentalHealthProject @EHPinfo

2001 Waterdam Plaza Drive, Suite 201 ▪ McMurray, PA 15317 ▪ 724.260.5504
www.environmentalhealthproject.org ▪ info@environmentalhealthproject.org