MODULE 1

Health and Environmental Effects of Smoke

Burning Household Trash

Smoke from burning trash can have both short-term and long-term health effects. Trash contains plastics, metals, and synthetic materials that create Toxic Air Contaminants (TACs) when burned. These TACs include dioxins, benzene, PCBs (polychlorinated biphenyls), toluene, polycyclic organic matter and other compounds. TACS are known to cause respiratory ailments, headaches, stress human immune systems, and are potentially carcinogenic (i.e., cancer-causing). Short-term effects include burning or itchy eyes, shortness of breath, and asthma attacks. Long-term effects may include respiratory disease, lung or immune system damage, cancer, and premature death. Infants, small children and the elderly are especially sensitive to the toxic compounds produced by trash.

Toxic Air Contaminants (TACs) in smoke from trash can travel long distances and deposit on soil, plants and in water. The largest source of dioxin emissions is the uncontrolled burning of household trash. The ash in a burn pile also contains toxic pollutants which can spread into the soil and water. Animals and fish can ingest the pollutants and accumulate them in their fatty tissue; plants can also absorb them.[1] When contaminated food is eaten, the pollutants are passed on to people. Simply avoiding the plume of smoke does not eliminate potential health risks.

The California Air Resources Board determined the health effects from burning household trash is so severe they enacted statewide rules banning household waste burning and burn barrel use in 2004[2]. District Rule 300 Open Burning Section 300.1.E.5.c also prohibits the burning of household trash.

[1] US EPA website: https://www.epa.gov/dioxin/dioxins-produced-backyard-burning

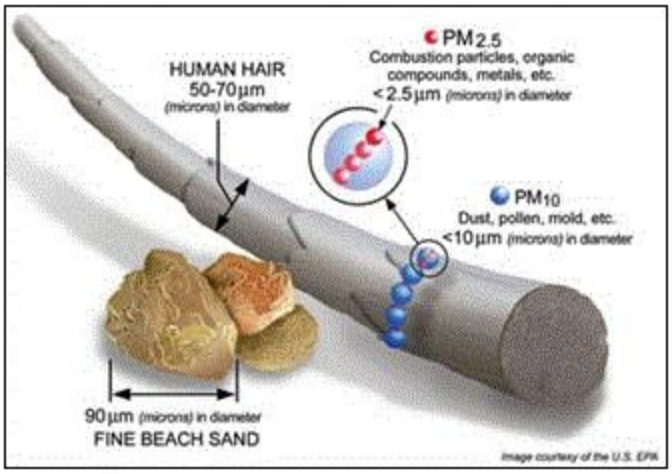
[2] CARB website: https://ww2.arb.ca.gov/news/garbage-burning-now-banned-statewide

Burning Wood & Vegetation

While trash burning is always prohibited because of these dangers, even smoke from the legal burning of vegetation can pose a threat to your health. Wood smoke contains a hazardous mixture of chemical substances such as carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOCs), dioxins, polycyclic aromatic hydrocarbons (PAHs) and particulate matter (PM). Some of the VOCs and PAHs are irritating, toxic, and/or cancer causing. The chemical makeup and total amounts of these pollutants depend on how the wood is burned. The more completely wood is burned, the more usable energy is produced and less harmful chemicals are emitted.

One of the greatest human health threats from smoke, indoors or outdoors, comes from PM. Wood smoke PM is composed of wood tars, gases, soot, and ashes. Particulate matter is a generic term for particles suspended in the air, typically as a mixture of both solid particles and liquid droplets. The size of particles affects their potential to cause health effects. Small particulate matter with diameters of less than or equal to 10 microns (PM10) or 2.5 microns (PM2.5), can cause burning eyes, runny nose, and be inhaled into the deepest recesses of the lungs where they stay for long periods of time. Breathing PM10 and PM2.5 can lead to bronchitis, chronic respiratory issues and heart disease.

Diameter Comparison: Human Hair, Sand, PM_{10}, and $PM_{2.5}$

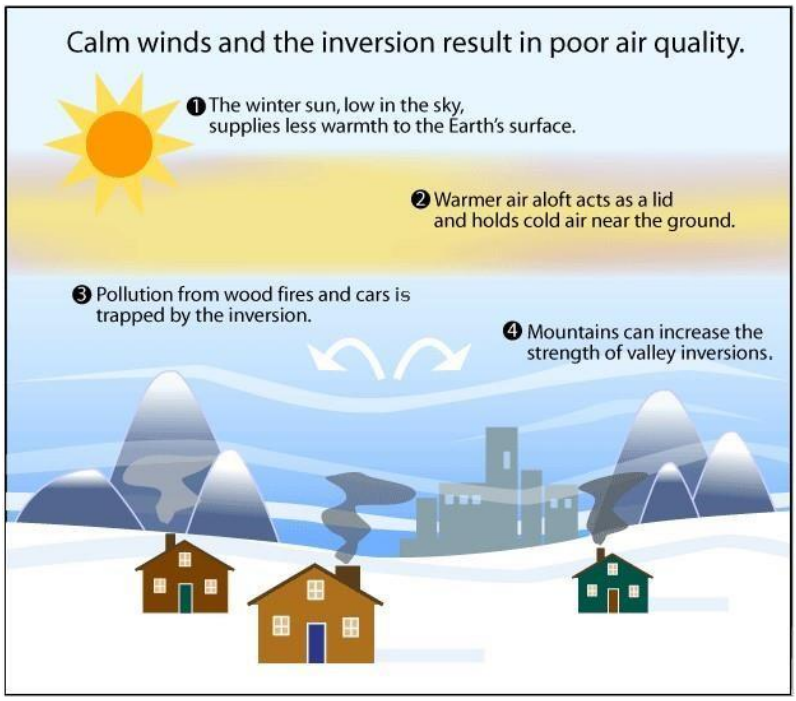


Short-term exposures to particles (hours or days) can aggravate lung disease, causing asthma attacks and acute bronchitis, and may increase susceptibility to respiratory infections. To learn more about asthma, visit www.epa.gov/asthma, www.noattacks.org or www.cdc.gov/asthma. To learn more about wood smoke health effects, view US EPA's Health Effects of Breathing Wood Smoke

Smoke in the "Breathable Zone"

Smoke does not always travel up and away, dispersing as it goes. Frequently in the evening and morning in mountain valleys and low-lying areas, temperature inversions can trap smoke near the ground. Inversions occur when air near the ground is cooler than the air above, preventing the upward movement of smoke. The lid effect of inversions, coupled with a drop in wind speed, causes smoke and pollutant accumulation in the "breathable zone" near the ground. Smoke near the ground can also reduce visibility on roadways increasing safety hazards and has caused severe vehicular accidents.

Photo: Makah Tribe



How to Reduce Adverse Health Effects from Burning

Reduce adverse health effects by burning only on burn days, burning only allowed materials, burning properly and/or employing one of the many alternatives to burning. Allowed materials include vegetation from trees, vines, brush, leaves, lawn clippings and dry plants originating on the property where the burning will occur. Observe minimum drying times of three days for leaves and pines needles, and six weeks for trees, stumps and large branches greater than six inches in diameter. These time periods are minimums. Longer drying periods may be necessary to ensure smoke emissions are minimized. Maintain a hot fire, so that less air pollution is created. Locate your pile as far away from neighbors and residences as possible. Be mindful of the wind patterns and the direction of the smoke plume. Curtail burning if smoke drifts toward your neighbors and becomes a nuisance. Avoid burning during the morning or early evening to avoid inversion layer conditions. Remember, localized weather patterns and topography can create conditions unfavorable to burning, even if it's a Burn Day for the region.

Moisture in Wood

Burning wood not properly dried (seasoned) generates much more smoke than dry wood. The US Environmental Protection Agency's *Burn Wise* Program has produced these two Public Service Announcements on the topic.

"Wet Wood is a Waste" (2 minute video) explains how to use a simple moisture meter to test wood to see if it is dry enough to burn. Moisture meters are available in all sizes and can cost as little as $20. Properly dried wood should have a reading of 20% or less.

http://www.youtube.com/watch?v=jM2WGgRcnm0

"Split, Stack, Cover, Store" (2 minute video) provides four easy steps on how to dry wood for proper use in wood stoves or fireplaces. They are:

- **Split** wood to a variety of sizes but no larger than a six-inch wedge
- **Stack** wood away from a building and off the ground on a pallet with split side down to promote drying
- **Cover** the top of wood with a tarp or woodshed
- **Store** wood to allow it to dry. This can be 6-12 months, depending on the type of wood.

http://www.youtube.com/watch?v=yo1--Zrh11s