

Quest 101: How Clean Is Clean Enough?

(Christine Young, Program Host) Coming up on Quest ... Pollution controls for the '90s. Car emissions testing is unpopular in Maine. Are there better ideas for cleaning up our polluted air? Maine's pulp mills are changing the way they make paper to decrease releases of one of the worst toxins around--dioxin. How deep should the cuts be with dioxin, and what kind of progress are we making in curbing the pollution we create in our homes and work places? We want to show you how science can give us a whole new way of looking at some of these issues. That's what Quest is all about.

(Narrator) Maine Public Television's production of "Quest, Investigating the World We Call Maine" is funded through a television demonstration grant from Rural Economic and Community Development, part of the USDA.

Opening Music

(Christine Young, Program Host) We are taking in the sights at one of the most splendid places to be in Maine this time of year, Sugarloaf USA ski area. Hi, I'm Christine Young, Program Host, and welcome to our first Quest. Our topic is "How clean is clean enough?" Over the past 20 years, those of us who live and do business in Maine have made a lot of progress cleaning up our heavily polluted air and water. It used to be easy to see what was fouling our air and rivers and bays. But now it's not always so easy to detect all the pollutants that officials insist are still out there hurting us--ozone burning our lungs, dioxin poisoning lobster, mercury contaminating game fish. How do we decide what's safe for us? There must be better ways to understand these risks, easier to grasp than measurements of ten parts per quadrillion. Or are we just scaring ourselves to death? And do we really want to know where the water comes from to make man-made snow? Well, more on that later. First, let's hear about an air pollution solution that turned into a political football. Here's Paul Leblond.

(Man at public hearing) And for you people that are so learned in legislative meetings, this is the first one I've ever been to that's such a chaos. This is a disgrace.

(Paul Leblond, Segment Host) When Mainers in the southern part of the state were told last year they were mandated to get their cars tested for pollution or lose federal funding, their hackles went up.

(woman at public hearing) So why should we have to suffer and pay for this, when tourists themselves come in and pollute much more than our poor little cars would?

(Roger Campagna, Auto Mechanic) We don't have any problem with cleaning up the air. We're all environmentalists in the state of Maine. We all want clean air. The problem is the program that's implemented at the moment is not something that Maine needs and therefore we don't want it.

(Paul Leblond, Segment Host) Car emissions testing is not popular in Maine, but if we take a scientific view of our air quality in this state, we should get a better look at how bad of an ozone problem we have, and what effect it may have on us and even our plant life. The debate over emissions testing for southern Maine vehicles continues to bedevil Maine's environmental leaders and state officials. There's an impassioned argument whether car testing is the best way to clean our air. Then there are those who think that our air quality problems are more than a southern Maine problem, and pollution controls could soon affect everyone in the state. Because of our rural setting and our lack of public transportation, you can get there from here in Maine, but it's likely to be by car. So as the brou-ha-ha continues over car tests, it makes you wonder whether we had enough scientific information to make the policies which led to this rancorous debate.

(Dennis Keschl, Director, Department of Environmental Protection) I've learned, and I believe many of my fellow air directors throughout the northeast have learned that it's easy to mouth the words that cars are part of the pollution problem and need to be corrected or improved in terms of their maintenance or the types of fuels they burn, or whatever. It's very hard to get that enacted into public policy.

(Conrad Schneider, Staff Attorney, Natural Resources Council of Maine) They could have put the burden more heavily on industry. They could have put all the burden on the mobile sector--cars, trucks, etc., but [what] they decided to do was essentially balance that but look at what was most cost effective.

(Paul Leblond, Segment Host) Those of us in Maine have a tendency to believe that our polluted air comes from other urban areas. "Maine is the tailpipe of the northeast" has long been a favorite expression of ours, but scientists are finding that's not as true as we'd like to think. The state has been testing air quality in several locations since the late 1970s, but the car emissions controversy has put air pollution testing in high gear. Cliff Michaelson monitors Maine's air quality at the Department of Environmental Protection.

(Cliff Michaelson, Senior Meteorologist, Department of Environmental Protection) Science has been pushed to its outer limits with the urban air shed modeling. We're trying to perfect the model in time to do the science that's required to drive the regulations. We're there almost.

(Paul Leblond, Segment Host) These Department of Environmental Protection computer models show air pollution every hour. Data also can be simulated to predict future air quality.

(Cliff Michaelson, Senior Meteorologist, Department of Environmental Protection) We take a model. We take the emissions inventory for 1990. We shrink it back to the growth levels in 1988. We run the model to see if it can duplicate what actually happened for air quality in '88, then when we're happy with those results, we run it again in 1990. And then we run it again with future year emissions files in 1996 to project what's going to happen with growth, what's going to happen with industry, what's going to happen with the amount of cars that we have on the road, and then try to simulate the ozone concentration.

(Paul Leblond, Segment Host) The main culprit in air pollution is ozone, but there are two different kinds of ozone. We need all the ozone we can get in the stratosphere--six to 19 miles up in the air, where it helps block out radiation from space, but we don't need any ozone at ground level, where it's the nastiest ingredient in smog. Ozone at ground level is formed from a chemical reaction between sunshine and two kinds of pollutants--nitrogen oxides and volatile organic compounds or VOCs. Both pollutants primarily come from the burning of fossil fuels in cars and industry. When the two pollutants mix with sunlight and cook together for several hours, ozone is formed. Ozone is a form of oxygen made up of three atoms instead of two. What makes ozone dangerous is it can hardly wait to get rid of the loosely attached extra atom, which oxidizes or burns the cells in anything from paint, to crops, to the inside of our lungs.

(Paul Leblond, Segment Host) Based on what has been learned in animal tests, it is believed that when ozone singes our lungs, it can take five to ten days for them to heal, and years of burning and healing can produce stiffened lungs, much like skin that has turned leathery after repeated sunburns. But it's not just asthmatics and joggers that are sensitive to high ozone. We may be raising a generation of children who will face chronic lung disease as adults. Workers who spend most of their time in the great outdoors, also are exposed to air pollution. Ozone has been linked to reduced resistance to infection and to cancer. What frustrates state officials is, since the public can't see or smell ozone, people don't appreciate its dangers. Many Mainers are not convinced our air is so bad that it's risking our health.

(Roger Campagna, Auto Mechanic) The state of Maine was out of compliance for the entire year of 1994 for approximately six hours.

(Paul Leblond, Segment Host) But air pollutants, like ozone, also have been proven to affect the growth of plants. Throughout the region, plants increasingly are seen in scientific circles as bio-indicators of air pollution. Ozone damage to plants means they have to use more energy in repairing tissue and less into growing. Ivan Fernandez is a soil scientist at the University of Maine.

(Ivan Fernandez, Soil Scientist, University of Maine) The primary cause of damage to plants by ozone is (because), ozone as a gas, will damage plant tissues. Direct contact, it doesn't have to be taken up, it doesn't have to get into the plant solutions, in fact it does its worst act as a gas, interacting right on the surface of plant tissues.

(Paul Leblond, Segment Host) Scientists believe plants anywhere in the eastern United States, particularly coastal Maine, would grow better if there was less ozone.

(Ivan Fernandez, Soil Scientist, University of Maine) Ozone affects plants by a direct mechanism, it's a strong oxidant, which means it's an irritant and much like most folks have heard about breathing smog, and how it might bother the eyes or bother the lungs, and that's because the tissue of our eyes and the tissue in our lungs is relatively sensitive, it's not like the palm of your hand that's rough. So ozone can damage those cells, it can cause holes in cell membranes, or abrade cell membranes. The same thing happens with plants.

(Paul Leblond, Segment Host) So if plants around the state are showing signs of ozone damage, what is the ozone danger for the state as a whole? The State Department of Environmental Protection's monitoring of ozone gives us a futuristic rendering of the air we live in, or our air shed. It shows that during summer heat waves, pollutants like ozone circulate and recirculate throughout the region, extending from the mid-Atlantic to Maine. Monitoring also shows how ozone levels fluctuate throughout the day, down to the hour of the day. Even at night during the summer months, ozone is circulating up and down, over and around the east coast region. At different times of the day, Maine can be both downwind and upwind of the polluted air. Even Acadia National Park gets smoggy.

(Bob Breem, Biologist, Acadia National Park) Our highest concentrations of ozone typically occur late in the day, frequently late, very late in the afternoon into the evening, maybe as late as midnight, which is indicative of long-range transport.

(Cliff Michaelson, Senior Meteorologist, Department of Environmental Protection) Maine is the most downwind state in the ozone transport region corridor. Many people, along with some scientists, do feel that it is virtually unrealistic for the state of Maine to come into compliance with the rules and regulations of the Clean Air Act before the other upwind states, i.e. Massachusetts, Connecticut, and Rhode Island, don't do so before we do. We are the recipients of bad air from our counterparts to the south, but also contribute greatly to the poor air quality to our bordering country of Canada.

(Paul Leblond, Segment Host) Most of Maine's harmful ozone does come from out-of-state, but the figures cited by critics of car testing, that 60 to 80 percent of the pollution is from away, are only a guess, with little scientific data to back them up.

(Roger Campagna, Auto Mechanic) The EPA and the DEP have failed to show us where, how much we're producing of our own pollution in the state of Maine, where the rest of it is coming from.

(Dennis Keschl, Director, Department of Environmental Protection) Can we tell you how much right now? No. That's what we're working on very hard to define. Will we ever know an exact percentage of that transported

pollutant? No, but we'll have a good understanding of it.

(Paul Leblond, Segment Host) Maine's air is unhealthy to breath for about one out of three days each summer, according to state standards, which are stricter than federal ones.

(Lou MacNally, Television Meteorologist) Let's zoom in on the northeast right now and show you just what has been happening in the last 12 to 24 hours.

(Paul Leblond, Segment Host) Last summer, those who live in southern Maine got to hear daily air quality reports during the weather on local television news.

Since most of the state's monitoring is done in southern Maine or along the coast, it may not have the data to determine the ozone danger for the entire state. Critics say the state's testing is not designed to show whether there are sources of ozone pollution in other parts of Maine.

(Conrad Schneider, Staff Attorney, Natural Resources Council of Maine) In the past, the state measured and monitored only along the coastal regions, and for that reason the ozone levels inland and in the northern part of the state really are a big question mark. The state in the last few years has made an effort to try to move monitors into the more rural regions and into the north. So we have some information about that. In addition, EPA was operating a monitor in the northern part of the state, really unbeknownst to the state of Maine, for about five years. What we know now is that each of those monitors have measured a violation of the health standard in Maine.

(Paul Leblond, Segment Host) There are no monitoring sites in Bangor, the state's third largest city, and ozone is not the only pollutant in the air. For more than a decade the Federal Environmental Protection Agency has set standards for six major pollutants. Ozone is just one of them. Except for ozone, most experts think we've done a good job cleaning up that so-called 'six-pack' of pollutants, which include lead and carbon monoxide.

(Ivan Fernandez, Soil Scientist, University of Maine) Back in the '70s, we began to use unleaded gasoline, and there's a dramatic decrease in the emissions and the deposition of lead over the last two decades. So that's somewhat of a success story.

(Paul Leblond, Segment Host) But there are more than 300 substances considered to be airborne toxics that have been largely ignored when we went after the six-pack. The worst of these include Benzene and Butadiene. Both cause cancer, both are found at high enough levels in Maine to concern health officials, and both come primarily from gasoline burning motor vehicles.

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(Paul Leblond, Segment Host) There are no quick-fix solutions to cleaning the air. State officials and environmentalists prefer emissions testing since motor vehicles are responsible for about half of the pollution fouling our air. But there is a growing movement in Maine that believes science has not proved car tests are the best solution. Thirty-four states already have some kind of car emissions testing. Maine was the first to put in place enhanced car tests, which are more sophisticated and effective, but these treadmill car test facilities were unpopular due to their long lines, poorly trained technicians, and expense. The Federal Clean Air Act mandates the enhanced car emissions program in only two areas of Maine at this time--Portland and Kittery. Beyond that, the Act gives the state some flexibility in determining how air pollution will be cleaned up in areas of seven southern Maine counties that have been in violation of the federal standard. Maine originally chose the enhanced car emissions program for the entire seven southern county area. It did so in the hopes of sparing businesses from more costly measures to clean up the air.

(Cliff Michaelson, Senior Meteorologist, Department of Environmental Protection) From purely a financial standpoint, the enhanced inspection maintenance program has a much better bang for the buck. We can reduce VOCs, comparable VOCs, for \$500.00 per ton with the car test program, compared to the \$5,000.00 per ton we'd need to get from additional controls on industry.

(Paul Leblond, Segment Host) Was the state on the right track, and if so, why not test diesel trucks as well? And what about including gasoline powered polluters, construction and farm equipment, off-road vehicles, lawnmowers, snowblowers, and marine engines? Now that's pollution we can see.

(Paul Leblond, Segment Host) We do know the state of Maine is considering testing diesel trucks and the EPA wants to regulate emissions on all kinds of gasoline powered equipment. And as we've seen, scientific modelling shows how the transport of ozone on the eastern seaboard contributes to unhealthy air in urban and rural areas alike. Cleaner burning reformulated gasoline can help, and since we've included sophisticated pollution control equipment in new cars, emissions from motor vehicles have decreased about 80 percent. Yet even the pollution control equipment in new cars needs to be maintained to keep it working properly. New scientific evidence points to a small number of cars, perhaps 20 percent of those on the road, as most responsible for our dirty air.

(Dennis Keschl, Director, Department of Environmental Protection) The question is how can we identify the gross polluters, and that gross polluter is basically one out of every five vehicles. How can we identify those vehicles and get them repaired?

(Paul Leblond, Segment Host) These high emitters are both old and new cars. They include cars that are poorly maintained and cars with sophisticated pollution control equipment that has been tampered with. Maine was hoping to alleviate that problem with state supervised car test centers. California, on the other hand, has been testing cars for more than 20 years now. It has expanded its pollution program and is now buying high polluters to get them off the highways. It's also looking to electric and ultra-low emissions vehicles, still in the design stage, to help clean its air. Here in Maine, even though we have scientific data to prove our air quality is deteriorating, we still have many loud skeptics when it comes to using car testing as a remedy.

(Paul Leblond, Segment Host) With an issue as controversial as car testing, it becomes harder to distinguish between science and politics, but a few things are clear. One reason we haven't reduced emissions overall is because we have more vehicles on the road, and we drive more miles each year, and I'm just as guilty as the next person when it comes to taking my car every time I need to go someplace. But because we drive twice as many miles as we did 20 years ago that means someone is going to be asked to pay for that added pollution.

(Christine Young, Program Host) We drive more than 12 1/2 billion miles a year here in Maine. I guess we'll just have to wait and see if car emissions testing will put a dent in our air pollution problem. It makes me think there's a new spin to the old not in my backyard argument, only this time it's not in my back pocket. But of all the alternatives, car emissions tests may turn out to be the least expensive. Finding cost effective methods of cleaning up our air and water pollution problems is a challenge. Even ski areas, like Sugarloaf here, have pollution problems to clean up. Resort areas have long wondered if there are cheaper ways of treating all the waste that's generated during ski season. It's an ongoing challenge, even for the communities and industries that have paid so much of the freight so far in cleaning up our air and water. Paper mills are a good example. Dana Hutchins explains.

(Dana Hutchins, Segment Host) You can't measure the environment and paper mills in the same breath, without agitating people here in Maine. Paper and pulp mills, the bedrock of our state's economy, also have been the source of a tremendous amount of pollution in the past. Anyone who has lived in Maine a while can remember when our rivers and air ranked among the worst in the country.

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(Dana Hutchins, Segment Host) The state's paper companies have paid the price to become respectable again in the eyes of a cynical citizenry, and have done much to clean Maine's air and waterways, but Maine paper mills are on the hook again, this time it's over one of the most toxic chemicals known--dioxin.

(David Critchfield, International Paper) What we're trying to do is focus on where we think society and our customers and the public at large want our manufacturing to move, and we think they want us to move to absolute minimize environmental impact.

(Marquita Hill, Chemical Engineering, University of Maine) The problem with dioxin though is, it's not only complicated in terms of so much involved there, but it's incredibly controversial.

(Dana Hutchins, Segment Host) Dioxin is on the same level as the notorious environmental poisons DDT, PCBs, and Agent Orange. The Federal Environmental Protection Agency reported last year it has not found a level of dioxin, no matter how small, that is safe. So far the EPA has measured dioxin to level of ten parts per quadrillion. That's equivalent to just one quarter of a cup of water in Moosehead Lake. If something as small as ten parts per quadrillion is not safe, what will it take to find a safe level or is that even possible? And how do you explain parts per quadrillion anyway?

(David Critchfield, International Paper) You know, it's like how many angels are dancing on the head of a pin, I'm not sure how much closer to zero we're going to get because we can't see beneath that, beneath that technological barrier, that detection limit.

(Dana Hutchins, Segment Host) In laboratory tests of animals, dioxin has caused cancer and also permanent hormonal changes, birth defects, reduced sperm count, infertility, impaired immune systems, and impaired ability to learn. Wildlife have also been bio-indicators of the effects of dioxin.

(Peter Washburn, Natural Resources Council of Maine) It's important to note that, in Maine, our bald eagle population has one of the lowest reproductive rates of any population in the country, and there is concern, and I think it's well-founded concern, that the contamination of fish by dioxin in our rivers may be causing some of the reproductive problems that the Maine bald eagles are experiencing.

(Dana Hutchins, Segment Host) In the Great Lakes region, species high on the food chain are suffering reproductive and developmental impairment due to exposure to dioxin. Predator fish, like large mouth bass, have deformed features. These impacts are often trans-generational, effecting offspring as well. Some experts say fish are like sponges for dioxin and it accumulates in fish ten to 1,000 times that of what's in their environments. What worries some experts is dioxin's ability to concentrate in body fat. Scientists call it bio-accumulation because dioxin in fat is insoluble and difficult to flush out of the body.

(Marquita Hill, Chemical Engineering, University of Maine) Seals, for example, and other marine mammals are an extreme example because they have all this blubber, a lot of fat, and they can accumulate very large amounts of some of these persistent fat soluble chemicals, and to a lesser extent, so can human beings and eagles and other animals, carnivores. Our bodies remove dioxin very slowly, in fact, depending on the study that you look at, the half life, and by the half life I mean the amount of time it takes to remove half of the chemical from your body, the half life ranges from six to eleven years and up, so that's a long time. It varies with species, but it's a long time in almost any species.

(Dana Hutchins, Segment Host) The origins of as much as 50 to 90 percent of dioxins are still unknown.

Scientists guess that most dioxins are emitted into the air by medical and waste incinerators and by burning wood, such as forest fires.

(Marquita Hill, Chemical Engineering, University of Maine) You can't totally eliminate dioxin from the environment because there are some natural sources, they are small relative to those generated by humans, but they're there. They're produced by volcanoes, they're produced by forest fires, and in fact, even if we come into our own homes here in Maine where we have our fireplaces or woodstoves, they're produced by burning wood.

(Dana Hutchins, Segment Host) But paper mills are a known source. Mills are probably the number one source of dioxins in Maine waterways. Recently state officials have found unsafe levels of dioxins in clams, the tomalley of lobsters, and at the mouths of major rivers.

(David Dow, Lobster Institute, University of Maine) If these are indeed warning signs, then we best pay guard and really ensure that this will not be a damaging thing for the quality and wholesomeness of seafood.

(Dana Hutchins, Segment Host) Health advisories for dangerous levels of dioxin in fish for most of Maine's largest rivers were issued in 1985, 1987, and 1990. Dioxin is persistent, it remains potent for years and concentrations of it multiply as it moves up the food chain. A question we need to answer is: Do we need to get rid of dioxin entirely or just reduce levels of it?

(Micky Kuhns, Department of Environmental Protection) That's a difficult question to answer because we don't know enough yet about dioxin to work to know whether or not there is a safe level. Right now we're operating under the premise that you can establish a water quality number, which means that there is some level that's safe to be put into the environment.

(Dan Kusnierz, Penobscot Indian Tribe) I think dioxin, because the seriousness of it, needs to be, every source needs to be eliminated. We know that it comes from craft mills, so I think we need to try to get rid of that source. Eating fish is one, probably one of the few things that Penobscot people have left that they can identify with and that makes them Indians.

(Jan Hitchcock, University of Southern Maine) But the key of the question, I think as you posed it, what's acceptable, and that can't be posed entirely based on science, the extent to which it's based on science is still underpinned with, do we tolerate no risk at all, are we talking about death, are we talking about illness, are we talking about quality of life, are we talking about equity issues, who actually experiences the harm? Those all figure into what is acceptable, and again, we need scientific data to inform those decisions, but we need to decide what's acceptable or not. Then, there is not an absolute number out there or standard that can tell us entirely just based on the data that we collect in terms of exposure.

(Dana Hutchins, Segment Host) Environmentalists, who are concerned about dioxin levels in Maine, argue that there's a big difference between national estimates of exposure and Maine's rate. They think in Maine dioxin is not so much from the air from incinerators, but running down our rivers from paper mills. But state biologist Barry Mower says paper mills have been making strides to clean up dioxin.

(Barry Mower, Department of Environmental Protection) It's the mills that have reduced their discharges since the late 80s, by up to 95 percent in some cases, we've seen significant reductions in dioxin in fish in the rivers that they discharge to.

(Dana Hutchins, Segment Host) Mainers thus can get a double whammy of dioxin, by eating fish and being exposed to whatever dioxin is in the air. The core of what it means to a Mainer, the tradition of eating a lot of fish, may mean much higher concentrations of dioxins for us than for most other people.

(David Dow, Lobster Institute, University of Maine) I eat a lot of tomalley. I have eaten gallons of it I suppose over my lifetime as a lobster fisherman, so whether it actually is or is not safe, the advisory is there just as a precaution in an industry that is being very cautious about ensuring the wholesomeness and healthfulness of the seafood.

(Dana Hutchins, Segment Host) That alarms environmentalists, who would like Maine to try to be dioxin free.

(Peter Washburn, Natural Resources Council of Maine) It's easy always to find somebody who will say something is not a problem. PhDs representing the tobacco industry will stand up in front of congress and tell the nation that cigarette smoking doesn't cause cancer and is not addictive.

(Dana Hutchins, Segment Host) To the public, it seems a lot like the age-old argument of payroll versus pickerel, jobs versus environmentalism, but it's difficult to get rid of a substance that comes from many sources and is so toxic even at minuscule amounts.

(Marquita Hill, Chemical Engineering, University of Maine) Starting in about 1970 or sometime in the 1970's, dioxin levels in the American environment, and also in western environments in general, and industrial countries started to go down, and they have continued to go down for this past 20 some years.

The only problem is that the EPA is not sure that they've accounted for all the sources of dioxin, so there still might be some new surprises.

(Dana Hutchins, Segment Host) For their part, paper mills are making efforts to reduce dioxin emissions. It comes right on the heels of investing millions of dollars in treatment systems which brought little financial return to the mills, but did go a long way in reducing their conventional pollution problems. Boise Cascade's Ralph Carpenter:

(Ralph Carpenter, Boise Cascade) We have spent well over a 100 million dollars here on our pulping process at Rumford in order to make pulp in a more environmentally friendly way, make a better pulp. This will continue as we come into the '90s and into the year 2000.

(David Critchfield, International Paper) Nobody can say well you haven't done a darn thing about it, cause we've done a lot about it. I think probably if you look at International Paper's mills as a group the number is huge, to date, I mean, at this point in time, we've spent about 130 million dollars just to get where we are today.

(Ralph Carpenter, Boise Cascade) The real issue we need to deal with is you can't have environmental compliance and improvement without some economic gain and you can't have economic gain without environmental improvements, and whatever changes we make here in the mill need to balance those two needs. What the paper mills are in the process of doing is constructing new facilities to reduce as much as 80 percent of the dioxins they release in their waste water. To do this they're cutting back on chlorine in the paper making process according to the Department of Environmental Protection.

(Micky Kuhns, Department of Environmental Protection) There's only one facility in this country that has gone totally chlorine free, and that's in California, so the rest of them, if they're making improvements, they're all sticking with the chlorine dioxide plus other technologies like the oxygen and things like that.

(Dana Hutchins, Segment Host) Dioxin is actually an unintentional by-product in the production or use of chlorine related chemicals. Pulp mills have been major users of chlorine because it's best for making the most desired kind of paper, strong and bright. In its natural form most chlorine is bonded to sodium as common salt. Chlorine

for industrial uses, such as pulp mills, is produced by subjecting salt water to large amounts of electricity. As an industrial chemical, chlorine is relatively cheap. It's also a favorite of pulp mills because it is so effective in removing lignin from pulp.

(Bill Sherman, Boise Cascade) Chlorine and chlorine dioxide are particularly useful because they selectively react with the lignin, which you're trying to get rid of and leave the cellulose in a strong undisturbed fashion. Some of the other bleaching processes, like oxygen or ozone, can harm cellulose more than the lignin and end up with a weaker pulp.

(Dana Hutchins, Segment Host) Tree trunks are reinforced by lignin, a tough adhesive that provides structural support to trees. Wood is typically 30 percent lignin. In order to make paper, lignin must be separated out of the wood. In Maine this is usually accomplished by boiling the wood with chlorine and other chemicals. Chlorine is valuable since it attacks lignin while leaving the rest of the pulp relatively undamaged, but chlorine reacts with other chemicals in the pulp to form dioxin and a 1,000 other chemical pollutants.

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(Dana Hutchins, Segment Host) Scientists have known about alternative chemical pulping techniques for some 20 years. Pulp mills in Maine and other states are still perfecting the technology and are making changes in different ways. Some of the mills are experimenting with chlorine-free methods. Others are going part way in using chlorine dioxide instead of straight chlorine in the bleaching process. Less chlorine in, less chlorinated pollutants, like dioxin out.

(Bill Sherman, Boise Cascade) Chlorine dioxide itself has been around for quite a while. I think the milestone is the fact that we have found that you can reduce or eliminate the formation of dioxin.

(Peter Washburn, Natural Resources Council of Maine) I think the real milestone would be to eliminate the dioxin problem once and for all in Maine's rivers. Chlorine dioxide will reduce the dioxin discharges from these mills, but it won't eliminate it.

(Dana Hutchins, Segment Host) The heavy weights in the industry in North America are pushing for chlorine dioxide because it virtually eliminates dioxins, but environmentalists argue that reduction of dioxins is not the same as elimination. They liken the paper industries efforts to a chain smoker switching from Malboros to Malboro Lights.

(Peter Washburn, Natural Resources Council of Maine) The analogy is if you cut down from 15 packs of cigarettes a day to one pack, your doctor would tell you you're doing something that's beneficial to your health, but your doctor would also tell you that if you would eliminate your cigarette smoking that would be even better for your health, and that's what we're looking for: the solution in Maine, to eliminate the problem. We have a opportunity now here in this state and across the country to eliminate a significant source of dioxin exposure. To solve the problem, to solve your wrest from cigarette smoking, the best way to solve that problem is to eliminate your use. Chlorine dioxide is still going to produce dioxin. Chlorine dioxide is in some words "chlorine light." When you use chlorine, whether it's chlorine dioxide or elemental chlorine, you're going to be producing dioxin.

(Dana Hutchins, Segment Host) Last year, Greenpeace began a full-fledged attack on dioxins. Paper mills and large users of paper, like Time magazine, were targeted, but despite opposition from Greenpeace and some 50 other environmental groups, what the paper mills are doing is okay with the EPA. Substituting chlorine dioxide for chlorine is one of EPA's suggested ways to cut back on dioxin being produced at paper mills. Boise Cascade's mill in Rumford has been working to fully implement new chlorine dioxide technology.

(Glenn Poulin, Boise Cascade) Chlorine dioxide is a very effective bleaching agent that virtually allows you to eliminate dioxin.

(Barry Mower, Department of Environmental Protection) It's a very complex, complicated issue. It's a national or international issue. There are no easy solutions. Fortunately, we're making some progress here in Maine and that's really great.

(Dana Hutchins, Segment Host) But since mills are spending money now to make the switch to chlorine dioxide, they may not be willing to spend more to put in chlorine-free methods. Maine paper mills, also, are trying other methods to cut down on chlorine use. Oxygen is being used to remove lignin and cut back on the use of bleaching chemicals. However, it typically can replace only about half of the chlorine. International Paper's operation in Jay is testing both chlorine dioxide and oxygen delignification.

(David Critchfield, International Paper) We don't measure dioxin below ten parts per quadrillion, ever. Can I say to myself or to my wife or my kids that it's not there? Not yet. Not until we get oxygen delignification on line. Then, I think I can say there's no dioxine there.

(Dana Hutchins, Segment Host) The search is on for newer techniques as well. As long as pulp mills use chlorine, they have to dump their wastewater because the chlorine is so corrosive on their machinery. Mills are considering a closed loop process to recycle water and non-chlorine chemicals.

(David Critchfield, International Paper) Getting a mill to what's called a closed loop or a totally enclosed facility, is a long term objective, I think of most manufacturing companies. But it's going to be long trek, and I think our first objective really is to make sure that the effluent we do generate is clean and does not adversely impact the environment.

(Dana Hutchins, Segment Host) But paper companies say there isn't enough demand for chlorine free paper.

(Dana Hutchins, Segment Host) There's not a strong demand among our customer base and that is people that use paper for printing and writing purposes for chlorine-free paper. We have two major customers that have a concern for it and they've been to Rumford and visited our processes and have reviewed our plans and know what we're doing, and that's Time, Incorporated, which publishes Life magazine, Time, Sports Illustrated, those publications.

(Dana Hutchins, Segment Host) The most familiar use of chlorine-free paper is the brown coffee filters that have been marketed for a number of years now. Other than that, only two major corporations are using some chlorine free paper--Kinkos, the nation's largest chain of copy stores, now offers chlorine free paper stock. McDonald's, as part of it's ongoing environmental initiative, is using chlorine-free french fry bags. It's been suggested that until paper companies are totally chlorine-free, their incremental steps are like the Greek philosopher Zeno's paradox with the race course. Zeno theorized it's impossible to reach the end of a race course because you first have to reach halfway on the course and then you have to reach the halfway point of the half still left and so on for an infinite number of halfway points, so that you never actually reach the finish line.

(Dana Hutchins, Segment Host) Zeno's paradox can be likened to our own efforts to try to measure safe doses of dioxin. Even as our measurements get more and more precise, are we really closing in on our target--a truly safe level of dioxin?

(Micky Kuhns, Department of Environmental Protection) It's almost like the more we know the more we realize we don't know. We don't know whether, what level is safe, what level is not safe, how it acts, how it's formed. We're knowing more and more of the pieces, but there's still a lot yet to find out.

(Christine Young, Program Host) Zeno and other ancient Greeks spent a lot of time coming up with paradoxes like that one. Of course we resolved his paradox and we determined the distances, such as around a track, are not infinite and obviously we can reach the finish line. Not so obvious were some of the solutions needed over the years to alleviate many of Maine's air and water pollution problems. Amazingly enough, some of the same technology that goes into making man-made snow here at Sugarloaf can also go into cleaning up pollution. It's going to take even more ingenuity to come up with ways to deal with our most intractable water pollution problem. Kate Arno has more.

(Kate Arno, Segment Host) When we first started to deal with our water pollution problems here in Maine 20 years ago, we turned to the most obvious offenders. Industry was asked to clean up its act first, and since the Clean Water Act was first passed in 1972, the quality of Maine's waters has improved immensely. We used to joke that our rivers were too thick to drink and too thin to plow, but control of point sources of pollution from factories and mills has been so successful that only 15 percent of today's water pollution can be traced to industry. But Maine's waters are still considered to be threatened by pollution. 300 lakes, 200 miles of rivers and streams, all of our wetlands, all our coastal waters, and virtually all groundwater and non-forested areas of the state are on that threatened list. Part of the problem comes from our air.

(Norm Marcotte, Department of Environmental Protection) It really is an amazing and challenging problem for us as civilization to face, and that is, you know, air pollution is now we know is linked very, very strongly with water pollution.

(Kate Arno, Segment Host) Non-point pollution is normally associated with run-off from agriculture, highways and parking lots. It's what seeps in the ground from landfills, construction sites, septic systems, underground storage tanks, wood harvesting operations, and our lawns. Yet non-point pollution also is contamination that cannot be easily traced to one source. It can come from places you wouldn't normally think of as a source. Heavy metals, so-called because of their atomic weight, can be non-point pollutants. Mercury, for one, is of particular concern to Maine.

(Norm Marcotte, Department of Environmental Protection) Well I guess first, mercury is very poisonous. Exposure to low doses of mercury, even by accident or by eating food that has contamination of mercury in it, is very significant to humans and animals. It has effects, such as on the developmental effects on the nervous system and has effects on the nervous system and kidney system for adults.

(Kate Arno, Segment Host) The state issued an advisory last year warning people about the potential dangers of eating fresh water fish because of mercury contamination. Like most heavy metals, mercury is poisonous. It's found naturally in the ocean but in fresh water where it has been detected in Maine, it's most likely from human activities. There are various theories on which activities cause mercury to fall as precipitation onto soil and into water. Coal-fired power plants and waste incinerators are the most likely culprits. According to the most recent studies, it looks as though mercury becomes more of a problem in Maine waters because of acid rain. Many northern U.S. storm tracks converge over Maine which greatly increases our risk of acid rain.

(Terry Haines, Fishery Biologist, University of Maine) Storms can originate, you know, in the Rockies, they can originate in the Gulf of Mexico, they can originate in the south Atlantic, and they can all move to the north and to the east and wind up in Maine.

(Kate Arno, Segment Host) Scientists think mercury actually becomes more of a danger once it mixes with fresh water. Lakes and ponds, already altered by acid rain, may be more prone to toxic forms of mercury.

(Terry Haines, Fishery Biologist, University of Maine) Right now we can not predict with any confidence, you know, which lake is going to have fish high in mercury and which one isn't.

(Kate Arno, Segment Host) Haines and other scientists assume mercury is first taken up through water by plants, then picked up by insects, then fish and the rest of the food chain. Mercury bio-accumulates as it moves up the food chain. Larger fish near the top of the food chain collect increasing amounts of mercury, as they eat smaller fish and organisms. Large predator fish can carry mercury concentrations up to a million times higher than those found in the water.

So the most dangerous fish to eat from contaminated waters are the oldest, largest fish, the ones most highly prized by sports fishermen.

(George Smith, Sportsman's Alliance of Maine) I think the issue here is, as far as mercury goes, is it accumulates in the tissues or the fat of these fish over time, and so obviously as the fish lives to a longer age and a bigger size, those are the fish that are going to accumulate this mercury. The younger fish don't seem to be as much of a problem or no problem.

(Kate Arno, Segment Host) Scientific circles generally agree, mercury accumulates in fish tissue, not in fat. If it were the fat then we may be able to cut it or cook it away.

(Norm Marcotte, Department of Environmental Protection) Just preparing fish to remove the skin and the fat and the organs, you know, doesn't diminish the exposure of the mercury, more of the mercury, actually, is contained within the fish tissue of the muscle or the fillet.

(Kate Arno, Segment Host) The bottom line is not that much is known about mercury except that it exists in hazardous levels in Maine fish. Ten years ago we didn't even understand the dangers of mercury. Science had to catch up.

(Terry Haines, Fishery Biologist, University of Maine) It's not an easy thing to detect. The early poisoning symptoms of mercury are extremely subtle and they can be easily missed.

(Kate Arno, Segment Host) There is more than enough evidence to show just how toxic mercury can be to us. It is well documented that mercury causes nervous system and kidney disorders. Much like lead, mercury attacks the developing brains of children and fetuses, lowering intelligence and impairing hearing, speech and coordination. Unborn children and infants are more sensitive to mercury than adults because their nervous systems are still developing. That's why the state of Maine's advisory last year warned pregnant women, nursing mothers, women who may become pregnant, and children younger than eight years not to eat fish from any lakes or ponds in the state.

(Norm Marcotte, Department of Environmental Protection) What this new information about mercury pollution in fish means to me is that, this on a personal level, it's really, it's outrageous that I have to tell my kids that they should not eat fish from Moosehead Lake or Rangely Lake or some pristine lake way up in the woods, the big woods of Maine. It's really very disappointing.

(Kate Arno, Segment Host) The advisory also suggested all other people not to eat more than six to 22 fish meals per year, a fish meal meaning an eight ounce portion of fish. Poor people in rural areas and native Americans are particularly vulnerable to mercury poisoning, since many depend heavily on fish caught in local waters as a staple in their diets.

(Norm Marcotte, Department of Environmental Protection) The place would be kind of a sad place to be, you

know, on earth when you can't just enjoy eating fish from some beautiful, clean lake in the big woods of Maine.

(Kate Arno, Segment Host) The mercury advisory was based on the study of almost 200 of about 5,800 lakes and ponds of varying size in the state.

(Norm Marcotte, Department of Environmental Protection) I think it was about 225 lakes were sampled last year for fish. They were tested for many kinds of pollutants. Waters were tested, fish tissue was tested, and even sediments, and from those results, which were rather surprising to us, the Bureau of Health chose to make, to issue that fish, fish advisory.

(Kate Arno, Segment Host) The state believes mercury levels in fish in waters not tested would be similar to their random survey. Scientists around the state can look at other wildlife or bio-indicators and see equally disturbing accumulations of mercury. Inland, bald eagles in Maine have the highest mercury levels measured anywhere in the nation. Data also are coming in linking Maine loons to mercury contamination.

(George Smith, Sportsman's Alliance of Maine) You know their still finding today, this year, DDT in eagles and that was discontinued decades ago. So anything that lingers in the environment tends to get in to some of these birds and other wildlife as well.

(Kate Arno, Segment Host) We have other non-point pollution problems that end up in our beautiful lakes, coastal waters or underground. As a rule our soils are pretty thin throughout the state, as a result our groundwater is particularly vulnerable to pollutants. Anything that can contaminate surface water can pollute groundwater. Pollutants can soak through soil to groundwater much like water makes it's way through and dissolves coffee beans. When we use the land, we may leave a site unvegetated, spill petroleum products, or apply too many farm or garden chemicals. When it rains or snows these pollutants are washed into streams, rivers, lakes, estuaries and the groundwater.

(John Jemison, University of Maine Cooperative Extension) What makes thin soils particularly risky is that a soil will act as a filtering mechanism and if the soils are too thin we can't ensure that we got enough filtering before the water reaches bedrock or fractures in below that can carry water down to the groundwater.

(Kate Arno, Segment Host) Especially dangerous are underground sources of pollution, such as malfunctioning septic tanks or leaking petroleum storage tanks. Recently three families in South Berwick went to court to force a waste oil disposal business to pay for illegally dumping hazardous wastes near their homes. It was six years ago when nine South Berwick residents first complained of a gasoline odor in their well water.

(Holly Roy, Resident, South Berwick) And I could never figure out and then I put the kids upstairs for a shower and if you didn't have the fan on you'd get out of the shower and the next thing they'd be falling onto the floor, and it was just crazy things like that for the last, since we've been here, since 1978. It's just been crazy things like that and no matter how I searched for help, people thought I was crazy, you know, until that actually broke out and I started doing study on what these chemicals would do that it all actually fit in and I knew what had happened and the state brought in bottled water every two weeks and that's what my family has been living on for five and 3/4 years and it's just a thing that we do, you don't brush your teeth with the faucet or you always have these little glasses around, it's not a thing that, I still can't bring myself to drink the water, even though the water's fine, I just, it's just not a thing that I do. So I'll be drinking bottled water for a long time.

(Kate Arno, Segment Host) The toxic wastes had worked their way through the underground aquifer. Water has been called the universal solvent.

(Holly Roy, Resident, South Berwick) You know, a lot of people will come into this house and they'll tell me, you know, what a beautiful area it is, and it really was a beautiful area, but pollution is the thing where if you can't see it, then people assume that everything is all right and it really isn't all right. I lived like 100 feet from the Superfund site. We can't use the land. We can't use it at all. We can't consume vegetables. The DEP has told us don't consume vegetables, you can grow flowers and stuff but don't eat anything on this property. So, I mean, it may look good to the eye, but it really isn't, it's a bad area.

(Kate Arno, Segment Host) There are some 38,000 registered underground petroleum storage tanks in Maine. Over 500 wells in Maine are already known to have been contaminated by petroleum products. There isn't much we can do about these except hope that it doesn't happen to us. Yet there are things that we can do almost any day that will help affect the quality of Maine's waters.

For those of us struggling to eke out a living on the land, these can be tough choices indeed. Meet Hanson Ray of New Gloucester:

(Hason Ray, Dairy Farmer, New Gloucester) We have Collier brook that is along the edge of the woods over there. They've drank there since the farm was here, and the farm's probably been here 75 or 100 years and they've drank out of it right along. Water quality in this brook I do not believe is an issue at all. We have a very clean stream. There are trout fishing in it and I don't see any problem with the water quality here, but we're trying to make sure that it stays that way.

(Kate Arno, Segment Host) Pesticides, nutrients, like phosphorous and fertilizers, and bacteria from animal waste are of particular concern in Maine. Bacteria from cows can foul drinking water as it did in the Milwaukee, Wisconsin area several years ago, where thousands became ill. John Jamison, water quality specialist of the University of the Maine Cooperative Extension, is using a unique method of testing animal pollution in streams. He uses insects.

(John Jemison, University of Maine Cooperative Extension) We're going to test how, what the impact is and the best management practices that we'll install on the farm, have over time. So what we've done this year is we have three sets of these above the farm, three sets in the middle of the farm and three sets below the farm. What we'll do is look at the insects that inhabit this rock basket, look at the numbers of insects, and look at the types of insects and I think that'll give us a real good picture about the quality of the stream that flows through here.

(Kate Arno, Segment Host) Controlling runoff is also the key to keeping pesticides and nutrients in check. The development of new chemicals is on the fast track in many companies. Chemicals that can do the same job as today's pesticides and herbicides, but in increasingly smaller amounts, sometimes with just grams instead of pounds per acre. Excess nutrients, like phosphorous, can cause algae to grow out of control in lakes and ponds. When phosphorous levels rise, even by a small amount, algae multiply. The water can become cloudy and green leading to taste and odor problems, and oxygen levels are reduced which can kill off salmon and trout. Phosphorous readily attaches to gravel and dirt,

(Kate Arno, Segment Host) Perhaps the magnitude of this problem can best be appreciated when you consider the amount of fresh gravel brought in each spring to maintain lake camp roads. What happens to much of this gravel? Well a lot of it ends up in the lakes and along with it many nutrients. The same kind of non-point source pollution can happen on a smaller scale at our homes if we use too many pesticides or too much fertilizer or if we don't keep up our septic systems. These pollutants can run into Maine's waters. Waters where we play and from which many of us make our living.

(Christine Young, Program Host) I want to tell you a little bit more about this particular snow making technique. It actually sprays wastewater out in the air. It's called snow fluent and they started making it here in the

Carrabassett Valley at the foot of Sugarloaf Mountain just a few months ago. Here's how it works. When water freezes it expands, in this case the frozen wastewater coming out of the snow nozzles expands, the pressure from expanding kills almost all the bacteria. The small fraction of bacteria that do survive live only for another two to three days in this snow pile. That's because ultraviolet radiation from the sun kills them, even on cloudy days. The nutrients left over in the waste either evaporate out as vapor at the top of the snow clumps or are left behind at the end of the ski season as a lump of fertilizer at the bottom of the melted snow pile. Who would have thought skiing and wastewater treatment would be such a good mix. Next time on Quest, Maine's not known for having such great weather year round, but we're learning more about predicting the weather and finding new ways to get around our unpredictable weather. Until then, I'm Christine Young, Program Host, thanks for watching.

(Narrator) Maine Public Television's production of Quest, Investigating The World We Call Maine, is funded through a television demonstration grant from Rural Economic and Community Development, part of the U.S.D.A.

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