On MAY 18 AT EF INTERNATIONAL ACADEMY
DR. KATHLEEN SULLIVAN, Hibakusha Stories Director, will lead a 40-minute prep lesson.
  o How does a nuclear power plant create energy?
  o How is it related to nuclear weapons?
ACTIVITY – The nuclear fuel chain game

In preparation, we offer these curricular materials.
Please use as many or as few as fits your classroom parameters.
We sail on the Hudson River within view of the Indian Point Energy Center.

INTRODUCTION TO THE INDIAN POINT ENERGY CENTER

Indian Point Energy Center is a three-unit nuclear power plant in Westchester County, New York, on the east bank of the Hudson River 36 miles north of Midtown Manhattan. The facility permanently ceased power operations when it was decommissioned on April 30, 2021. Before its closure, the station’s two operating reactors generated about 25% of New York City’s usage. The station is owned by Holtec International and consists of three permanently deactivated reactors. Units 2 and 3 were Westinghouse pressurized water reactors. About 1,000 employees lost their jobs as a result of the shutdown. New York City and Newark, NJ, are both within the 50-mile evacuation zone should there be a major accident.
**Fuel Rods** (metal tubes filled with radioactive uranium pellets)
Indian Point stores used fuel rods in two spent fuel pools at the facility, contained within an indoor 40-foot-deep pool and submerged under 27 feet of water. Water is a natural barrier to radiation. The spent fuel pools at Indian Point are set in bedrock and are constructed of concrete walls that are four to six feet wide, with a quarter-inch thick stainless steel inner liner. The pools each have multiple redundant backup cooling systems. Indian Point began dry cask storage of spent fuel rods in 2008. Some rods have already been moved to casks from the spent fuel pools. The fuel is cooled and stored in the spent fuel pool for at least five years before being transferred to dry casks.

**Earthquake Risk**
In 2008, researchers located a previously unknown active seismic zone that intersects the Ramapo Fault, the longest fault in the Northeast and which passes less than a mile north of Indian Point. Scientists dispute how active this roughly two-hundred-million-year-old fault is. Many earthquakes in the state’s varied seismic history are believed to have occurred on or near it. According to a company spokesman, Indian Point was built to withstand an earthquake of 6.1 on the Richter Scale.

**Economic Impact**
The Indian Point Energy Center was a major employer of Westchester County and directly employed about 1,000 full-time workers. This employment created another 2,800 jobs in the five-county region and 1,600 in other industries in New York, for a total of 5,400 in-state jobs. The Energy Center was a major contributor to the tax base of Westchester County.

**Emergency Planning**
There are two emergency planning zones around nuclear power plants:
1. Plume exposure with a radius of 10 miles concerned with airborne radioactive contamination
2. Ingestion pathway of about 50 miles concerned primarily with ingestion of food and liquid contaminated by radioactivity.

The 2010 U.S. population within 10 miles of Indian Point was 275,000, and the population within 50 miles was 17 million. This includes New York City and Newark. Many scholars have argued that any evacuation plans shouldn’t be called plans, but rather "fantasy documents".
THE CIVIC LENS

This curriculum will focus on the role that civil society plays in the health and safety of the local communities affected by Indian Point Energy Center, an area that includes New York City and Newark, NJ. We will look at the economic, health and environmental issues related to the nuclear energy industry.

Civil Society

Civil society consists of all the community groups, non-governmental organizations, labor unions, indigenous groups, charitable organizations, faith-based organizations, professional associations, foundations and grassroots activists who work outside the government and business sectors. They provide the expertise that informs governments. In the case of Indian Point many organizations have come together to inform local, state and national officials. Among them are Riverkeeper, Hudson River Sloop Clearwater, the Safe Energy Coalition, the Sierra Club, Federated Conservationists of Westchester County and United for Clean Energy.
After more than 70 years into the nuclear age there is still no technological ‘solution’ to the ‘disposal’ of radioactive materials. For materials that remain life-threatening beyond any conventional notion of time, ‘disposal’ cannot be achieved. Wherever the material is placed, it will continue to be both mutagenic and carcinogenic. The only way to take on the colossal task of isolating radioactive materials from the environment is to make that responsibility visible. It is through this visibility that future generations are called into a responsible relationship with the nuclear legacy they are inheriting. Nuclear Guardian Sites require communities to perceive radioactive materials as part of a culture of responsibility in everyday life that must be passed on to future generations. Therefore, it is paramount that the materials remain in view in order that their safe containment be achieved. By watching the radioactive materials, by monitoring and correcting any found problems, it is then that these materials can be continually isolated from the environment. Radioactive waste storage is likewise envisioned as decentralized, occurring where possible at the site of generation. Storing radioactive materials where they have been produced avoids the further risk of contamination that might occur in the transportation of these materials.

For more information visit the Hibakusha Stories website: [https://hibakushastories.org/why-disarmament-education/nuclear-guardianship/](https://hibakushastories.org/why-disarmament-education/nuclear-guardianship/)
CLASSROOM RESEARCH

This curriculum is based on two on-line public sessions that occurred in January and February of 2023. These are the general questions it will address:

WHAT ARE THE WASTE PRODUCTS OF THE PRODUCTION OF NUCLEAR ENERGY?
WHAT IS DECOMMISSIONING AND WHAT ARE THE CHALLENGES FACING INDIAN POINT?
WHAT ARE THE EFFECTS OF THE WASTE ON HUMAN HEALTH AND THE ENVIRONMENT?
WHAT ARE THE ECONOMIC, ENVIRONMENTAL, HEALTH AND SOCIAL EFFECTS OF DECOMMISSIONING AND HOW IS THE GOVERNMENT AND CIVIL SOCIETY ENGAGED?
HOW DO WE PRACTICE NUCLEAR GUARDIANSHIP?

Instruct your students to watch the Introduction to Forum I and one additional segment of the Decommissioning Indian Point Forum and:

1. provide written answers to the questions
2. present a summary of the session
3. name one important thing they learned.

Then dedicate one class period to discussing their findings.
CIVIL SOCIETY IN ACTION – INDIAN POINT EXPERT FORUM I

CRITICAL PUBLIC HEALTH AND SAFETY IMPACTS OF DECOMMISSIONING INDIAN POINT

JANUARY 26, 2023

For those interested in civic engagement.

INTRODUCTION – THE EFFECTS OF DECOMMISSIONING ON THE COMMUNITY (15 min)
https://www.youtube.com/watch?v=_tPyH5RGgHk&t=337s

1. Name the coalition groups that are working to oversee safety at Indian Point.
   Safe Energy Rights Group, Hudson River Sloop Clearwater, Federated Conservationists of Westchester County, Upper Nyack Green Committee, Physicians for Social Responsibility NY, Sierra Club Atlantic & Lower Hudson.

2. When did Indian Point begin operations and how far is it from New York City?
   1962, 26 miles.

3. When were the 3 reactors shut down?

4. Who now owns it and how much are rate-payers subsidizing them?
   Holtec is being paid 2 billion dollars.

5. What is co-located at Indian Point that makes it particularly dangerous?
   A 42” gas pipeline.

6. What is Holtec’s plan in disposing of waste water?
   Releasing 1 million gallons of wastewater with tritium into the Hudson River.

7. According to Senator Harckham what are 3 challenges the neighboring communities face with the decommissioning?
   Indian Point the largest tax payer in Westchester County.
   The County needs to create a sustainable flow of money.
   The waste canisters will be in place in perpetuity.
   It is hard to do economic redevelopment there.
   Replacing good paying union jobs for local workers.

8. What are the opportunities?
   Provide a model for just transition for transitioning from fossil fuels.
   Provide a model for decommissioning other nuclear power plants in NY/NJ.
   The Decommissioning Oversight Board is a national model.
CRITICAL PUBLIC HEALTH AND SAFETY IMPACTS OF DECOMMISSIONING INDIAN POINT

JANUARY 26, 2023

For those interested in health.

DR. HELEN CALDICOTT – THE EFFECTS OF RADIATION ON HUMAN HEALTH (18 min)
https://www.youtube.com/watch?v=M27YdJ3pbD4

Holtec, the company that has been hired to decommission the plant, intends to dump 1 million gallons of radioactive waste from Indian Point’s cooling ponds into the Hudson River. According to Dr. Caldicott – (she begins at 4:51 min)

1. What is a cooling pond? Why is it dangerous?
   It cools radioactive fuel rods. The water becomes radioactive.

2. How is the Hudson River used presently?
   Drinking water, swimming, fishing, recreation.

3. Who is most vulnerable to radioactive isotopes?
   Children & fetuses.

4. How does the radioactive waste move up the food chain?
   From algae to crustaceans to little fish to big fish to us

5. Name the 3 radioactive elements created when uranium depletes (decomposes) that will be released in the Hudson River and their effect on human health.
   **Cesium 137** with a half-life of 30 years can cause cancers and sarcomas and can stay around for 600 years.
   **Strontium 90** sends out electrons that constantly pulsate and produce millions of unregulated cells that migrate into lymph and blood vessels and spread throughout the body to the brain and the lungs producing secondary cancers.
   **Plutonium** is a big particle that emits 2 protons and 2 neutrons and acts like iron and deposits in the liver to produce liver cancer and leukemia and gets into the fetus and is deadly. It remains in the environment for 240,000 years.
   **Tritium** cannot be removed from water but rather becomes part of the water as H3O. Tritium is a beta emitter, emitting an electron which bombards healthy cells. It can’t be removed from the water and you can’t evaporate it.

6. What does Dr. Caldicott recommend? Why might she not be the best person to answer this question?
   We ship it to the desert and bury it.
   Her focus is on the medical effects on the body, not on what to do with the waste.
CRITICAL PUBLIC HEALTH AND SAFETY IMPACTS OF DECOMMISSIONING INDIAN POINT
JANUARY 26, 2023
For those interested in civic engagement.
DIANE TURCO – DECOMMISSIONING PILGRIM NUCLEAR REACTOR (13 min)
https://www.youtube.com/watch?v=OoylHxZ7rDQ&t=5s

1. What does Downwind mean?
   Downwinder refers to people who live downwind from a nuclear power plant.

2. What is a present campaign of Cape Downwinders?
   To prevent Holtec from dumping a million gallons of radioactive water into Cape Cod Bay. Advocating for safer storage and security at the spent fuel storage installation.

3. Where is the Pilgrim Nuclear Reactor?
   Plymouth, MA.

4. When did the decommissioning of Pilgrim begin? 2019

5. What areas will be affected by the discharge of the radioactive water?
   The marine life in Cape Cod Bay and the recreational beaches on the oceanside.

6. Name three ways the community is trying to stop Holtec from discharging the waste.
   Non-binding ballot initiatives in the township were overwhelmingly against the discharge.
   Federal EPA laws that state that chemical pollutants cannot be discharged into US waters.
   Massachusetts Attorney General settlement.
   Massachusetts Protected Ocean Sanctuary Act.

7. What are the lessons learned by Cape Downwinders?
   Know the laws that protect water in your state.
   Find out what state powers exist to enforce these laws.
   Check to see that permits have been filed and approved.
   Organize on the local, state and national levels.
1. **Name an important trait for a civic activist.** Endurance.
2. **Why is Holtec being accused of being “anti-democratic”?** They are disobeying local, state and federal law and the wishes of the public.
3. **How close is the elementary school to the plant and why is that dangerous?** 4000 feet. Children are especially sensitive to the radioactive wastes that escape into the air.
4. **Is there an effective evacuation plan?** No. All the evacuation personnel have their own families to care for.
5. **Why is it dangerous to co-locate a natural gas pipeline and a nuclear power plant?** The pipeline could explode and damage the plant and release radioactive particles.
6. **Does the plant release radioactive materials into the air?** Yes! Even evaporation doesn’t work.
7. **What action steps are there to take?** Dilution is not the solution for tritium. Best possible state-of-the-art monitoring. Total site-tested for contamination. No exemptions for Holtec. Demand emergency planning and wastewater radionuclide disclosure.
CRITICAL PUBLIC HEALTH AND SAFETY IMPACTS OF DECOMMISSIONING INDIAN POINT
FEBRUARY 16, 2023
For those interested in public safety.
INTRODUCTION (14 min)
https://www.youtube.com/watch?v=v8TAcKT9Vg8
George Latimer, Westchester County Executive
Courtney Williams, Safe Energy Rights Group & Resist Spectra

1. Why is it not a good idea to put a 45” gas pipeline next to Indian Point nuclear reactor?
   It is right next to the plant’s power supply and gas is a very explosive material and next to the elementary school.

2. What is the NRC? The Nuclear Regulatory Commission.

3. What is FERC and what is its nickname?
   The Federal Energy Regulatory Commission, a rubber stamp for big oil and gas.
For those interested in environmental science.

DR. KATHY NOLAN (11 min)
Potential impacts of environmental exposures to children
https://www.youtube.com/watch?v=Z_xJNqzj1PE

1. **What are Kathy Nolan’s credentials?**
   Pediatrician, bio-ethicist and President of Physicians for Social Responsibility of New York, Concerned Health Professionals of New York and an Ulster County legislator.

2. **Name 4 factors that need to be considered in evaluating health impacts.**
   What toxins, what concentrations, what routes of exposure, what is the condition of the person receiving exposure.

3. **What is the drawback of the standard guidelines and reference values?**
   They are derived from analysis of adult white males, so they don’t tell the whole story.

4. **Name four groups who have unique susceptibilities to radiation toxins?**
   Women, children, embryos and fetuses, elderly, people with pre-existing conditions.

5. **What are the five main categories of toxins?**
   Infectious like the flu, caustic (burn), mutagenic (changes in DNA), carcinogenic (cancer causing) teratogenic (causing abnormal growth).

6. **Which of the above toxins does not apply to radioactivity?** Infectious.

7. **Why are children more susceptible?**
   They are growing cells which need proper DNA coding and they are much more exposed. They have more exposure to dust, they are breathing more heavily, they don’t wash their hands as frequently.

8. **Which type of toxin is most dangerous for fetuses and embryos and why?**
   Teratogenic because cells are dividing and reproducing at a very rapid rate and small alterations in DNA can have disastrous results.

9. **What is the precautionary principle?**
   If we don’t know enough to know that it is safe, we should consider it harmful.
1. What are Arnie Gunderson’s credentials?
He is chief engineer at Fairwinds Associates, a nuclear engineer and former nuclear industry executive with over 51 years of experience in engineering, operating and safety maintenance.

2. What is nuclear fission? It is when a uranium atom, a huge atom with an atomic number of 238, splits apart and creates an enormous amount of heat energy.

3. What is the disadvantage of fission? The rubble is radioactive and hot.

4. What is the use of the spent fuel pools? They keep the radioactive uranium cool, they shield workers from radiation, they contain boron to stop the possibility of a nuclear chain reaction starting up again.

5. What is the lightest atom? Hydrogen with one proton and one neutron, an atomic number of 1.

6. What is tritium? It is a hydrogen atom with two neutrons and one proton circling around it. It’s three times heavier than the original hydrogen atom and it is unstable, which means radioactive.

7. How long does it take tritium to decay and what happens when it decays? Its half-life is 12 years and when it decays it lets off a particle called a beta particle and can form chemical bonds with other atoms.

8. What is a bequerel? – 1 disintegration per second.


10. How many times higher is the radioactivity of the tritium in the spent fuel pool?
Thousands of times higher than the EPA standards and there are a million gallons of tritium contaminated water in the spent fuel pools.

11. What are three alternatives to dealing with tritium and which does Gunderson prefer?
The cheap solution which Holtec wants to do – dump it into the Hudson River. Zero liquid discharge plan – ship in tanker trucks to a licensed facility. Keep in the fuel pool which will decay in 120 years, top choice of Gunderson.
MARY OLSON (14 min)
Disproportionate harm from radiation exposure tied to biological sex

https://www.youtube.com/watch?v=N345FkqibSw&t=5s

1. **What are Mary Olson’s qualifications?**
   Founder of the Gender and Radiation Impact Project, Staff Biologist for the Nuclear Information and Resource Service.

2. **What is a health impact of radiation exposure in women?**
   Infertility. It can break the DNA.

3. **What are the 3 ways we can get radioactive particles into our bodies?**
   Breathing, eating & drinking.

4. **Tritium travels like water. Where are two places in the body where tritium can go that blood cannot?** The brain and the placenta.

5. **Name 5 ways tritium can get out of a reactor.**
   Routine venting, leakage, refueling, planned dumping, spills.

6. **Why is radiation more harmful to children?**
   Their bodies are growing and their cells are dividing more frequently.
CIVIL SOCIETY IN ACTION – INDIAN POINT EXPERT FORUM II

CRITICAL PUBLIC HEALTH AND SAFETY IMPACTS OF DECOMMISSIONING INDIAN POINT
FEBRUARY 16, 2023

PANEL DISCUSSION (24 min)
https://www.youtube.com/watch?v=zt0aJAp36Uo

1. What is the radius around the plant that should be of concern to parents of elementary school children?
   1000 gallons of tritiated water evaporates each day. 2 miles east/west; 5-6 north/south.

2. What are 8 take home lessons?
   Legal does not equal safe.
   Legal limits are based on outdated science.
   Radioactivity cannot be filtered out of water.
   Feasible alternatives to dumping exist.
   Holtec is motivated by profit, not public good.
   Once this water is dumped, we cannot undo it.
   You must take action.

3. What can we do?
GLOSSARY

Bio-accumulation - an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment

Bio ethicist - one who conducts research on ethical, social and legal issues arising in biomedicine and biomedical research

Carcinogenic – cancer causing

Caustic – able to burn tissue

Cesium 137 – a radioactive isotope of caesium that is formed by the nuclear fission of uranium-235 in nuclear reactors and nuclear weapons.

Civil society – all the community groups, non-governmental organizations, labor unions, indigenous groups, charitable organizations, faith-based organizations, professional associations, foundations and grassroots activists who work outside the government and business sectors

Co-location – the placement of several things in a single location

Deactivate – to make inactive, to disconnect

Decommission – to withdraw from service

Dilution - the action of making something weaker

Discharge – to allow a liquid to flow out from where it has been contained

Dry cask storage – steel cylinders that are used to house spent radioactive fuel rods and keep them from contaminating the environment

Embryo – unborn offspring in the process of developing

EPA – the Environmental Protection Agency, a Federal agency
Evacuation – moving from a place of danger to a place of safety

Evaporation – turning from liquid to gas

FERC – the Federal Energy Regulatory Commission

Fetus – an unborn child

Holtec International – the corporation who owns Indian Point and is responsible for its decommission

Isotope – a form of an atom that has more than one neutron and is therefore unstable

Infectious – spreading through the environment

Mutagenic – causing mutations of DNA

Non-binding – having no legal force

NRC – the Nuclear Regulatory Commission

Nuclear fission – the process of a neutron slamming into a larger atom, forcing it to excite and split into two smaller atoms

Nuclear fuel rod - metal tubes filled with radioactive uranium pellets

Nuclear guardianship – the practice of communities to perceive radioactive materials as part of a culture of responsibility in everyday life that must be passed on to future generations.

Nuclear reactor – a device that uses fission to produce heat that creates steam which powers turbines and generates energy.

Nuclide – a distinct kind of atom or nucleus characterized by its number of neutrons and protons

Placenta – an organ in the uterus that provides oxygen and nutrients to the fetus
Plutonium 239 – a very heavy radioactive isotope used as the fuel for nuclear weapons. It emits 2 protons and 2 neutrons and acts like iron and deposits in the liver to produce liver cancer and leukemia and gets into the fetus and is deadly. It remains in the environment for 240,000 years.

Precautionary principle – an ethical stance used in science and medicine that posits that if we don’t know enough to know that it is safe, we should consider it harmful.

Radiation – the emission of energy as sub-atomic particles

Radionuclide – a nuclide that has excess nuclear energy, making it unstable.

Strontium 90 – Strontium-90 is a radioactive isotope of strontium produced by nuclear fission, with a half-life of 28.8 years. It sends out electrons that constantly pulsate and produce millions of unregulated cells that migrate into lymph and blood vessels and spread throughout the body to the brain and the lungs producing secondary cancers

Teratogenic – causing abnormal growth

Tritium – hydrogen-3, is a rare and radioactive isotope of hydrogen with a half-life of about 12 years. The nucleus of tritium contains one proton and two cannot be removed from water but rather becomes part of the water as H3O. Tritium is a beta emitter, emitting an electron which bombards healthy cells. It can’t be removed from the water and you can’t evaporate it.

Uranium – a silvery-white metallic chemical element in the periodic table, with atomic number 92. It is assigned the chemical symbol U. A uranium atom has 92 protons and 92 electrons, of which 6 are valence electrons. Uranium has the highest atomic weight of all naturally occurring elements.