Maine Indoor Air Quality Council: HVAC Basics for COVID-19 Readiness

MODULE TWO: VENTILATION

Learning Objectives of this Badge Program

- An understanding of mechanical systems within a building that have significant impact on indoor air quality and our health.
- An understanding of the role of ventilation air in minimizing risk of transmission.
- An understanding of the role of filtration in minimizing risk of virus transmission.
- Recommended practices for operating and improving HVAC system to minimize risk of virus transmission.

Module Two

In module two we will focus on ventilation, and its role in minimizing the risk of transmission indoors of COVID-19.

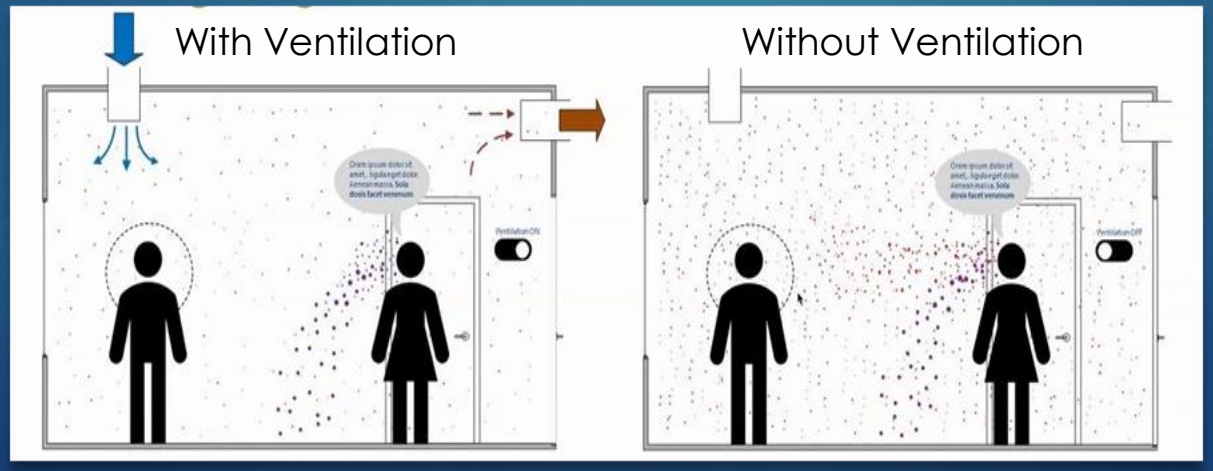
This module is based on School Facilities and intended to inform facility users and operators of these facilities. Many of the recommendations and practices are applicable to other facility types.

Maine Indoor Air Quality Council

Ventilation:

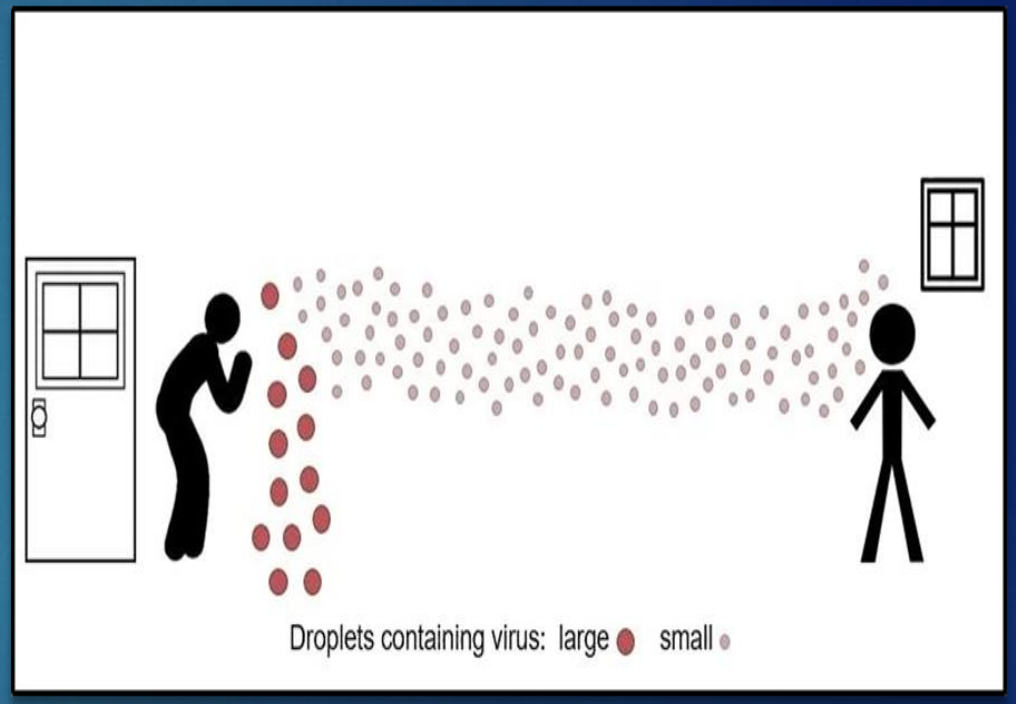
What is it the role of ventilation to minimize the risk of transmission?

- Ventilation is the introduction of outside air into occupied spaces. A ventilation system provides the pathway for the removal of particles from the airstream.
- Providing ventilation reduces the amount of virus particles in an occupied space.



Ventilation

- As we breath, talk, cough, etc., we expel various size droplets depending on activity that may contain virus. The large droplets settle much quicker onto surfaces that should be cleaned. The smaller droplets remain airborne longer and can travel significant distances in the air.
- ASHRAE Standard 62.1 "Ventilation for Acceptable Indoor Air Quality" provides recommendations for Minimum Ventilation rates based on number of people in space and room size. These minimum ventilation rates along with improved filtration is the preferred strategy to reduce virus exposures.
- The ventilation air provided to occupied spaces is intended to be distributed uniformly through out space and into the breathing zone of the occupants. Proper air flow through space is important for proper ventilation effectiveness.



Two Ventilation Types

NATURAL:

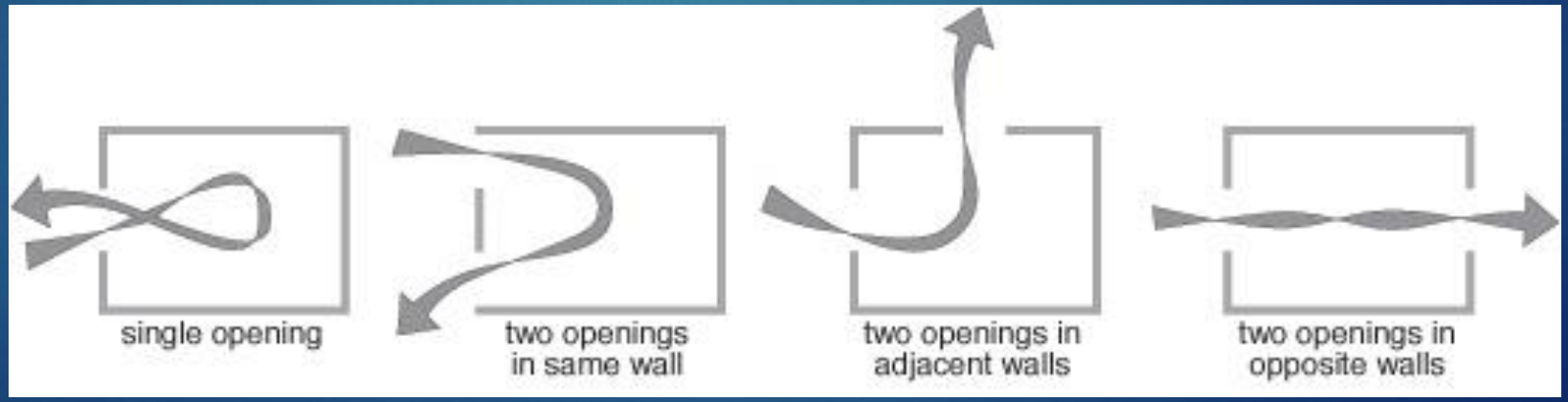
Natural ventilation relies on air moving in and out of a space without the assistance of a mechanical fan. Natural ventilation includes air that may come in through open windows, doors and cracks around building.

MECHANICAL:

Mechanical ventilation relies on air moving in and out of a space with the assistance of a mechanical fan. Fans are used to draw outside air into building to delivery to the occupied spaces.

Natural Ventilation

- There are two major concerns with naturally ventilating a space that relate to effectiveness.
- First, natural ventilation is inconsistent. Sometimes the natural forces will move enough air in and out of a space to ventilate it and sometimes they won't. Wind and temperature are the driving natural ventilation forces and both of these can change on a daily if not hourly basis.
- Second, natural ventilation provides unpredictable distribution of fresh air throughout the space. Unless the ventilation air pathways are uniform, some areas may be under ventilated while some areas will be ventilated adequately.

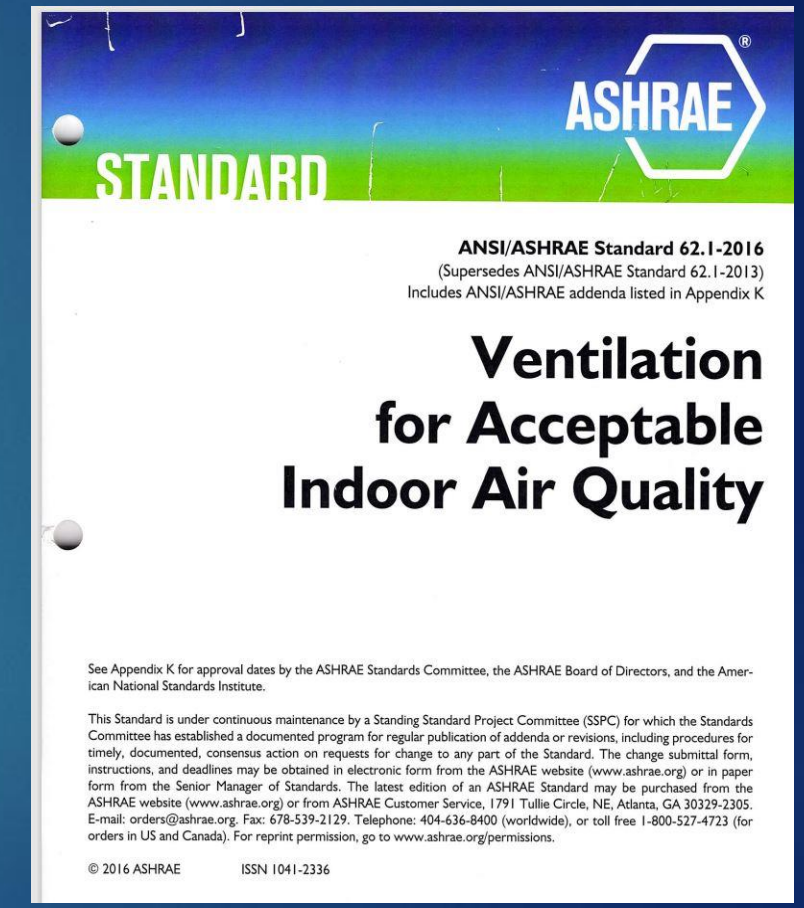


Ventilation less effective on left to more effective on right

Mechanical Ventilation

- ASHRAE standard 62.1 provides recommendations for Minimum Ventilation rates based on space usage, number of occupants and room size. ASHRAE 62.2 is a similar document that applies to residential units.

- The standard addresses various occupancies and activities that may occur in spaces such as classrooms, offices, assembly spaces, toilet rooms, etc.



Mechanical Ventilation

- To determine the minimum ventilation rate of outside air for a classroom would consist of the following information: room size (square footage), number of occupants (students & teachers).
- ASHRAE table 6.2.2.1 requires 10 cfm/occupant plus 0.12 cfm/square foot for classrooms. CFM is Cubic Feet per Minute.
- If classroom is 900 sf and has 26 occupants, (900 sf * 0.12 cfm/sf)+(26 occupants *10 cfm/occupant = 368 cfm minimum ventilation rate (outside air) required.

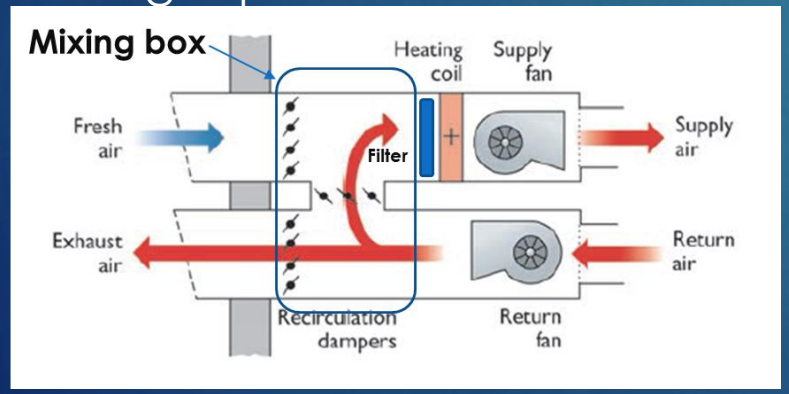
TABLE 6.2.2.1 Minimum Ventilation Rates in Breathing Zone
(Table 6.2.2.1 shall be used in conjunction with the accompanying notes.)

	People Outdoor Air Rate R_p		Area Outdoor Air Rate R_a			Default Values			
						Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
Occupancy Category	cfm/ person	L/s· person	cfm/ft^2	L/s·m^2	Notes	#/1000 ft^2 or #/100 m^2	cfm/ person	L/s· person	Air Class
Correctional Facilities									
Cell	5	2.5	0.12	0.6		25	10	4.9	2
Dayroom	5	2.5	0.06	0.3		30	7	3.5	1
Guard stations	5	2.5	0.06	0.3		15	9	4.5	1
Booking/waiting	7.5	3.8	0.06	0.3		50	9	4.4	2
Educational Facilities									
Daycare (through age 4)	10	5	0.18	0.9		25	17	8.6	2
Daycare sickroom	10	5	0.18	0.9		25	17	8.6	3
Classrooms (ages 5–8)	10	5	0.12	0.6		25	15	7.4	1
Classrooms (age 9 plus)	10	5	0.12	0.6		35	13	6.7	1
Lecture classroom	7.5	3.8	0.06	0.3	H	65	8	4.3	1
Lecture hall (fixed seats)	7.5	3.8	0.06	0.3	H	150	8	4.0	1

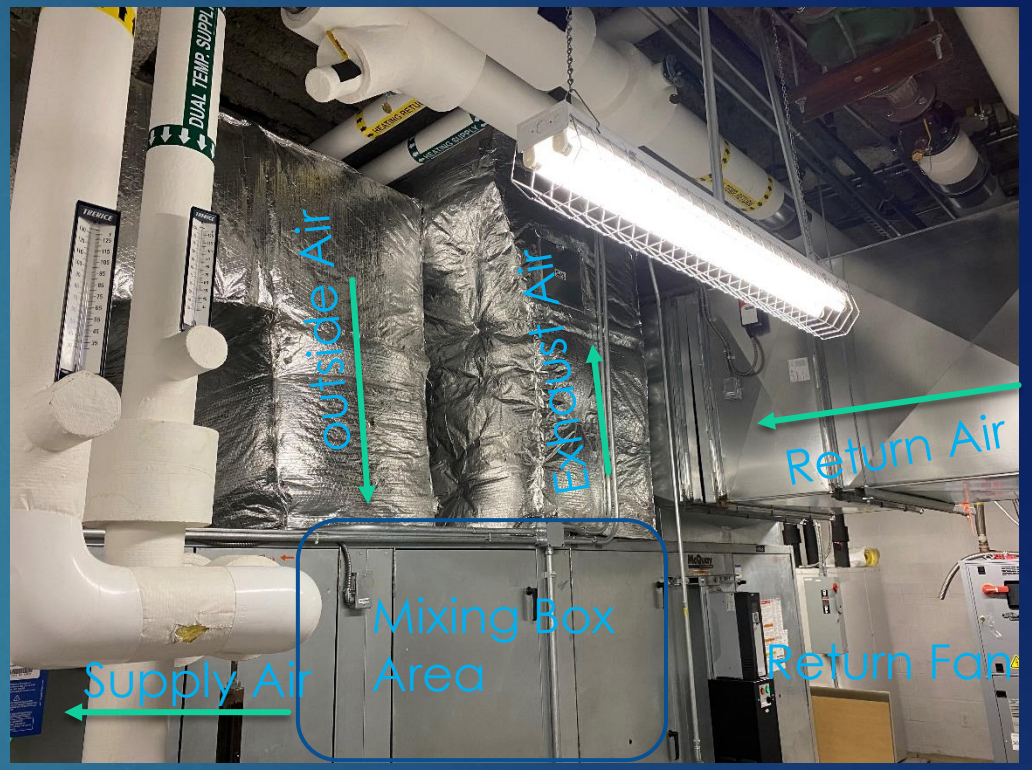
Mechanical Ventilation

- Relies on operation of motor driven fan to draw outside air into HVAC system that delivers air to occupied spaces.

- On most systems, ventilation air (outside air) is drawn into building at outside air louvers and tied to mixing box or return ductwork. Dampers are provided at outside air and return air ducts for balancing amount of each airflow. These systems tend to provide a higher overall air exchange rate through spaces.



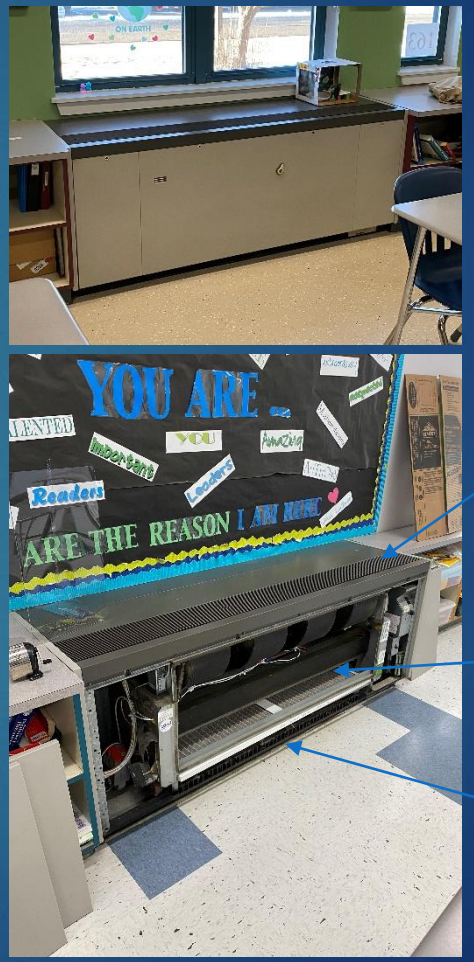
Airflow schematic at Mixing Box



AHU Airflow at Mixing Box

Mechanical Ventilation – Unit Ventilators

- Unit Ventilators draw outside air from exterior into back of the unit and mixes with room return air. The return air damper and outside air dampers are adjustable to vary the amount of outside air.
- Air is then filtered, heated if required and discharged thru grilles in top of units.
- An exhaust grille or relief air grille is typically provided to allow for the ventilation air into the space and it forces the excess room air to be exhausted to exterior.



Unit Ventilators

Supply Air Discharge

Air Filters

Return Air Intake at Bottom, Outside Air Intake is behind Return

Mechanical Ventilation – Air Handling Units

- Air Handling Units (AHU) are common in many schools where the are located in mechanical rooms or rooftop equipment and serve multiple spaces. Some AHUs contain a single supply fan and other AHUs contain both supply and return fans. Return fans provide better method to exhaust air for introduction of ventilation air.

- The ventilation air is drawn into the building through exterior wall louvers and ducted to a mixing box where return air is brought back to unit. Mixing box dampers modulate to mix the percent of outside air to desired conditions.

- The supply air delivered is a blend of return air and ventilation air that is filtered and heated/cooled as required.

- The return air from rooms is blended with the ventilation air and excess return air is exhausted.

Air Handling Unit (Supply Fan)

Air Handling Unit (Supply & Return Fans)

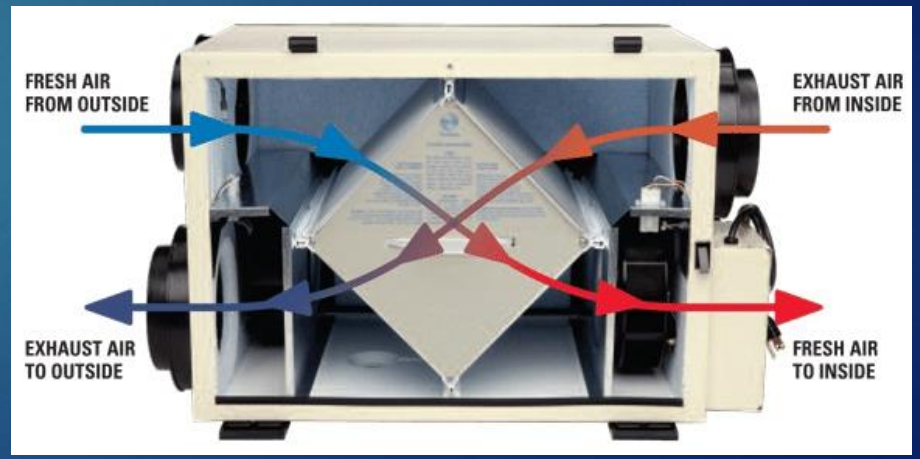
Mechanical Ventilation – Energy Recovery

- At many newer and updated facilities, the use of a Dedicated Outside Air Systems (DOAS) or an Heat/Energy Recovery Ventilator (HRV/ERV) is provided. These units provide100% outside air with room air exhausted to exterior.

- Heat Recovery Ventilators (HRV) recover heat from airstream, Energy Recovery Ventilators (ERV) recover heat and moisture from airstream. Most HRV/ERVs have basic on/off control, filters and a means of preventing formation of frost during colder winter days.

- Heating and Cooling components can be added to discharge of the units to provide additional treatment to air before delivery to rooms.

Heat/Energy Ventilator Unit



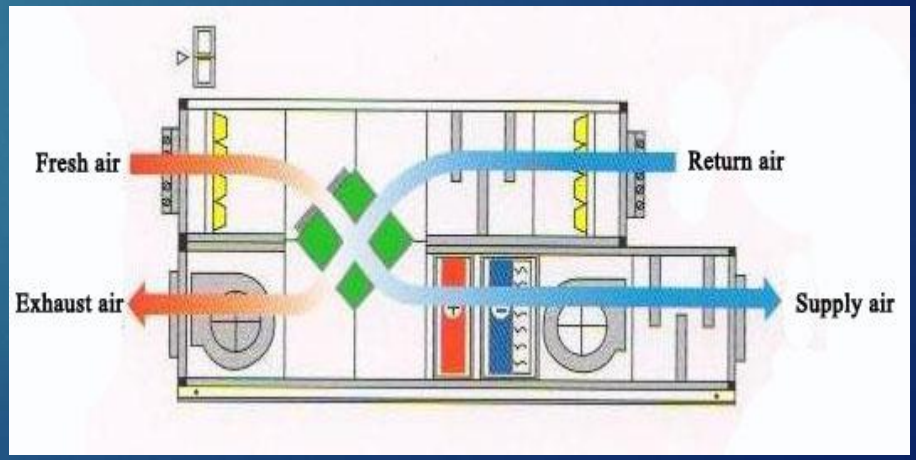
HRV/ERV Airflow Schematic

Mechanical Ventilation – Dedicated Outdoor Air System (DOAS)

- DOAS units are more complex than H/ERVs and provide ability to heat/cool/dehumidify air delivered to occupied spaces as required. The use of a heat or energy recovery module tempers outside air to conserve energy and associated operating costs.

- These systems are typically designed to meet minimum ventilation air requirements and do not provide same level of air changes that conventional air based systems provide. They are intended to condition only the ventilation air being introduced into the occupied spaces.

Dedicated Outdoor Air Unit



Dedicated Outdoor Air Unit Airflows

Ventilation: Knowledge Check

1. Ventilation is the introduction of _____ _____ into an occupied space.
2. _____ventilation is more effective than _____ ventilation.
3. _____ is the ASHRAE standard for "Ventilation for Acceptable Indoor Air Quality."
4. Mixing Boxes are used to mix _____ air and _____ air?
5. Heat Recovery Ventilators recover heat from airstream. Energy Recovery Ventilators recovery _____ and _____ from airstream

Ventilation:
Knowledge Check - Answers

1. Ventilation is the introduction of **outside air** into an occupied space.

2. **Mechanical** ventilation is more effective than **natural** ventilation.

3. **62.1** is the ASHRAE standard for "Ventilation for Acceptable Indoor Air Quality."

4. Mixing Boxes are used to mix **outside** air and **return** air.

5. Heat Recovery Ventilators recover heat from airstream. Energy Recovery Ventilators recovery **heat** and **moisture** from airstream.

To learn more…

- Visit the COVID-19 Resources Page on the website of the Maine Indoor Air Quality Council. Click here: **COVID-19 Resources Page - Maine Indoor Air Quality Council**

- Contact:

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Congratulations!

You made it to the end of this session for Maine Indoor Air Quality Council: Ventilation.

Your next step is to start learning about Filtration.