**Hands-On Climate Change Activities**

**The Easiness Rating**

Each of these activities can be done as a student-centered hands-on activity, a teacher demo, or as a projected video. To help you decide which way you want to do the activity, we have created the following rating scale that shows how much time or difficulty each of these requires.

**🕥** This is an activity that is easy to set-up, easy to do in small groups, and takes little time. Let the students explore the materials.

**🕥🕥** This should be a student activity or a teacher demonstration.

**🕥🕥🕥** This should be a teacher demonstration or screened as a video.

**🕥🕥🕥🕥** This activity takes a long time to do, is hard to set up or has safety concerns. Show the video.

| **Topic** | **Video Title** | **Easiness Rating** | **Video Demonstration** | **Suggested Discussion Points** | **Teacher Notes** |
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| The Earth’s Energy Balance(Conduction) | Conduction Experiment/ Heat |  **🕥🕥** | <https://www.youtube.com/watch?v=tLiI7Zr_xTY&t=72s> (Length - 2:29) *\*turn off sound\**Paper clips are stuck along the handle of a metal spoon with wax. The spoon is heated by a candle. Conduction of Heat – Observing heat conduction within a metal rod.<https://www.youtube.com/watch?v=LxJoLeeqk88> (Length 1:50 but just show 0:54-1:24. Turn the sound off.)Candles are stuck onto a rod and one end of the rod is heated. Candles may be easier to set-up. A gas flame is used instead of a candle because the rod is so thick it needs a lot of heat/ | What will happen when the spoon is heated by the candle? The paper clips will all fall at the same time. The paper clip nearest the candle will fall off first. The paper clip farthest from the cradle will fall off first. Something else.  | The metal conducts heat quickly, so you might expect that they would fall at the same time. However, they fall off one at a time, with the paper clip nearest the candle falling first. This suggests that the heat is being used up to melt the wax and not travelling farther. This also explains why the person holding the spoon doesn’t get hurt. If you do this as a demo, you could continue holding the spoon while you talk and pretend that you don’t realize this and do a dramatic yelp, when the heat gets to you.  |
| The Earth’s Energy Balance(Albedo, Radiation, Absorption, Reflection) | Albedo Experiment | **🕥🕥🕥**  | <https://www.youtube.com/watch?v=L9URerDJmC8> (Length - 3:00) White and black foam core board under a heat lamp, viewed with an ir camera. Use an ir-thermometer instead. | When have you experienced something like this? | Possible answers to the posed question* Walking in bare feet on a light grey sidewalk vs. a black driveway or road.
* Wearing a black T-shirt or a white T-shirt on a sunny day.
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| The Earth’s Energy Balance(Albedo, Radiation, Reflection, Absorption) | Demonstration of Albedo Ice Reduction |  **🕥🕥** | <https://www.youtube.com/watch?v=TGOSxa6kymM&t=5s> (Length - 0:24)Ice cubes melting under a heat lamp, one is covered in dirt and melts much faster | You have an icy sidewalk. You can add salt or sand. Which should you use? Why? | Salt will melt the ice much faster by lowering the melting point, but the salty run off is bad for the environment. Sand provides traction and some albedo melting. |
| The Earth’s Energy Balance(Radiation, Reflection, Absorption) | Absorption of Thermal Radiation | **🕥🕥🕥**  | <https://www.youtube.com/watch?v=AZWgDUy4dC4> (Length: 2:44) Flasks with thermometers are placed near a bulb. One has a black surface and the other is silver.  | Order the following surfaces from the highest albedo (black flask) to the lowest (silver flask), * Skating rinks
* Asphalt roads
* Rooftops
* Soccer field
 | Answer to suggested question: Asphalt roads > Soccer field > Skating Rink. Rooftops would depend on color*.*  |
| The Earth’s Energy Balance(Radiation, Reflection, Transmission, Absorption) | Heat Transfer Demonstration | **🕥🕥🕥**  | <https://www.youtube.com/watch?v=FCCEmElczBs> (Length: 10:59 Suggested section - 6:51 to 7:54)*\*Turn off sound\**This shows how you can pop a balloon with a laser pointer. Pause the video before he adds the black spot. | The balloon didn’t pop even when the laser was focussed. What could you do to make the balloon pop? Make a spot on the balloon with a A) Green markerB) Red MarkerC) Black Marker  | The person doing the demo thinks the problem is due to the lack of intensity of colour. However, red things look red because they reflect and don’t absorb red. He uses a black marker, but a green marker or a green balloon would also work. You will need a fairly good laser pointer for this. Probably one that the students should not be handling. |
| The Earth’s Energy Balance(Conduction, Convection) | Short View: Convection CurrentsDemonstration | **🕥🕥🕥**  | <https://www.youtube.com/shorts/iBkdwZIm-sQ> (Length - 1:00). A see through tank of water placed on top of beakers of ice water and hot water. Red and blue food colouring is added to the bottom. It shows the up movement of hot water, but not the down movement of cold. It shows the sideways movement that connects the two.  | This demonstration shows a convection current driven by \_\_\_\_\_\_\_\_ water.1. cold
2. hot
3. hot and cold
 | The rising hot (red) water drives the current. It rises and then spreads over the surface. The rising causes the blue water to move sideways to replace the hot water. The movement of the blue water draws the red water down. The cold (blue) water can’t drive the current because it is already at the bottom. |
| The Earth’s Energy Balance(Radiation, Absorption, Albedo) | How a Crookes radiometer works | **🕥🕥🕥** | <https://www.youtube.com/watch?v=r7NEI_C9Yh0> (Length 6:16, but only show the first 20 seconds and turn sound off).The video gives a thorough explanation, but it is too complicated for grade 10. These are easy to buy for about $30 and are very delicate. | The energy is transferred from the light to the radiometer by1. conduction
2. convection
3. radiation
4. reflection
 | There is no physical contact between the light and the radiometer, so it must be radiation. When the light reaches the vanes it is absorbed more by the dark sides which heat up. This is another example of albedo.Air molecules that collide with the warmer side are reflected faster and push the vane away. |
| The Earth’s Energy Balance(Specific Heat Capacity) | Specific Heat Capacity and Balloons  | **🕥**  | <https://www.youtube.com/watch?v=I3ta8x5cBq4> (Length - 1:58) This is a really easy demo. It should be done over a large basin or garbage pail so that it is more surprising when the expected mess does not happen.  | Predict what will happen with each balloon. Explain. Observe. Explain. | The ocean has absorbed 90% of the heat that humans have caused. The students may be able to make the right predictions, but explaining their predictions will be more challenging. Ask them to think about what they have noticed about heating water. They may mention how long it takes a pot of water to boil and that boiling water won’t pop a balloon. Ask them to think about temperatures at the beach. The sand and air get really hot in the day and can be quite cold at night but the water changes very little. This demo is from the resource from the Perimeter Institute.  |
| The Earth is Warming(Greenhouse Gases) | CO2-Ink Demonstration | **🕥🕥🕥**  | <https://www.youtube.com/watch?v=81FHVrXgzuA&t=129s> (Length - 3:50)A tiny drop of good ink (not food colouring) is placed in a large clear container of water. The water becomes opaque.  | The CO2 in the atmosphere is only 400 ppb. What fraction is this? Why does it matter? | 400/1,000,000,000 = 4/10,000,000 = 0.0000004. The demonstration shows that small concentrations can have huge effects on the absorption of electromagnetic radiation. Therefore even though carbon dioxide is only 400 ppb of the atmosphere - it can have a huge effect..  |
| The Earth is Warming(Greenhouse Gases) | Evidence for Climate Change - The Physics of Climate Change | **🕥🕥🕥**🕥 | <https://www.youtube.com/watch?v=l7rqlvzWrEw&list=PL1608DAAD37A04B35&index=9> (Length - 3:21)  Four gases (methane, carbon dioxide, oxygen and nitrogen) are shown. You can see which ones absorb the heat from a heating pad when viewed with an infrared camera .  | The air is made of 78% nitrogen, 21% oxygen and trace amounts of other gases. Which of the four gases will absorb the infrared radiation?  | Many students will already know about CO2 and one or two may already know about methane. You might want to mention water as another very important GHG. This video is from the PI resource. |
| The Earth is Warming(Greenhouse Gases) | The Greenhouse Gas DemoGreenhouse Effect in a Bottle Explained | **🕥🕥🕥** | <https://www.youtube.com/watch?v=kwtt51gvaJQ> (Length - 3:59, suggestion start at 0:30 and end at 2:30)This compares the temperatures inside two clear 2-L bottles. One has a carbon dioxide atmosphere from added Alka Seltzer. They are placed in front of a heat lamp and start with a temperature of 21 C. After an hour the air is 35.1 C and the carbon dioxide enriched air is 44.0 C. <https://www.youtube.com/watch?v=Ge0jhYDcazY> (Length 2:19)This is very similar to the previous video. The image is not as clear but the presenter is more lively. In this video, one bottle has extra CO2 from the reaction of vinegar with baking soda. The bottles go from 23.4 C to 31.2 and 36.1 C.  | Predict what the temperatures of the two bottles will be after an hour. Explain. Observe. Explain | The students don’t have enough information to predict the actual temperatures, however they should predict that the bottle with the CO2 will be warmer because of the absorption seen in the previous demo. Few will predict that the other bottle will warm up as much as it does. This needs explaining.What greenhouse gas is absorbing the infrared light in both bottles? Water vapor.  |
| Feedback Loops | Mousetrap Fission | **🕥🕥🕥** | <https://www.youtube.com/watch?v=vjqIJW_Qr3c> (Length - 2:21) This is a physical demonstration of positive feedback, which is a very important concept in climate change. The number of balls in the air, increases the number of balls getting launched into the air. (Until you run out of balls) You might want to set up a smaller version of this, and then show the video. | What will happen when a ball is dropped? The number of balls released each second will …1. increase steadily until all the traps are triggered.
2. increase steadily and stop before all the traps are triggered.
3. increase and decrease and increase and decrease randomly.
4. increase and then decrease steadily.
 | The concept question format can force the students to consider more detailed responses than if you just ask for a prediction. The first drop showed that it is possible to have the reaction stop when there are still some traps not triggered. However, the rate does not increase steadily. There is a pause when the balls are in the air and there is a fair bit of randomness, especially when there are only a few traps triggered. Answer c) looks like the best of the four choices. |
| The Oceans are Changing(Temperature Affects Density, Convection Currents) | Convection in Hot and Cold Water | **🕥🕥🕥** | <https://www.youtube.com/watch?v=UYlVmgn6iDk> (Length - 0:35) Hot (red) water is put into two jars and cold (blue) water is put into another two. Explain that a red jar will be placed over a blue one and a blue jar will be placed over a red one.  | Predict what will happen in each case. Explain. Observe. | They will probably all predict that hot water will rise and cold water will fall. That’s a good start. Prompt for more. What will each look like? The case with the hot on top will not change and in the other case, the water will mix and become purple. Prompt some more. Why does the cold-water sink? It sinks because it is more dense. Prompt some more. Why is it more dense? Have them draw a picture of water molecules in the two situations to show how the hotter molecules are moving faster and pushing each other farther apart. The water expands when heated. |
| The Oceans are Changing(Temperature Affects Density, Convection Currents) | Convection Current Demonstration  | **🕥🕥🕥** | <https://www.youtube.com/watch?v=Ga1hs2T48Nw> (Length - 2:25) *\* Turn the sound off\** Suggestion: Start at 0:32 and pause at 1:06 There is an aquarium of water. Blue ice is placed on the upper right. Hot red liquid in a flask is placed bottom left.  | This video shows a convection current driven by \_\_\_\_\_\_\_\_ water.1. cold
2. hot
3. hot and cold

Ocean currents are driven by \_\_\_\_\_\_\_\_ water.1. cold
2. hot
3. hot and cold
 | Both the rising hot (red) water and the sinking cold (blue) water drive the current in the demonstration. The situation for the ocean currents is different. The sun mostly heats the water near the surface, so the hot water is already on top. The sinking of cold (and salty) water drives the ocean currents. (Prevailing winds and land formations also affect the currents.) |
| The Oceans are Changing(Salt Affects Density, Convection Currents) | Ocean Science in Your Kitchen 1.Salinity and Density | **🕥🕥** | <https://www.youtube.com/watch?v=-B5PDNmSidY>(Length - 5:15) Changes in salt concentration will make a raw egg float or sink in a cup of water.  | Why does salt change how an egg floats? How can you explain this with sand and marbles? Try to get the egg to float in the middle. How did you do it? | The salt makes the water denser than the egg. The volume of the water and the volume of the salt is less than the volume of salt water because salt can fit into spaces between the water molecules. A jar full of marbles can hold a lot of sand. For the challenge: Give water, cup, egg. and salt to small groups. It is surprisingly easy to do. |
| The Oceans are Changing(Acidity, Indicator, Carbonic Acid, Calcium Carbonate) | Bromothymol Blue Changing Colours with only a breath | **🕥🕥** | <https://www.youtube.com/watch?v=VYw2csIBngY> (Length - 0:24) A container of water has a few drops of bromothymol blue indicator. Someone blows their exhaled breath into the solution using a straw. | What made the solution more acidic? How could you test your answer? | When you blow into the solution using a straw, it goes from blue to green and then to yellow, showing increasing acidity (but lower pH). The CO2 in your breath forms carbonic acid in the solution.You can add standard air to the solution by mechanical means i.e. stirring, pouring the solution back and forth between containers, or using adding air with a pump. Doing this to the yellow solution will turn it blue again, but it won’t change the blue solution.This is from the Perimeter Institute’s resource.  |
| The Oceans are Changing(Effect of Acidity on Sea Life) | Egg in Vinegar Experiment | **🕥** | <https://www.youtube.com/watch?v=khgOTDvG-4A> (Length - 1:44) Placing an egg in a cup of vinegar and watching the reaction.  | What is in the ocean that is similar to eggshells and will be affected by increasing acidity? | Have small groups take their egg from the salt activity above and put it in vinegar. They will immediately see bubbles. After fifteen minutes, they can feel that the shell is changing. After 24 hours, the shell will be gone and it will be held together just by its membrane and will bounce. You can also put chalk in the vinegar and it dissolves even faster. They are both made of calcium carbonate and so are seashells and corals. Carbonic acid dissolves calcium carbonate. In addition to coral and seashells, the acid affects the shells of tiny creatures that form the base of many ecosystems. |
| The Sea Level is Rising(sea level rise, thermal, expansion of water)  | Thermal Expansion of Water | **🕥🕥** | <https://www.youtube.com/watch?v=IHhvaUdWfDI> (Length - 2:49) Coloured water in a bottle with a clear straw sealed into a hole in the lid is placed near a heat lamp. This can be combined with the next demos. | The sea level is rising. What is causing this? 1. melting glaciers
2. melting icebergs
3. melting ice sheets
4. warming water

 | The demonstration shows that ice that is in the water and melts - like icebergs - does not cause the water level to rise. The water of the melted ice is more dense than when frozen, so the part that used to be sticking out is now squashed into the space that the submerged ice occupied. The demonstrations show that the rise could be due to melting land ice (glaciers, ice sheets) and/or warming water. These demos are from the resource from the Perimeter Institute.  |
| The Sea Level is Rising(sea level rise, melting of ice) | Sea Level Rise Part II  | **🕥🕥** | <https://www.youtube.com/watch?v=2slKkJbBriI> (Length - 3:27) Ice is placed on top of rocks or around rocks in water and then warmed. These demos can be sped up by being heated by a hot water bath or microwave oven. |