Sci10 Climate Project Jan 2014

**SCI 10 Climate Project NAME:**

**1. Radiation Budget and Greenhouse Effect**

Use the interactive link below and answer the following questions:

<http://www.teachersdomain.org/assets/wgbh/ipy07/ipy07_int_albedo/ipy07_int_albedo.html> or

<http://d43fweuh3sg51.cloudfront.net/media/assets/wgbh/ipy07/ipy07_int_albedo/ipy07_int_albedo.html>

1. What is the source of all energy on Earth?

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1. What is albedo?

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1. What is the “ice-albedo feedback” discussed in the lesson?

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1. What is soot’s effect on ice melt?

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1. What is ice melt’s effect on land and sea and overall albedo?

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**2. Energy transfer.** What is **conduction, convection and radiation**?

Watch the following animation: <http://www.teachersdomain.org/asset/lsps07_int_heattransfer/> or

<http://www.pbslearningmedia.org/asset/lsps07_int_heattransfer/>

Define and give 1 example of:

**a) conduction –**

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**b) convection –**

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**c) radiation –**

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**3. Spheres of the Earth.** Watch this short video: <http://www.youtube.com/watch?v=5FooHD0atuc>

a) Define the following:

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**i) hydrosphere -**

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**ii) atmosphere -**

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**iii) lithosphere -**

b) Use this website: <http://cwanamaker.hubpages.com/hub/The-Interconnected-Spheres-of-the-Earth>

to explain how energy is transferred from one “sphere” to another “sphere”. Give one example.

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**4. Glaciers and Heat Transfer.** Use this video to discuss glaciers. <http://www.teachersdomain.org/asset/ess05_vid_esglaciers/> or <http://www.pbslearningmedia.org/asset/ess05_vid_esglaciers/>

a) What are glaciers’ “inputs”? What do they do to a glacier’s mass?

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b) What are glaciers’ “outputs”? What do they do to a glacier’s mass?

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c) Name 6 things that affect the input vs output balance of a glacier.

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d) What are most glaciers’ most sensitive to?

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 e) What do scientists believe this is caused by?

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f) What is most likely leading to global warming?

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g) What is happening to most glaciers around the world? Why is this a concern? (ie – what is the function of ice and why do we care if it starts to disappear? – Give 2 reasons!)

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**5. The Earth’s Radiation Budget**

a) According to the above diagram, the sun’s energy is both reflected and absorbed. What sorts of things are involved in the reflection of the sun’s rays?

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b) What is the difference between “reflection” and “radiation”? Explain. <http://missionscience.nasa.gov/ems/13_radiationbudget.html>

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c) What would affect the amount of energy absorbed by the land? Discuss.

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 **LAB BREAK: ALBEDO EFFECT**

Design a lab that would test the albedo effect of various surfaces.

Materials available: thermometers, various surfaces (outside or inside), sun or incandescent light (season dependent)

Provide a full lab write-up: Title, Hypothesis, Variables, Materials, Procedure, Observations, Data Analysis, Conclusion, Experimental Error.

**Title:
Hypothesis:
Variables** – Independent (manipulated):

 Dependent (responding):

 Controlled (list 3) :
**Materials:**

**Procedure:** (provide a step-by-step instruction)

**Observations:**

**Data Analysis:** (table of data with graph for analysis)

**Conclusion:**

**Experimental Error:**

6. **Seasons and the Earth’s Tilt**

a) Try this activity to understand how the earth’s tilt affects the seasons:
 <http://www.teachersdomain.org/asset/ess05_int_seasonsgame/> or [http://pbs.panda-
 prod.cdn.s3.amazonaws.com/media/assets/wgbh/ess05/ess05\_int\_seasonsgame/index.html](http://pbs.panda-prod.cdn.s3.amazonaws.com/media/assets/wgbh/ess05/ess05_int_seasonsgame/index.html)

b) <http://www.suntrek.org/earth-beyond/spinning-orbiting-earth/what-causes-seasons/watch-tilt.shtml>

 (animation showing the Earth’s tilt affecting seasons).

c) If you are still unsure as to how the seasons work, this short video may help:

 <http://www.youtube.com/watch?v=NydSuHoQZqk>

a) Does the angle of the tilt of the Earth’s axis change? How does the Earth’s tilt affect the seasons? How does how high or low the sun is in the sky affect our seasons?

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b) Explain why the Arctic circle is described as the “land of the midnight sun” throughout the summer.

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c) How many seasons do places along the equator experience? Why is that?

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d) What are the 3 places and respective times of year that Max travels to?

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**7. The Gulf Stream.** Watch the next 2 short videos and answer the questions.

<http://www.teachersdomain.org/asset/ess05_vid_gulfstream/> or [www.pbslearningmedia.org/asset/ess05\_vid\_gulfstream/](http://www.pbslearningmedia.org/asset/ess05_vid_gulfstream/)

<http://www.teachersdomain.org/asset/ttv10_vid_currents/> or [www.pbslearningmedia.org/asset/ttv10\_vid\_currents/](http://www.pbslearningmedia.org/asset/ttv10_vid_currents/)

a) What is the “gulf stream” and how is it formed?

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b) How do oceans affect the earth’s climate?

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c) The oceans , , and heat.

d) What do ocean surface currents have to do with climate? Give an example of this concept.

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e) What are “trade winds”?

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**8. The Coriolis Effect.** Watch the videos to learn about this concept.

<http://www.youtube.com/watch?v=mcPs_OdQOYU>

<http://www.youtube.com/watch?v=rdGtcZSFRLk>

a) Write down what the coriolis effect means in your own words.

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| Coriolis Effect: |

Now watch these clips: <http://www.classzone.com/books/earth_science/terc/content/visualizations/es1904/es1904page01.cfm>

<http://www.youtube.com/watch?v=i2mec3vgeaI>

b) How does the Coriolis effect affect wind patterns and overall climate?

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c) Does the rotation of the Earth affect toilet bowl flushes and baseball games? Answer this question using the article: <http://science.howstuffworks.com/science-vs-myth/everyday-myths/rotation-earth-toilet-baseball.htm>

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**9. The Greenhouse Effect**

Use the following resources to answer the questions below.

<http://www.teachersdomain.org/resource/ess05.sci.ess.watcyc.maunaloadata/> or <http://www.pbslearningmedia.org/resource/ess05.sci.ess.watcyc.maunaloadata/cosub2sub-concentrations-at-mauna-loa-observatory-hawai699i/>

(data illustrating CO2 (g) levels in Hawaii from 1958 – 2005)

<http://www.teachersdomain.org/asset/phy03_vid_co2/> or <http://www.pbslearningmedia.org/asset/phy03_vid_co2/>

(video on CO2 (g) and the greenhouse effect)

<http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/>

(animation explaining how greenhouse gases work)

a) What are the 3 types of incoming radiation from the Sun?

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b) Why does some of the incoming energy get trapped?

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c) What main gases contribute towards the greenhouse effect?

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Try this simulation: <http://phet.colorado.edu/en/simulation/greenhouse>

How do greenhouse gases affect the climate?

Explore the atmosphere during the ice age and today.

What happens when you add clouds?

Change the greenhouse gas concentration and see how the temperature changes. Then compare to the effect of glass panes. Zoom in and see how light interacts with molecules.

Do all atmospheric gases contribute to the greenhouse effect? ­­­­­­­­­­­­

**10. Specific Heat Capacity**

Watch the video: <http://www.teachersdomain.org/asset/ean08_int_seasurface/> or <http://www.pbslearningmedia.org/asset/ean08_int_seasurface/>

Look at the temperature anomalies. What is happening to the sea surface temperature?

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Watch the video on Specific Heat Capacity: <http://www.youtube.com/watch?v=hyPLusD-tyM>

Why do the scientists at NASA care about the Specific Heat Capacity of the oceans?

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Specific heat capacity can be studied by analyzing the amount of heat put into a substance, the temperature gained or lost and the mass of the substance.

The formula for SHC is: Q = mc∆T where: Q = amount of heat in Joules (J)

 m = mass of the substance (g)

 ∆T = change in temperature (ºC)

Some specific heat capacities of substances:

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| **SUBSTANCE** | **SPECIFIC HEAT CAPACITY (J/gºC)** |
| pure water | 4.19 |
| steam | 2.02 |
| ice | 2.00 |
| sea water | 3.89 |
| dry air | 1.00 |
| moist air | 1.15 |

**Example problem:**

A house contains 170 kg of dry air. The furnace has broken, and the temperature of the air has fallen to 2.0 ºC. How much energy is needed to heat the air to 20 ºC?

**Given:** m = 170 x 1000 g = 170 000 g (or 1.7 x 105g) Q = mc∆T

 SHC (dry air) = 1.00 J/gºC = (1.7 x 105g) x 1.00J/gºC x 18 ºC)

 ∆T = 20 ºC – 2 ºC = 18 ºC = 3.06 x 106 J

**Specific Heat Capacity Problems:**

1. How much energy is released when 35 g of water cools from 25ºC to 10ºC?

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2. How much heat is absorbed by 1000 kg of seawater in a large hole on the beach as the

 seawater’s temperature rises from 20ºC to 25ºC?

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3. What mass of water could have its temperature raised 35ºC by absorbing 100 kJ of energy?

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4. If 2.09 x 103 J of energy raised the temperature of moist air from 23ºC to 37ºC, what was the

 mass of the air?

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5. Assume that the tissues of the human body have an average specific heat capacity of 3.50 J/gºC.

 A 55 kg person goes for an 30 min run and generates 6.50 x 105 J of thermal energy. If the body

 had no mechanisms for removing the thermal energy, what would be the temperature increase

 of the person’s body? (this is why sweating is so important!)

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6. What is the specific heat capacity of a substance if it requires 2334 J of energy to change the

 temperature of 40 g of the substance by 15ºC?

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7. If 300 g of a substance releases 3.8 kJ of energy while cooling 15 ºC, what is its specific heat

 capacity?

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**11. The Heat of Fusion and Heat of Vapourization of Water**

Watch the following video: <http://www.teachersdomain.org/asset/rr11_vid_heatfus/> or <http://www.pbslearningmedia.org/asset/rr11_vid_heatfus/>

What is the heat of fusion?

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* The amount of energy required to melt one mole of a substance is called the **Heat of fusion (Hfus)** of a substance.
* The amount of energy required to convert one mole of a substance from a liquid to a gas is called the **Heat of vapourization (Hvap)** of a substance.

Energy required for melting – Q = *n*Hfus

Energy required to convert liquid to gas - Q = *n*Hvap

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| **Q = amount of energy in kilojoules (kJ)*****n* = the number of moles (no units)****Hfus = the heat of fusion in kilojoules per mole (kJ/mol)****Hvap = the heat of vapourization in kilojoules per mole (kJ/mol)** |

Heats of Fusion and Vapourization of Some Common Substances

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| **SUBSTANCE** | **HEAT OF FUSION****Hfus (kJ/mol)** | **HEAT OF VAPOURIZATION****Hvap (kJ/mol)** |
| water | 6.01 | 40.65 |
| ammonia | 5.66 | 23.33 |
| methanol | 3.22 | 35.21 |
| nitrogen | 0.71 | 5.57 |
| oxygen | 0.44 | 6.82 |

\*Remember: when you are trying to solve Heat of fusion questions, if you are given mass and need to find the number of moles – you will need to use ratios to find the **n** (number of moles).

Example: If you are given 45g of H2O – how many moles is that?

1 mol of H2O = 18.02 g

x mol of H2O = 45 g

x = 2.5 mol of H2O

**Solve the following Heat of fusion/vapourization problems:**

1. How much thermal energy is required to melt 4.525 mol of ice at 0 ºC to liquid water at 0ºC?

 (Hint: the units in the question are moles. You do not have to convert units). You will need the

 Heat of Fusion of water information from the chart above.

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2. How much energy is required to boil 48.8 mol of liquid water at 100ºC to steam (water vapour)

 at 100 ºC?

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3. How much energy (Q) is released when 42.3 mol of nitrogen gas condenses into liquid nitrogen

 without any changes in temperature?

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4. How much energy is required to convert 48.8 mol of liquid methanol into a gas at the same temp?

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5. How much heat is lost when 63.07 g of steam at 100 ºC condenses and forms liquid water

 at 100 ºC? (Hint: you must convert g to mol)

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6. How much heat is released when 2.0 kg of water at 0 ºC freezes and forms ice at 0 ºC?

 (Hint: Notice that the units of water are kg not g)

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7. If 187 kJ of heat caused a chunk of ice at 0 ºC to melt to liquid water at 0 ºC, how many moles

 were in the ice? How many grams of ice were in the chunk?

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8. How much energy is required to melt 18 ice cubes in a tray at 0 ºC to liquid water at 0 ºC?

 Assume that the ice cubes are identical and each has a mass of 29 g.

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 **Phase Change in Water Graph –** When water changes state from solid to liquid or liquid to gas, there is very little if any change in temperature during the phase change. The energy absorbed by the water molecules goes directly into breaking the hydrogen bonds and allowing them to change state – therefore there is no change in temperature.

Click through the following animation to help you understand this process:<http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks3/science/changing_matter/index.htm>

What does the graph look like during a phase change?

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**12. Climatographs**

A **climatograph** is a graphical representation of climate data for a specific region and time period.

The climate data includes: average monthly temperature (line graph) and total monthly precipitation (bar graph). Months of the year are recorded on the x-axis. Precipitation (mm) is recorded on the

left y-axis and temperature (ºC) is recorded on the right y-axis.

How to make a climatograph - <http://www.youtube.com/watch?v=t8vAe4HcbAA>

On google images, find the climatographs of 3 cities that you would love to visit, and fill in the following table with the range of values you find for precipitation and temperature and best months to visit!

**1. NAME OF THE CITY:**

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| PRECIPITATION DESCRIPTION | TEMPERATURE DESCRIPTION |
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**2. NAME OF THE CITY:**

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**3. NAME OF THE CITY:**

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| PRECIPITATION DESCRIPTION | TEMPERATURE DESCRIPTION |
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**13. Biomes of the World**

A **biome** is a major geographic region with similar environmental conditions and life forms. Some examples of terrestrial (land) biomes are: (from least biologically diverse to most diverse)

**tundra**

**desert**

**grassland**

**taiga (boreal)**

**temperate deciduous**

**temperate rainforest**

**tropical rainforest**

Use the following links to study the various biomes of the world: <http://www.teachersdomain.org/asset/ess05_int_biomemap/> or <http://www.pbslearningmedia.org/asset/ess05_int_biomemap/> and

<http://highered.mcgraw-hill.com/sites/9834092339/student_view0/chapter58/animation_-_biomes.html>

Tundra: <http://www.teachersdomain.org/asset/tdc02_vid_arctic/> or <http://www.pbslearningmedia.org/asset/tdc02_vid_arctic/>

Desert: <http://www.teachersdomain.org/asset/tdc02_vid_desert/> or <http://www.pbslearningmedia.org/asset/tdc02_vid_desert/>

Tropical rainforest: <http://www.teachersdomain.org/asset/tdc02_vid_rainforest/> or <http://www.pbslearningmedia.org/asset/tdc02_vid_rainforest/>

**PROJECT BREAK**

Choose **1** of the biomes mentioned above and describe the following:

* find a climatograph (or make one) to describe temp and precipitation
* description of the biome
* locations in the world (examples)
* animal and plant adaptations (<http://www.teachersdomain.org/resource/tdc02.sci.life.oate.lp_environment/>) or <http://www.pbslearningmedia.org/resource/tdc02.sci.life.oate.lp_environment/where-creatures-live/>
* human impact on that biome (<http://www.youtube.com/watch?v=HLemFucgDfc>
* pictures of animals and plant adaptations

**14. Paleoclimatology** – the study of past climates

Use the link: <http://www.teachersdomain.org/assets/thinktv/ttv10/ttv10_int_clues/index.html> or <http://d43fweuh3sg51.cloudfront.net/media/assets/thinktv/ttv10/ttv10_int_clues/tree-rings.html>

to learn about the science of paleoclimatology.

Choose **3** areas and describe how each gives scientists information about past climates.

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**15. Arctic Ecosystem**

The arctic and antarctic ecosystem has proven to be very sensitive to climate (particularly temperature) changes. Use the links below to learn more about the current situation of the arctic ecosystem.

<http://www.teachersdomain.org/asset/ipy07_int_antarcticecosys/> or <http://www.pbslearningmedia.org/asset/ipy07_int_antarcticecosys/> (arctic ecosystem info)

<http://www.teachersdomain.org/asset/lsps07_int_oceanfoodweb/> or <http://www.pbslearningmedia.org/asset/lsps07_int_oceanfoodweb/> (antarctic food web game)

<http://www.teachersdomain.org/asset/ipy07_vid_arcticland/> or <http://www.pbslearningmedia.org/asset/ipy07_vid_arcticland/> (video – changing arctic landscape)

<http://www.teachersdomain.org/asset/ess05_vid_esglaciers/> or <http://www.pbslearningmedia.org/asset/ess05_vid_esglaciers/> (ice and climate change)

<http://www.teachersdomain.org/asset/ipy07_vid_inuitobserv/> or <http://www.pbslearningmedia.org/asset/ipy07_vid_inuitobserv/> (video – Inuit observations of climate change)

<http://www.teachersdomain.org/asset/ess05_int_icemelt/> or <http://www.pbslearningmedia.org/asset/ess05_int_icemelt/> (simulation – what if the ice melts?)

Write a few paragraphs outlining the information that you have gathered from the links. What is happening to the arctic ecosystem and what evidence is there of this?

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**16. Humans and Climate Change**

The Global Impact of Climate Change on Humans <http://www.youtube.com/watch?v=lnVGzlXmgko>

Use the IPCC (International Panel on Climate Change) website: <http://www.ipcc.ch/> to find out about the human health concerns for North America (use latest data – 2007).

(Hint: go to “Publications and Data first – then go to Working Group II Report
"Impacts, Adaptation and Vulnerability" – then #8 “Human Health” – then 8.7 “Future Vulnerability to Climate Change”

What could potentially happen to human health with an increasing global climate change?

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Does the data from this website show that climate change is occurring?

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Use the following information: <http://www.climate.org/topics/sea-level/index.html>

to describe 4 areas affecting the planet due to climate change.

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**17. So….. what can we do about it?**

Use the following websites and come up with 20 **“green”** solutions to the problem of climate change.

<http://www.greensolutionsmag.com/>

<http://www.envirogadget.com/>

<http://www.davidsuzuki.org/what-you-can-do/>

Check your smartphone – there is an app “Green Tip a Day” that you can download for free!

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THAT’S IT – YOU’RE DONE!! MAKE SURE YOU’VE ANSWERED ALL OF THE SECTIONS.