# *Literature Review* - Secondary Students' Concepts of Climate Change

| | Categories | Students' Concepts |
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| **Basic notions** | The kind of radiation involved in greenhouse effect | • Sunrays in general (Koulaidis & Christidou, 1999).<br>• UV radiation bounced off the earth surface (Koulaidis & Christidou, 1999)<br>• Heat or thermal rays emitted from the sun (Koulaidis & Christidou, 1999)<br>• Increase of the incoming UV or general solar radiation by the ozone layer depletion (Boyes & Stanisstreet, 1997; Koulaidis & Christidou, 1999). |
| | Distinction of the kinds of radiation and their properties | • Sunrays in general were indicated to be involved in global warming (Koulaidis & Christidou, 1999)<br>• UV is strong, so very hot radiation coming from the sun (Boyes & Stanisstreet, 1997; Koulaidis & Christidou, 1999)<br>• No distinction among UV rays, heat rays and high atmospheric temperature (Boyes & Stanisstreet, 1997 & 1998; Fisher, 1998; Österlind, 2005) |
| | The kinds of greenhouse gases | • Considering greenhouse gases as air pollutants (Koulaidis & Christidou, 1999; Boyes & Stanisstrret, 1997)<br>• Not considering "ground-level ozone" or "gas from fertilizer" as a greenhouse gas (Boyes et al., 1993; Boyes & Stanisstreet, 1993).<br>• Not considering $CO_2$ as a greenhouse gas (Boyes et al., 1993; Boyes & Stanisstreet, 1993 & 1997; Pruneau et al., 2001)<br>• Not considering water vapor as a greenhouse gas (Fisher, 1998) |

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| | • A layer of greenhouse gases, ozone gases or dust trapping heat. | • Greenhouse gases forms a thin around the earth and trap heat inside (Andersson & Wallin, 2000; Koulaidis & Christidou, 1999; Pruneau et al., 2003).<br>• Greenhouse effect is that solar rays are trapped by the ozone layer (Boyes & Stanisstrret, 1997; Koulaidis & Christidou, 1999; Pruneau et al., 2003).<br>• Heat is trapped under a layer of dust created by pollution (Pruneau et al., 2001)<br>• The atmospheric gases make a barrier bouncing back heat from the earth (Andersson & Wallin, 2000) |
| | • The definition of greenhouse effect | • Do not know (Pruneau et al., 2001; Andersson & Wallin, 2000)<br>• Confusion between greenhouse effect and global warming (Andersson & Wallin, 2000)<br>• Considering greenhouse effect as an environmental problem (Koulaidis & Christidou, 1999) |
| | • Confusion between climate and weather | • Able to sense climate change (Pruneau et al., 2003; Gowda et al., 1997) |
| **Causes** | • Environmentally harmful action in general | • Littering (Boyes & Stanisstreet, 1993; Gowda et al., 1997)<br>• Using environmentally unfavorable products (Gowda et al., 1997) |
| | • Pollution | • Acid rain (Boyes & Stanisstreet, 1993; Boyes et al., 1993; Pruneau et al., 2001)<br>• Nuclear waste (Boyes & Stanisstreet, 1993; Boyes et al., 1993)<br>• Air pollution or pollutants in general (Andersson & Wallin, 2000; Boyes & Stanisstrret, 1997; Gowda et al., 1997 Koulaidis & Christidou, 1999)<br>• Pollution in general (Gowda et al., 1997; Fisher, 1998; Pruneau et al., 2001 & 2003) |
| | • Ozone hole | • The ozone layer depletion in general (Boyes & Stanisstreet, 1993 & 1998; Boyes et al., 1993; Fisher, 1998, Gowda et al., 1997; Pruneau et al., 2001) |

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| | | al., 1999; Boyes & Stanisstrret, 1994 & 1997 ; Rye et al., 1997).<br>• Ozone hole lets cooler air escape out of the Earth, increasing global average temperature (Boyes & Stanisstrret, 1997). |
| | • Change in solar irradiation | • Increase of solar energy coming into the Earth (Boyes & Stanisstreet, 1993; Boyes et al., 1993; Pruneau et al., 2003)<br>• The Earth gets closer to the sun (Pruneau et al., 2003)<br>• Solar rays hits more areas of the Earth. (Pruneau et al., 2003) |
| **Impacts** | • No change in my life | • Nothing would happen in my life time (Pruneau et al., 2001 & 2003) |
| | • Over estimates of the degree of global warming | • Over estimates of the degree of global warming (e.g., about 7°F increase to date &18.4°F in the 50 years) (Andersson & Wallin, 2000; Gowda et al., 1997) |
| | • Skin cancer | • Global warming causes skin cancer (Pruneau et al., 2003; Boyes & Stanisstreet, 1993 & 1998; Boyes et al., 1993) |
| | • Not understanding the variety of climate change | • The expected climate change is limited to warming in general (Boyes & Stanisstreet, 1998; Gowda et al., 1997; Pruneau et al., 2001) |
| | • Depletion of ozone layer | • The greenhouse gases cause ozone layer to deplete (Boyes & Stanisstreet, 1994; Rye et al., 1997; Boyes et al., 1999)<br>• The greenhouse effect causes air pollutants to go up higher and deplete the ozone layer (Boyes & Stanisstrret, 1997) |
| | • General air pollution | • As greenhouse gases are air pollutants, increased greenhouse gases will cause air pollution (Koulaidis & Christidou, 1999) |

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| **Resolutions** | • Proenvironmental action in general | • Indicating specific pro-environmental actions, not closely related to global warming (e.g., Protection of rare species; Reduction of the global nuclear arsenal; Keeping beaches clean, The use of unleaded petrol) (Boyes & Stanisstreet, 1993; Boyes et al., 1993)<br>• Pro-environmental action in general (e.g., pollute less; put waste in the trashcan; clean the streets) (Pruneau et al., 2003) |
| | • Unawareness of the difficulties of $CO_2$ control | • Showing radically positive attitude to the limitation of $CO_2$ emission, implying the unawareness of dependence of modern life on fossil fuel and the huge societal consequences of $CO_2$ control (Andersson & Wallin, 2000) |
| | • Negative attitude toward taking action regarding global warming | • There is nothing people can do (Pruneau et al., 2001)<br>• People would not willing to change their lifestyle (Pruneau et al., 2001) |

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