EARTHLABS: CRYOSPHERE STANDARDS MATCHING

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| **Labs** | **Content TEKS**  |
| **Lab 1: Frozen in Time** (<http://serc.carleton.edu/earthlabs/cryosphere/1.html>) teachesabout the components of the cryosphere, annual changes in land and sea ice coverage, and ways that changes in the cryosphere are impacting human life. | ESS: 11D; 13AEnvir. Sys. 6A.  |
| **Lab 2: Sea Ice Thermodynamics** (<http://serc.carleton.edu/earthlabs/cryosphere/2.html>). Students explore properties of liquid and frozen salt water and how sea ice formation influences ocean currents. | ESS: 11D; 13A, BEnvir. Sys. 6A, C, D, E.  |
| **Lab 3: Sea Ice Dynamics** (<http://serc.carleton.edu/earthlabs/cryosphere/3.html>). Students explore forces that influence sea ice dynamics, as well as changes in the distribution and composition of sea ice change over time. Developed by TERC for EarthLabs.  | ESS: 11D; 13A, 15AEnvir. Sys. 6A, C, D, E.; 8B; 9D  |
| **Lab 4: Land Ice Thermodynamics** (<http://serc.carleton.edu/earthlabs/cryosphere/4.html>). Students learn about land ice and the processes and timescales involved in glaciation. In Part B, they use an online interactive to explore how glaciers provide scientists with evidence for climate change. | ESS: 11A, D; 13AEnvir. Sys. 6A, C,D, E; 8B; 9D  |
| **Lab 5: Glacier Dynamics** (<http://serc.carleton.edu/earthlabs/cryosphere/5.html>).Students learn about how & why glaciers move and make a model of a glacier. | ESS: 11A, D; 13 AEnvir. Sys. 8B; 9D  |
| **Lab 6: Interactions and Feedback** (<http://serc.carleton.edu/earthlabs/cryosphere/6.html>). Students explore the ice-albedo feedback effect and learn how the reflectivity of ice helps regulate the planet's temperature. | ESS: 11D; 13D ; 14 A, B, C. Envir. Sys: 6C,D, E; 8B, C; 9D 9E |
| **Lab 7: Climate History and the Cryosphere** (<http://serc.carleton.edu/earthlabs/cryosphere/7.html>). Students learn how scientists use ice cores to glean information about past climate and atmospheric events, and interpret ice core data to look for connections among the cryosphere, temperature, and atmospheric conditions. | ESS: 13A, C; 15BEnvir. Sys. 9D |
| **Lab 8: Future of the Cryosphere** (<http://serc.carleton.edu/earthlabs/cryosphere/8.html>). Students contemplate what the future might hold for climate and the cryosphere. | ESS: 11D; 13A, C, D; 15BEnvir. Sys.: 9D, E, H, L |

Content TEKS

§112.36. Earth and Space Science (ESS)

112.36 (11) Solid Earth. The student knows that the geosphere continuously changes over a range of time scales involving dynamic and complex interactions among Earth's subsystems. The student is expected to:

(A)  compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface;

(D)  interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies; and

112.36 (13) Fluid Earth. The student knows that the fluid Earth is composed of the hydrosphere, cryosphere, and atmosphere subsystems that interact on various time scales with the biosphere and geosphere. The student is expected to:

(A)  quantify the components and fluxes within the hydrosphere such as changes in polar ice caps and glaciers, salt water incursions, and groundwater levels in response to precipitation events or excessive pumping;

(C)  analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years;

(D)  discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;

112.36 (14) Fluid Earth. The student knows that Earth's global ocean stores solar energy and is a major driving force for weather and climate through complex atmospheric interactions. The student is expected to:

(A)  analyze the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface albedo, Earth's tilt, duration of insolation, and differences in atmospheric and surface absorption of energy;

(B)  investigate how the atmosphere is heated from Earth's surface due to absorption of solar energy, which is re-radiated as thermal energy and trapped by selective absorbers; and

(C)  explain how thermal energy transfer between the ocean and atmosphere drives surface currents, thermohaline currents, and evaporation that influence climate.

112.36 (15) Fluid Earth. The student knows that interactions among Earth's five subsystems influence climate and resource availability, which affect Earth's habitability. The student is expected to:

 (B) investigate evidence such as ice cores, glacial striations, and fossils for climate variability and its use in developing computer models to explain present and predict future climates;

§112.37. Environmental Systems (Envir. Sys.)

112.37 (6) Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:

(A) define and identify the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere and the interactions among them;

 (C) explain the flow of energy in an ecosystem, including conduction, convection, and radiation;

(D) investigate and explain the effects of energy transformations in terms of the laws of thermodynamics within an ecosystem; and

(E) investigate and identify energy interactions in an ecosystem.

112.37 (8) Science concepts. The student knows that environments change naturally. The student is expected to:

 (B) explain how regional changes in the environment may have a global effect;

 112.37 (9) Science concepts. The student knows the impact of human activities on the environment. The student is expected to:

 (D) describe the effect of pollution on global warming, glacial and ice cap melting, greenhouse effect, ozone layer, and aquatic viability;

(E) evaluate the effect of human activities, including habitat restoration projects, species preservation efforts, nature conservancy groups, hunting, fishing, ecotourism, all terrain vehicles, and small personal watercraft, on the environment;

 (H) analyze and evaluate different views on the existence of global warming;

(L) analyze past and present international treaties and protocols such as the environmental Antarctic Treaty System, Montreal Protocol, and Kyoto Protocol.