Gap and Thin Spot Analysis

Climate Literacy and Energy Awareness Network (CLEAN, cleanet.org)

This gap and thin spot analysis of educational resources in the CLEAN collection (cleanet.org) is based on key terms and topical vocabularies that outline the breadth of climate science and energy awareness. The list of topics was developed, tested and refined by CLEAN team members in collaboration with the NOAA climate office.

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Total number of educational resources in the CLEAN collection addressing the listed topics listed in **bold**. *In parenthesis the number of resources at different grade levels (middle school, high school, college level).*

Topic level	Subtopic level	Subsubtopic level	Total	Activity	Short Demo	Visualization	Video
Climate System			202 (140, 174, 88)	88 (47, 64, 33)	4 (4, 3, 0)	49 (39, 49, 26)	59 (50, 57, 28)
	Global Energy Balance		22 (11, 17, 8)	16 (6, 11, 6)	0	2 (2, 2, 0)	4 (3, 4, 2)
	Orbital Cycles		22 (15, 18, 8)	12 (6, 8, 3)	0	7 (7, 7, 4)	3 (2, 3, 1)
		Long-term Cycles	4 (2, 3, 4)	1 (0, 0, 1)	0	2 (2, 2, 2)	1 (0, 1, 1)
		Seasons	16 911, 13, 4)	11 (6, 8, 2)	0	4 (4, 4, 2)	1 (1, 1, 0)
	Solar Radiation		31 (18, 25, 7)	21 (10, 15, 5)	0	5 (5, 5, 0)	5 (3, 5, 2)
	Atmospheric Composition		29 (17, 24, 14)	19 (8, 15, 10)	0	4 (3, 4, 2)	6 (6, 5, 2)

Topic level	Subtopic level	Subsubtopic level	Total	Activity	Short Demo	Visualization	Video
		Greenhouse Gases	21 (11, 17, 10)	13 (4, 10, 7)	0	4 (3, 4, 2)	4 (4, 3, 1)
		Aerosols	9 (7, 9, 5)	4 (2, 4, 3)	0	2 (2, 2, 1)	3 (3, 3, 1)
		Evolution of Atmosphere	0	0	0	0	0
	Greenhouse Effect		27 (18, 24, 11)	10 (2, 8, 4)	0	8 (8, 8, 3)	9 (8, 8, 4)
	Atmospheric Circulation		6 (2, 5, 2)	6 (2, 5, 2)	0	0	0
		Hadley Cells	0	0	0	0	0
		Coreolis Effect	1 (1,1,0)	1 (1,1,0)	0	0	0
	Ocean and Climate		48 (34, 43, 18)	23 (13, 19, 8)	3 (3, 2, 0)	4 (4, 4, 1)	17 (14, 17, 8)
		Heat Capacity of Water	5 (2, 4, 2)	5 (2, 4, 2)	0	0	0
		Thermohaline Circulation	14 (7, 13, 7)	6 (1, 5, 2)	0	2 (2, 2, 1)	5 (4, 5, 3)
		Thermal Expansion	4 (3, 2, 0)	1 (1, 0, 0)	1 (1, 0, 0)	1 (1, 1, 0)	1 (0, 1, 0)
	Climate Feedbacks		54 (36, 49, 27)	25 (10, 20, 11)	0	11 (10, 11, 6)	18 (16, 18, 10)
		Albedo	24 (17, 21, 11)	12 (5, 9, 5)	0	4 (4, 4, 2)	8 (8, 8, 4)
		Deforestation	4 (3, 4, 4)	1 (0, 1, 1)	0	2 (2, 2, 2)	1 (1, 1, 1)

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	Water Cycle		8 (5, 8, 1)	4 (2, 4, 0)	0	1 (1, 1, 0)	3 (2, 3, 1)
	Carbon Cycle		56 (36, 50, 28)	18 (8, 13, 9)	3 (3, 3, 0)	19 (12, 19, 10)	16 (13, 15, 9)
		Biogeochemical Processes	19 (14, 19, 9)	3 (2, 3, 2)	1 (1, 1, 0)	10 (8, 10, 4)	5 (3, 5, 3)
		Sources and Sinks	22 (16, 21, 9)	4 (1, 3, 2)	2 (2, 2, 0)	13 (10, 13, 5)	3 (3, 3, 1)
	Regional Climates		24 (14, 19, 10)	19 (11, 14, 7)	0	3 (1, 3, 3)	2 (2, 2, 0)
	Climate Compared to Weather		11 (11, 9, 3)	5 (5, 3, 0)	0	0	6 (6, 6, 3)

Topic level	Subtopic level	Subsubtopic level	Total	Activity	Short Demo	Visualization	Video
Causes of Climate Change			115 (90, 105, 61)	43 (23, 35, 19)	0	33 (30, 33, 25)	39 (37, 37, 17)
	Cyclical and Natural Changes		54 (40, 49, 34)	25 (12, 21, 12)	0	16 (16, 16, 15)	13 (12, 12, 7)
		El Nino, La Nina, ENSO	8 (6, 8, 5)	5 (3, 5, 3)	0	2 (2, 2, 2)	1 (1, 1, 0)
		Other Oscillations	1 (1, 1, 0)	1 (1, 1, 0)	0	0	0
		Volcanic Eruptions	4 (4, 2, 1)	2 (2, 1, 0)	0	1 (1, 1, 1)	1 (1, 0, 0)
		Solar Output Variability	2 (2, 0, 0)	1 (1, 0, 0)	0	0	1 (1, 0, 0)

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		Seasonal Variability	14 (9, 12, 6)	10 (5, 8, 3)	0	3 (3, 3, 2)	1 (1, 1, 1)
		Long-term Variability (Such as Milankovitch cycles, Snowball Earth)	3 (2, 3, 2)	1 (1, 1, 0)	0	1 (1, 1, 1)	1 (0, 1, 1)
	Anthropogenic Changes		72 (61, 66, 38)	19 (11, 15, 8)	0	23 (21, 23, 18)	30 (29, 28, 12)
		Greenhouse Gas Emissions	29 (20, 24, 17)	13 (6, 10, 7)	0	5 (3, 5, 5)	11 (11, 9, 5)
		Land Use Changes	8 (7, 7, 2)	3 (3, 2, 0)	0	2 (1, 2, 1)	3 (3, 3, 1)

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Measuring and Modeling Climate			220 (163, 200, 134)	73 (39, 55, 37)	1 (1, 1, 0)	56 (44, 56, 46)	90 (79, 88, 51)
	Climate Data		186 (144, 170, 110)	62 (37, 48, 29)	1 (1, 1, 0)	40 (33, 40, 35)	83 (73, 81, 46)
		Measurements and Observations	144 (115, 132, 84)	40 (21, 30, 18)	1 (1, 1, 0)	29 (26, 29, 26)	74 (67, 72, 40)
		Proxy Data	31 (23, 29, 20)	13 (7, 11, 8)	0	4 (4, 4, 3)	14 (12, 14, 9)
		Paleoclimate Records	35 (26, 32, 22)	16 (10, 13, 10)	0	7 (7, 7, 5)	12 (9, 12, 7)
	Global Climate Modeling		54 (23, 47, 44)	25 (5, 18, 20)	0	21 (14, 21, 18)	8 (4, 8, 6)

Topic level	Subtopic level	Subsubtopic level	Total	Activity	Short Demo	Visualization	Video
		Climate Projections	11 (2, 10, 10)	6 (0, 5, 5)	0	5 (2, 5, 5)	0
		Climate Reconstructions	5 (2, 5, 4)	5 (2, 5, 4)	0	0	0
		Scenario Development	12 (6, 12, 12)	3 (0, 3, 3)	0	8 (6, 8, 8)	1 (0, 1, 1)

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Impacts of Climate Change			208 (161, 193, 109)	68 (36, 56, 23)	1 (1, 1, 0)	48 (39, 48, 37)	92 (85, 89, 50)
	Sea Level Rise		36 (30, 33, 23)	8 (7, 5, 1)	0	15 (13, 15, 13)	13 (10, 13, 9)
	Extreme Weather		27 (19, 24, 17)	5 (0, 4, 3)	0	8 (7, 8, 7)	14 (12, 12, 7)
		Heavy Precipitation/Floods	2 (1, 1, 1)	0	0	0	2 (1, 1, 1)
		Heat Waves	4 (4, 3, 3)	0	0	1 (1, 1, 1)	3 (3, 2, 2)
		Drought	6 (5, 5, 2)	1 (0, 1, 1)	0	1 (1, 1, 1)	4 (4, 3, 0)
		Hurricanes	3 (0, 2, 1)	3 (0, 2, 1)	0	0	0
	Ecosystem Changes		70 (62, 61, 28)	19 (13, 12, 3)	0	11 (10, 11, 6)	40 (39, 38, 19)
	Plants and Animals		62 (52, 55, 23)	23 (15, 17, 4)	0	7 (6, 7, 4)	32 (31, 31, 15)
	Melting Ice and		59 (50, 55, 31)	23 (16, 19, 8)	0	14 (13, 14, 11)	22 (21, 22, 12)

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	Permafrost						
	Ocean Warming / Acidification		26 (19, 24, 8)	13 (7, 11, 1)	1 (1, 1, 0)	3 (2, 3, 2)	9 (9, 9, 5)
	Availability of Water Resources		18 (15, 17, 9)	2 (0, 2, 2)	0	7 (6, 7, 5)	9 (9, 8, 2)
	Agricultural Changes / Food Security		10 (9, 9, 4)	4 (3, 3, 1)	0	4 (4, 4, 3)	2 (2, 2, 0)
	National Security		5 (5, 4, 3)	2 (2, 1, 0)	0	1 (1, 1, 1)	2 (2, 2, 2)
	Public Health		13 (8, 12, 9)	4 (1, 3, 2)	0	3 (2, 3, 2)	7 (5, 7, 6)
	Economic Impacts		8 (6, 7, 5)	4 (2, 3, 2)	0	1 (1, 1, 1)	3 (3, 3, 2)

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Human Responses to Climate Change			80 (61, 72, 34)	40 (23, 35, 17)	0	7 (6, 7, 4)	33 (32, 30, 13)
	Mitigation Strategies		56 (43, 50, 21)	32 (20, 28, 13)	0	4 (3, 4, 2)	20 (20, 18, 6)
		Emissions Reduction	28 (22, 24, 10)	22 (17, 19, 7)	0	1 (0, 1, 1)	5 (5, 4, 2)
		Carbon-free Energy	9 (8, 9, 3)	3 (2, 3, 0)	0	0	6 (6, 6, 3)

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		Land Use Changes	2 (2, 2, 0)	1 (1, 1, 0)	0	0	1 (1, 1, 0)
		Carbon Capture and Storage	1 (0, 1, 1)	1 (0, 1, 1)	0	0	0
	Adaptation Strategies		14 (10, 13, 6)	5 (1, 5, 2)	0	2 (2, 2, 1)	7 (7, 6, 3)
		Retrofitting Infrastructure	1 (1, 0, 0)	0	0	0	1 (1, 0, 0)
		New Infrastructure	2 (2, 1, 1)	0	0	1 (1, 1, 1)	1 (1, 0, 0)
		Social Innovation	3 (3, 2, 2)	0	0	1 (1, 1, 1)	2 (2, 1, 1)
	Risk Management		3 (2, 3, 3)	1 (0, 1, 1)	0	1 (1, 1, 1)	1 (1, 1, 1)
	Personal Responsibility		23 (21, 21, 5)	13 (11, 11, 5)	0	2 (2, 2, 0)	8 (8, 8, 0)

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Nature of Climate Science			31 (19, 27, 24)	13 (4, 9, 10)	0	2 (2, 2, 1)	16 (13, 16, 13)
	Process of Science		25 (16, 21, 20)	13 (4, 9, 10)	0	0	12 (12, 12, 10)
	Common Misconceptions		0	0	0	0	0

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Energy Use			121 (89, 108, 62)	56 (33, 45, 25)	1 (1, 1, 0)	21 (16, 21, 15)	43 (39, 41, 22)
	Fossil Fuels		40 (27, 32, 19)	26 (18, 18, 10)	0	6 (2, 6, 5)	8 (7, 8, 4)
	Nuclear Energy		10 (6, 10, 5)	6 (5, 6, 2)	0	3 (0, 3, 3)	1 (1, 1, 0)
	Solar Energy		33 (23, 33, 16)	13 (7, 13, 5)	1 (1, 1, 0)	6 (3, 6, 5)	13 (12, 13, 6)
	Wind Energy		22 (16, 20, 12)	9 (7, 8, 4)	0	7 (4, 7, 5)	6 (5, 5, 3)
	Other Alternatives		33 (23, 32, 18)	13 (7, 12, 6)	0	7 (4, 7, 6)	13 (12, 13, 6)
	Efficiency and Conservation		46 (36, 43, 18)	29 (20, 26, 11)	1 (1, 1, 0)	2 (2, 2, 1)	14 (13, 14, 6)
	Carbon Capture and Storage		2 (0, 2, 1)	2 (0, 2, 1)	0	0	0
	Usage Trends		14 (5, 14, 10)	9 (4, 9, 5)	0	4 (0, 4, 4)	1 (1, 1, 1)
	Energy Policy		4 (0, 3, 3)	4 (0, 3, 3)	0	0	0
	Energy Infrastructure		9 (8, 8, 7)	6 (6, 5, 4)	0	1 (0, 1, 1)	2 (2, 2, 2)