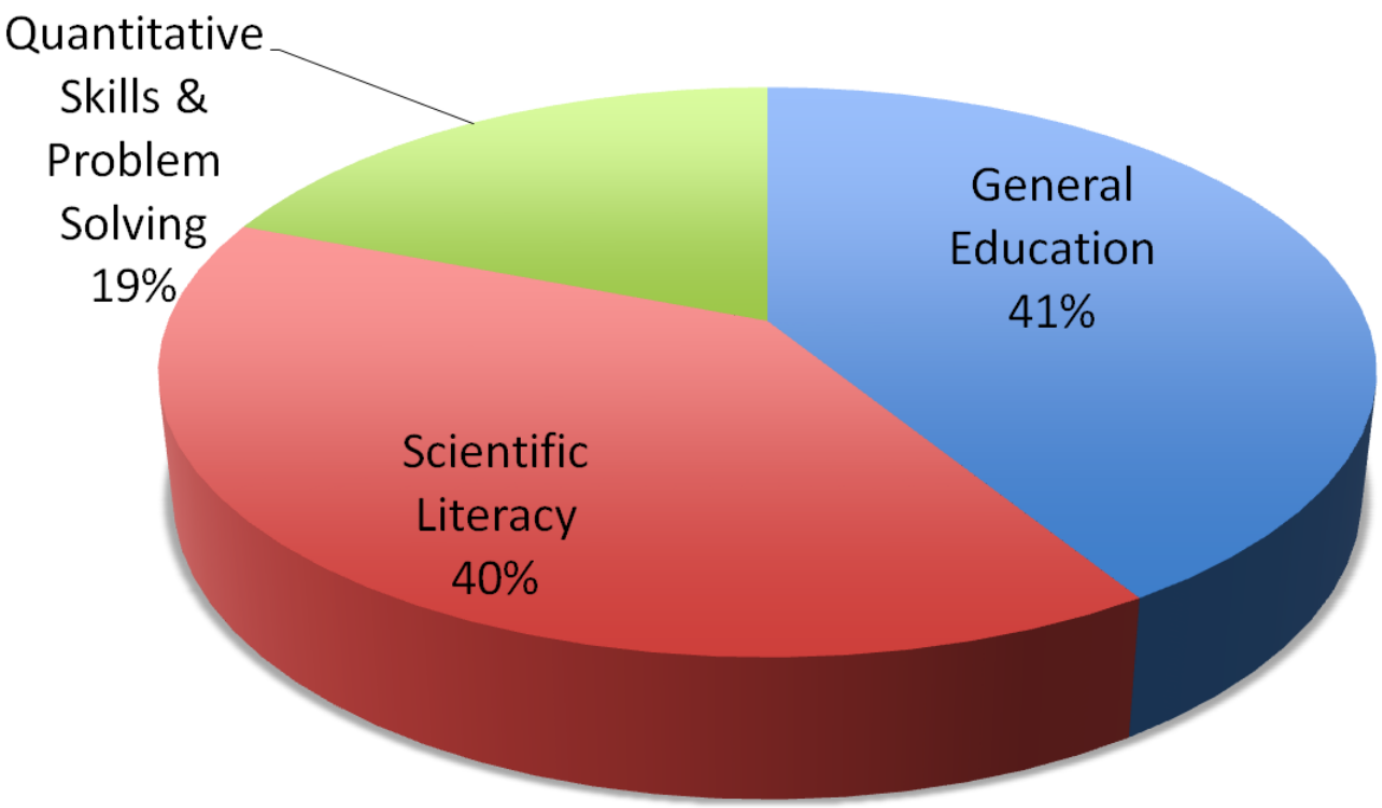
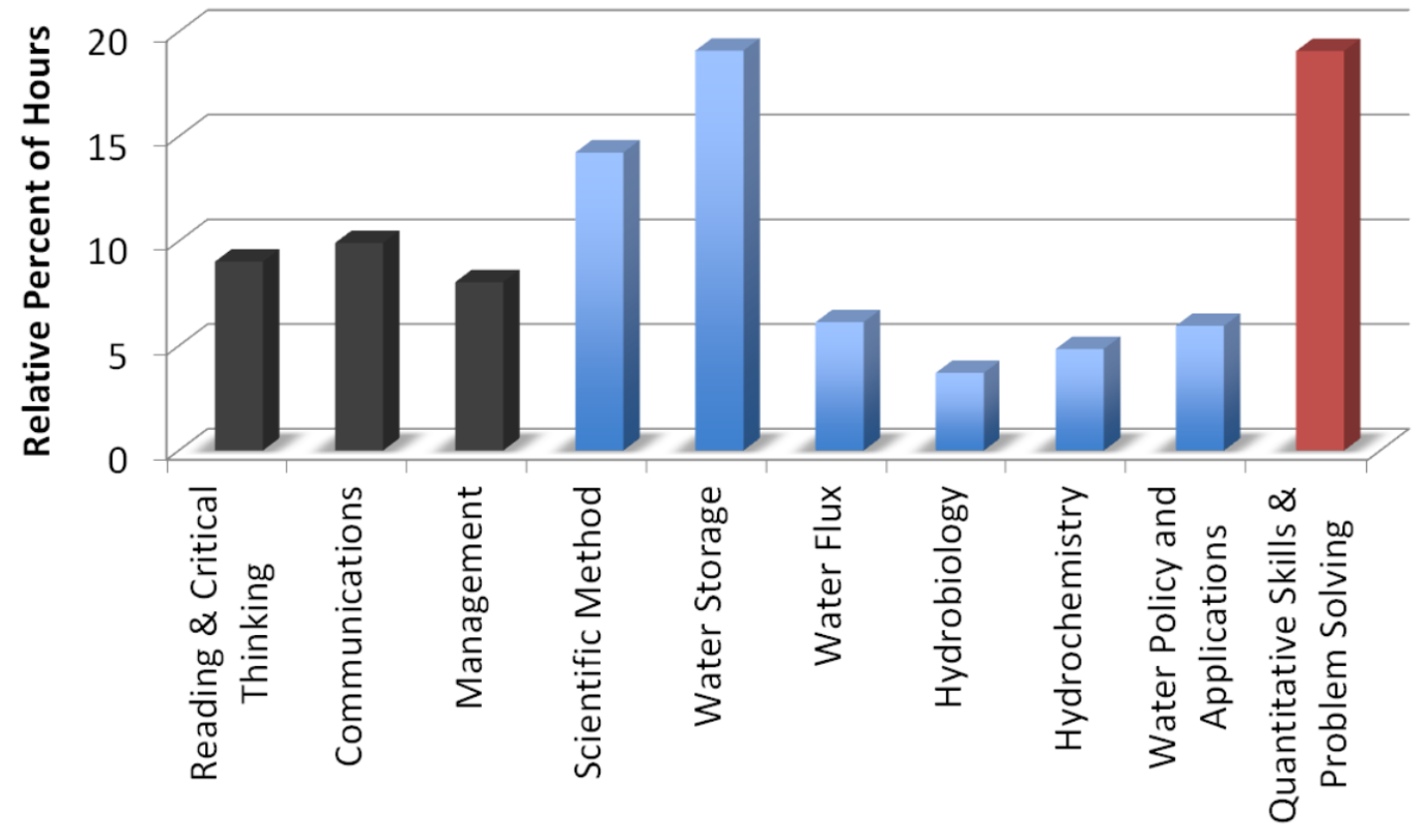
General Education CCOs
Reading & Critical Thinking
Students should know how to find hydrological knowledge in primary literature.
Students should be able to read primary hydrological literature for content.
Students should be able to critically assess the structure and content of primary hydrological literature.
Students should be able to perceive and summarize the different logical, coherent approaches commonly used to structure hydrological research in a journal article
Communications
Students should be able to produce high-quality conceptual and scientific graphics.
Students should be able to stand in front of an audience and present their ideas orally with visual aids.
Students should be able to write proposals and technical reports that are well organized, clear, present meaningful content, and are persuasive.
Students should be able to use the internet and/or other media outlets to communicate their scientific ideas to the general public.
Management
Students should demonstrate proficiency in understanding and implementing the stages of a project.
Students should demonstrate strong time management skills.
Students should demonstrate strong organizational skills.
Students should understand how to work as a member of a team when collaborating on scientific projects.
Scientific Method
Students should be able to design transparent, repeatable scientific experiments using the scientific method.
Students should understand how hydrologic science draws from and informs basic sciences as well as allied environmental sciences.
Students should perceive when conclusions rest on unverified assertions, including poorly constructed simulation models or unsound application of statistics.
Students should understand and apply concepts and tools for stochastic and deterministic analysis in hydrology.
Students should understand that hydrological data are uncertain and should know methods to quantify uncertainty.
Students should understand how perception and analysis are scale dependent in hydrology.

Scientific Literacy
Water Storage
Students should be able to perform a descriptive and quantitative analysis for each storage component and flux in the water cycle, including but not limited to: precipitation, fog drip, snow accumulation, snowmelt, bare soil and open water evaporation, transpiration, canopy-scale evapotranspiration, interception, infiltration, surface runoff, surface and groundwater storage, groundwater recharge, groundwater flow, and streamflow.
Students should be able to write out mass balance equations for water, energy, sediment, and chemical constituents and then use those equations to solve storage and flux problems.
Students should understand what a hydrologic model is and how one works; they should develop proficiency in the use of one such model.
Students should develop proficiency in the direct measurement of physical and chemical phenomena associated with water.
Water Flux
Students should understand and be able to use the three fundamental equations of fluid mechanics: Continuity equation, momentum equation and energy equation.
Students should be able to write out a momentum conservation equation for water, understand the terms, and know the hydrological circumstances under which each term may be simplified or excluded.
Students should be familiar with common solutions to applied mass and momentum equations (including specified input and boundary conditions) for different hydrological and/or hydrodynamic circumstances.
Hydrobiology
Students should understand how biota influence the hydrologic cycle and vice versa.
Students should understand the ecological function of water in disturbance regimes and physical habitat for terrestrial and aquatic species.
Hydrochemistry
Students should demonstrate an understanding of what it means to perform chemical analysis of natural waters.
Students should understand how abiotic and biologically mediated reactions influence the fate of chemical species impacting water quality and how environmental conditions affect the reactions.
Water Policy and Applications
Students should understand the major concepts in water governance, management, and decision-making.
Students should understand the implications of hydrologic research to societal problems.

Quantitative Skills & Problem Solving
Students should develop proficiency in the use of mathematics to solve hydrological problems.
Students should develop proficiency in statistical and stochastic analysis of hydrological data.
Students should develop proficiency in the writing and use of computer programs for hydrological analysis and/or prediction.
Students should develop proficiency in obtaining data, maps, and imagery from the internet and processing them for use in hydrological analysis.
Students should develop proficiency in geospatial mapping and geospatial analysis.
Students should develop proficiency in remote sensing


Quantitative Skills & Problem Solving 19%
General Education 41%
Scientific Literacy 40%


Relative Percent of Hours
0
5
10
15
20
Reading & Critical Thinking
Communications
Management
Scientific Method
Water Storage
Water Flux
Hydrobiology
Hydrochemistry
Water Policy and Applications
Quantitative Skills & Problem Solving

Hydrologic Sciences Graduate Group

Cross-Curriculum Objectives (CCOs)

Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
# of units			79	3	4	4	3	3	4	3	4	1	4	2	6	5	3	1	5	4	3	3	3	4	3	4	1
MAXIMUM # of hours to distribute			2370	90	120	120	90	90	120	90	120	30	120	60	180	150	90	30	150	120	90	90	90	120	90	120	30
REMAINING # of hours to distribute				0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
General Education	**41.20**	**40.4**	**968.5**	22	40	69	21.5	33	29	16	29	10	27	16	60	117	37	13	61	43	65	63	79	22	32	42	22
Reading & Critical Thinking	*9.02*	*8.83*	*212*	6	9	42	12	12	0	0	0	2	0	0	0	14	4	3	4	6	14	11	24	11	11	17	10
Students should know how to find hydrological knowledge in primary literature.	1.40	*1.38*	33	0	3	1	0	0	0	0	0	0	0	0	0	2	2	1	2	3	2	3	8	2	2	2	0
Students should be able to read primary hydrological literature for content.	3.66	*3.58*	86	6	6	25	5	5	0	0	0	2	0	0	0	2	2	2	2	3	2	3	5	4	3	5	4
Students should be able to critically assess the structure and content of primary hydrological literature.	2.64	*2.58*	62	0	0	12	5	5	0	0	0	0	0	0	0	0	0	0	0	0	10	3	10	5	3	5	4
Students should be able to perceive and summarize the different logical, coherent approaches commonly used to structure hydrological research in a journal article	1.32	*1.29*	31	0	0	4	2	2	0	0	0	0	0	0	0	10	0	0	0	0	0	2	1	0	3	5	2
Communications	*9.91*	*9.71*	*233*	2	12	4	1	7	0	0	12	0	5	6	25	25	11	2	13	17	19	20	30	0	7	9	6
Students should be able to produce high-quality conceptual and scientific graphics.	2.52	*2.47*	59.3	0.3	6	1	1	2	0	0	2	0	1	5	5	10	2	2	7	3	8	0	0	0	2	2	0
Students should be able to stand in front of an audience and present their ideas orally with visual aids.	2.54	*2.49*	59.7	0.7	0	0	0	1	0	0	5	0	1	0	0	5	2	0	0	8	10	10	7	0	3	5	2
Students should be able to write proposals and technical reports that are well organized, clear, present meaningful content, and are persuasive.	4.42	*4.33*	104	1	6	3	0	4	0	0	5	0	3	1	20	10	5	0	6	6	1	10	15	0	2	2	4
Students should be able to use the internet and/or other media outlets to communicate their scientific ideas to the general public.	0.43	*0.42*	10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	8	0	0	0	0
Management	*8.04*	*7.88*	*189*	3	10	3	2	2	1	1	5	0	5	4	18	53	11	1	14	6	2	14	21	3	4	6	0
Students should demonstrate proficiency in understanding and implementing the stages of a project.	1.76	*1.72*	41.3	0.3	3	0	0	0	0	0	0	0	1	2	1	20	3	0	3	0	0	1	2	1	2	2	0
Students should demonstrate strong time management skills.	1.40	*1.37*	32.8	0.3	1	0.5	1	1	1	1	0	0	1	1	1	10	4	0	3	1	1	1	1	1	1	1	0
Students should demonstrate strong organizational skills.	1.26	*1.24*	29.7	0.2	1	0.5	1	1	0	0	0	0	1	1	1	10	2	0	3	1	0	1	3	1	1	1	0
Students should understand how to work as a member of a team when collaborating on scientific projects.	3.62	*3.55*	85.2	2.2	5	2	0	0	0	0	5	0	2	0	15	13	2	1	5	4	1	11	15	0	0	2	0
Scientific Method	*14.23*	*13.9*	*334.5*	11	9	20	6.5	12	28	15	12	8	17	6	17	25	11	7	30	14	30	18	4	8	10	10	6
Students should be able to design transparent, repeatable scientific experiments using the scientific method.	1.28	*1.25*	30	3	1	0	0	0	1	0	0	0	4	0	0	10	2	0	3	1	0	2	1	0	0	0	2
Students should understand how hydrologic science draws from and informs basic sciences as well as allied environmental sciences.	4.79	*4.69*	112.5	2	6	6	4.5	6	20	10	2	2	4	1	10	10	2	2	5	2	2	4	1	5	2	2	2
Students should perceive when conclusions rest on unverified assertions, including poorly constructed simulation models or unsound application of statistics.	2.87	*2.81*	67.5	0	0	7.5	2	2	1	1	5	2	2	1	5	0	5	2	7	3	8	5	1	2	2	2	2
Students should understand and apply concepts and tools for stochastic and deterministic analysis in hydrology.	1.74	*1.71*	41	2	0	2	0	0	1	1	5	2	5	2	0	0	0	0	2	3	10	2	0	0	2	2	0
Students should understand that hydrological data are uncertain and should know methods to quantify uncertainty.	1.60	*1.56*	37.5	0	2	2.5	0	0	1	1	0	2	2	2	2	5	0	2	4	1	6	1	0	0	2	2	0
Students should understand how perception and analysis are scale dependent in hydrology.	1.96	*1.92*	46	4	0	2	0	4	4	2	0	0	0	0	0	0	2	1	9	4	4	4	1	1	2	2	0

Hydrologic Sciences Graduate Group
Cross-Curriculum Objectives (CCOs)

				INSTRUCTOR/COURSE NUMBER											Hydrology with Matlab				Bioremed. of Organic Contam.				Climate Change, Water & Society	CCWAS Seminar & Capstone (I,II,III)			GW for Ag	
course count	24																											
Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
# of units			79	3	4	4	3	3	4	3	4	1	4	2	6	5	3	1	5	4	3	3	3	4	3	4	1
MAXIMUM # of hours to distribute			2370	90	120	120	90	90	120	90	120	30	120	60	180	150	90	30	150	120	90	90	90	120	90	120	30
REMAINING # of hours to distribute				0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
Students should understand how perception and analysis are scale dependent in hydrology.	1.96	*1.92*	46	4	0	2	0	4	4	2	0	0	0	0	0	0	2	1	9	4	4	4	1	1	2	2	0
Scientific Literacy	**39.73**	**38.9**	**934.0**	51	55	23	29	14	67	50	67	14	67	9	90	20	31	17	66	40	0	27	11	89	37	60	0
Water Storage	*19.10*	*18.7*	*449*	35	46	10	0	1	52	42	30	4	25	9	20	15	15	2	38	30	0	4	0	24	27	20	0
Students should be able to perform a descriptive and quantitative analysis for each storage component and flux in the water cycle, including but not limited to: precipitation, fog drip, snow accumulation, snowmelt, bare soil and open water evaporation, transpiration, canopy-scale evapotranspiration, interception, infiltration, surface runoff, surface and groundwater storage, groundwater recharge, groundwater flow, and streamflow.	7.32	*7.17*	172	15	7	0	0	0	40	30	10	2	15	2	0	5	5	0	9	5	0	2	0	10	5	10	0
Students should be able to write out mass balance equations for water, energy, sediment, and chemical constituents and then use those equations to solve storage and flux problems.	4.08	*4.00*	96	9	7	4	0	1	10	10	10	0	6	1	0	0	5	1	9	5	0	1	0	10	2	5	0
Students should understand what a hydrologic model is and how one works; they should develop proficiency in the use of one such model.	4.21	*4.13*	99	9	2	3	0	0	1	1	10	2	0	6	0	0	5	0	10	20	0	1	0	4	20	5	0
Students should develop proficiency in the direct measurement of physical and chemical phenomena associated with water.	3.49	*3.42*	82	2	30	3	0	0	1	1	0	0	4	0	20	10	0	1	10	0	0	0	0	0	0	0	0
Water Flux	*6.13*	*6.0*	*144*	0	0	9	4	3	6	6	2	4	28	0	0	5	16	0	8	4	0	1	0	30	3	15	0
Students should understand and be able to use the three fundamental equations of fluid mechanics: Continuity equation, momentum equation and energy equation.	1.87	*1.83*	44	0	0	3	2	1	2	2	1	2	3	0	0	0	3	0	4	2	0	1	0	10	3	5	0
Students should be able to write out a momentum conservation equation for water, understand the terms, and know the hydrological circumstances under which each term may be simplified or excluded.	1.28	*1.25*	30	0	0	2	0	1	2	2	0	0	15	0	0	5	3	0	0	0	0	0	0	0	0	0	0
Students should be familiar with common solutions to applied mass and momentum equations (including specified input and boundary conditions) for different hydrological and/or hydrodynamic circumstances.	2.98	*2.92*	70	0	0	4	2	1	2	2	1	2	10	0	0	0	10	0	4	2	0	0	0	20	0	10	0
Hydrobiology	*3.70*	*3.6*	*87*	14	0	2	20	4	0	0	15	2	7	0	3	0	0	0	6	2	0	6	1	0	0	5	0
Students should understand how biota influence the hydrologic cycle and vice versa.	1.45	*1.42*	34	10	0	2	0	1	0	0	5	0	5	0	1	0	0	0	2	2	0	1	0	0	0	5	0
Students should understand the ecological function of water in disturbance regimes and physical habitat for terrestrial and aquatic species.	2.25	*2.21*	53	4	0	0	20	3	0	0	10	2	2	0	2	0	0	0	4	0	0	5	1	0	0	0	0

Hydrologic Sciences Graduate Group
Cross-Curriculum Objectives (CCOs)

				INSTRUCTOR/COURSE NUMBER											Hydrology with Matlab				Bioremed. of Organic Contam.				Climate Change, Water & Society	CCWAS Seminar & Capstone (I,II,III)			GW for Ag	
course count	24																											
Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
# of units			79	3	4	4	3	3	4	3	4	1	4	2	6	5	3	1	5	4	3	3	3	4	3	4	1
MAXIMUM # of hours to distribute			2370	90	120	120	90	90	120	90	120	30	120	60	180	150	90	30	150	120	90	90	90	120	90	120	30
REMAINING # of hours to distribute				0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Cross-Curriculum Objective (CCO)	Rel. %	AVG	SUM	Pasternack HYD143	Pasternack HYD151	Pasternack HYD252	Pasternack HYD254	Pasternack HYD256	Grismer ESM 100	Grismer HYD 147	Sandoval ESM121	Sandoval HYD221	Dahlke HYD145	Dahlke HYD298	Hernes HYD134	Hopmans SSC107	Hopmans HYD210	Mackay HYD298	Fogg HYD146	Fogg HYD269	Fogg HYD273	Fogg HYD298	Fogg HYD298	Harter HYD144	Harter HYD274	Harter HYD298	Grismer HYD 200
Students should understand how perception and analysis are scale dependent in hydrology.	1.96	*1.92*	46	4	0	2	0	4	4	2	0	0	0	0	0	0	2	1	9	4	4	4	1	1	2	2	0

Scientific Literacy (continued)

Hydrochemistry	*4.85*	*4.8*	*114*	0	5	0	0	0	5	0	0	0	3	0	52	0	0	14	6	2	0	0	0	15	4	8	0
Students should demonstrate an understanding of what it means to perform chemical analysis of natural waters.	2.93	*2.88*	69	0	5	0	0	0	1	0	0	0	0	0	42	0	0	2	3	0	0	0	0	10	1	5	0
Students should understand how abiotic and biologically mediated reactions influence the fate of chemical species impacting water quality and how environmental conditions affect the reactions.	1.91	*1.88*	45	0	0	0	0	0	4	0	0	0	3	0	10	0	0	12	3	2	0	0	0	5	3	3	0
Water Policy, Economics, and Applications	*5.95*	*5.8*	*140*	2	4	2	5	6	4	2	20	4	4	0	15	0	0	1	8	2	0	16	10	20	3	12	0
Students should understand the major concepts in water governance, management, and decision-making.	2.38	*2.33*	56	0	0	0	0	0	2	1	10	2	2	0	1	0	0	0	3	1	0	8	5	15	0	6	0
Students should understand the implications of hydrologic research to societal problems.	3.57	*3.50*	84	2	4	2	5	6	2	1	10	2	2	0	14	0	0	1	5	1	0	8	5	5	3	6	0
Quantitative Skills & Problem Solving	**19.08**	**25.8**	**448.5**	17	25	28	39.5	2	24	24	24	6	26	35	30	13	22	0	23	37	25	0	0	9	21	18	0
Students should develop proficiency in the use of mathematics to solve hydrological problems.	8.21	*8.04*	193	10	10	10	9	2	20	20	10	2	10	1	30	10	10	0	15	4	5	0	0	5	5	5	0
Students should develop proficiency in statistical and stochastic analysis of hydrological data.	2.36	*2.31*	55.5	5	5	0	3.5	0	2	1	4	0	10	4	0	3	2	0	2	2	10	0	0	0	0	2	0
Students should develop proficiency in the writing and use of computer programs for hydrological analysis and/or prediction.	4.76	*4.67*	112	2	0	0	18	0	0	1	10	2	0	30	0	0	10	0	3	30	0	0	0	0	5	1	0
Students should develop proficiency in obtaining data, maps, and imagery from the internet and processing them for use in hydrological analysis.	1.40	*1.38*	33	0	5	6	0	0	2	2	0	2	2	0	0	0	0	0	0	0	0	0	0	4	5	5	0
Students should develop proficiency in geospatial mapping and geospatial analysis.	2.34	*2.29*	55	0	5	12	9	0	0	0	0	0	4	0	0	0	0	0	3	1	10	0	0	0	6	5	0
Students should develop proficiency in remote sensing	0.00	*0.00*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2351.0																								