FORMAT 2

Submit originals (including syllabus) and one copy and electronic copy to the **Faculty Senate Office**
See http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/ for a complete description of the rules governing curriculum & course changes.

CHANGE COURSE (MAJOR) and DROP COURSE PROPOSAL
Attach a syllabus, except if dropping a course.

SUBMITTED BY:

Department	**MSL**	**College/School**	**SFOS**
Prepared by	**Ana M. Aguilar-Islas**	**Phone**	**1524**
Email Contact	**amaguilarislas@alaska.edu**	**Faculty Contact**	**Ana M. Aguilar-Islas**

1. COURSE IDENTIFICATION: As the course now exists.

Dept	MSL	Course #	660	No. of Credits	3

COURSE TITLE	**Chemical Oceanography**

2. ACTION DESIRED: √ Check the changes to be made to the existing course.

Change Course	x	If Change, indicate below what is changing.	Drop Course	

NUMBER		**TITLE**		**DESCRIPTION**	
PREREQUISITES*	x			***FREQUENCY OF OFFERING***	

*Prerequisites will be *required* before a student is allowed to enroll in the course.

CREDITS (including credit distribution)			***COURSE CLASSIFICATION***	
***STACKED** (400/600)* *Include syllabi.*	x	Dept. MSL	Course #	461

Stacked course applications are reviewed by the (Undergraduate) Curricular Review Committee and by the Graduate Academic and Advising Committee. Creating two different syllabi—undergraduate and graduate versions—will help emphasize the different qualities of what are supposed to be two different courses. The committees will determine: 1) whether the two versions are sufficiently different (i.e. is there undergraduate and graduate level content being offered); 2) are undergraduates being overtaxed?; 3) are graduate students being undertaxed? In this context, the committees are looking out for the interests of the students taking the course. Typically, if either committee has qualms, they both do. More info online – see URL at top of this page.

ADD NEW CROSS-LISTING		Dept. & No.		Requires approval of both departments and deans involved. Add lines at end of form for additional signatures.
STOP EXISTING CROSS-LISTING		Dept. & No.		Requires notification of other department(s) and mutual agreement. Attach copy of email or memo.
OTHER (specify)				

3. COURSE FORMAT

NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council **and** the appropriate Faculty Senate curriculum committee. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

COURSE FORMAT: (check **all** that apply)		*1*		*2*		*3*		*4*		*5*	x	*6 weeks to full semester*
OTHER FORMAT (specify all that apply)	**none**											
Mode of delivery (specify lecture, field trips, labs, etc.)	**Lecture**											

4. COURSE CLASSIFICATIONS: (undergraduate courses only. Use approved criteria found on Page 10 & 17 of the manual. If justification is needed, attach on separate sheet.)

H = Humanities		S = Social Sciences	

Will this course be used to fulfill a requirement for the baccalaureate core?	**YES**		**NO**	**x**

IF YES*, check which core requirements it could be used to fulfill:

O = Oral Intensive, ***Format 6** also submitted		W = Writing Intensive, ***Format 7** submitted		Natural Science, ***Format 8** submitted	

4.A ***Is course content related to northern, arctic or circumpolar studies? If yes, a "snowflake" symbol will be added in the printed Catalog, and flagged in Banner.***

YES		**NO**	X

5. COURSE REPEATABILITY:

Is this course repeatable for credit?	**YES**		**NO**	**x**

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).	**na**

How many times may the course be repeated for credit?	**na**	**TIMES**

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course?	**na**	**CREDITS**

6. <u>COMPLETE</u> CATALOG DESCRIPTION including dept., number, title, credits, credit distribution, cross-listings and/or stacking, clearly showing the changes you want made. (<u>Underline new wording</u> ~~strike through old wording~~ and use complete catalog format including dept., number, title, credits and cross-listed and stacked.)

Example of a <u>complete</u> description:

PS F450 Comparative ~~Aboriginal~~ <u>Indigenous</u> Rights and Policies (s)
3 Credits
Offered As Demand Warrants
~~Case study~~ <u>Comparative</u> approach ~~in assessing Aboriginal~~ <u>to analyzing Indigenous</u> rights and policies in different nation-state systems. ~~Seven Aboriginal situations~~ Multiple countries and specific policy developments examined for factors promoting or limiting self-determination. Prerequisites: Upper division standing or permission of instructor. (Cross-listed with ANS F450.) (3+0)

<u>MSL F461 Chemical Oceanography</u>

<u>3 Credits</u>
<u>Offered Spring</u>

<u>An integrated study of the chemical, biological, geological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Prerequisites: Upper division standing, CHEM 106, BIOL 116. Stacked with MSL F660. (3+0)</u>

MSL F660 Chemical Oceanography

3 Credits
Offered Spring

<u>An integrated study of</u> ~~T~~<u>t</u>he chemical, biological<u>, geological</u> and physical processes that determine the distribution of chemical variables in the sea. <u>Topics include biogeochemical cycles and the use of tracers</u> ~~The distribution of stable and radioisotopes are used~~ to follow <u>these</u> complex chemical cycles~~, with particular emphasis on the cycles of nutrient elements~~. The chemistry of carbon is considered in detail. <u>Interactions with the atmosphere and lithosphere (including</u> ~~I~~<u>i</u>mplications of the mid-ocean ridge vent system to ocean chemistry<u>)</u> are examined. Prerequisites: Graduate standing ~~or permission of instructor~~. Cross-listed with CHEM F660. <u>Stacked with MSL F461</u> (3+0)

7. COMPLETE CATALOG DESCRIPTION AS IT SHOULD APPEAR AFTER ALL CHANGES ARE MADE:

MSL F461 Chemical Oceanography

3 Credits
Offered Spring

An integrated study of the chemical, biological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Prerequisites: Upper division standing, CHEM 106, BIOL 116. Stacked with MSL F660. (3+0)

MSL F660 Chemical Oceanography

3 Credits
Offered Spring

An integrated study of the chemical, biological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Prerequisites: Graduate standing. Cross-listed with CHEM F660. Stacked with MSL F461 (3+0)

8. GRADING SYSTEM: Specify only one.

LETTER:	x	PASS/FAIL:	

9. ESTIMATED IMPACT

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

The addition of a 400 level stacked course would potentially increase enrolment, and have a positive impact on the budget and the faculty teaching this course. This is a lecture-based course requiring a classroom with distance delivery facilities, and because it is a core course for the graduate program in oceanography an appropriate classroom is already allocated every spring. Thus, impact on facilities/space is not expected by the proposed change.

10. LIBRARY COLLECTIONS

Have you contacted the library collection development officer (kljensen@alaska.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.

No	x	Yes		Library resources for the 400 level course do not differ from those needed by the 600 level course. The current library facilities have been deemed adequate for this course.

11. IMPACTS ON PROGRAMS/DEPTS:

What programs/departments will be affected by this proposed action?
Include information on the Programs/Departments contacted (e.g., email, memo)

The proposed change will have a positive impact on the minor in marine sciences program by increasing the available elective courses offered to students. An upper division course in chemical oceanography will also be of interest to undergraduates in fisheries and environmental chemistry.

12. POSITIVE AND NEGATIVE IMPACTS

*Please specify **positive and negative** impacts on other courses, programs and departments resulting from the proposed action.*

Negative impacts are NOT expected from this change. Positive impacts include contribution to diversity of courses offered to science major undergraduates, contribution to elective courses for the new marine science minor, and potential increase enrolment in MSL courses.

13. JUSTIFICATION FOR ACTION REQUESTED

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. If you ask for a change in # of credits, explain why; are you increasing the amount of material covered in the class? If you drop a prerequisite, is it because the material is covered elsewhere? If course is changing to stacked (400/600), explain higher level of effort and performance required on part of students earning graduate credit. Use as much space as needed to fully justify the proposed change and explain what has been done to ensure that the quality of the course is not compromised as a result.

The ocean is central to the climate system and the natural resources of our planet. Providing ocean literacy at the undergraduate level is vital for training the future generation of scientists, as an understanding of the interactions among physical, chemical, and biological processes in the ocean is necessary to predict and address the effects of ongoing environmental changes. Currently the MSL program offers undergraduates courses in general oceanography (MSL 111, 211-213) and biological oceanography (MSL 449) which only cover briefly chemical interactions. One chemistry-focused course (MSL 463 Chemical Coastal Processes) addresses the coastal ocean, and does not provide a global perspective. The proposed course will provide upper division students with an integrated study of the chemical processes that take place in the global ocean, adding depth and complementing topics to existing MSL courses.

Undergraduate students will be assessed using different criteria that include modified learning objectives, workload, and assignment grade distribution. A greater level of sophistication and understanding will be expected from graduate students' homework and exams. In addition, a higher class workload will be required from graduate students. Differences are highlighted in the syllabi using underlined red text. The quality of the 600 level course will not be compromised by allowing undergraduates into the class, as expectations for graduate students are not modified, and the material covered during the class will also not be altered. The level at which lectures are delivered is accessible to upper division science undergraduates.

APPROVALS: (Additional signature blocks may be added as necessary.)

BJ Mc	Date	8/30/13	
Signature, Chair, Program/Department of:	GPMSL		
[signature]	Date	9/9/2013	
Signature, Chair, College/School Curriculum Council for:	SFOS curriculum Committee		
[signature]	Date	Sep 10, 2013	
Signature, Dean, College/School of:	SFOS		

Offerings above the level of approved programs must be approved in advance by the Provost:

	Date	
Signature of Provost (if applicable)		

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE.

	Date	

Signature, Chair
Faculty Senate Review Committee: ___Curriculum Review ___GAAC

___Core Review ___SADAC

ATTACH COMPLETE SYLLABUS (as part of this application).
The guidelines are online:
http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/uaf-syllabus-requirements/
The Faculty Senate curriculum committees will review the syllabus to ensure that each of the items listed below are included. If items are missing or unclear, the proposed course (or changes to it) may be denied.

SYLLABUS CHECKLIST FOR ALL UAF COURSES
During the first week of class, instructors will distribute a course syllabus. Although modifications may be made throughout the semester, this document will contain the following information (as applicable to the discipline):

1. **Course information:**
   ❑Title, ❑ number, ❑credits, ❑prerequisites, ❑ location, ❑ meeting time (make sure that contact hours are in line with credits).
2. **Instructor (and if applicable, Teaching Assistant) information:**
   ❑ Name, ❑ office location, ❑ office hours, ❑ telephone, ❑ email address.
3. **Course readings/materials:**
   ❑ Course textbook title, ❑ author, ❑ edition/publisher.
   ❑ Supplementary readings (indicate whether ❑ required or ❑ recommended) and
   ❑ any supplies required.
4. **Course description:**
   ❑ Content of the course and how it fits into the broader curriculum;
   ❑ Expected proficiencies required to undertake the course, if applicable.
   ❑ Inclusion of catalog description is *strongly* recommended, and
   ❑ Description in syllabus must be consistent with catalog course description.
5. ❑ **Course Goals (general), and (see #6)**
6. ❑ **Student Learning Outcomes (more specific)**
7. **Instructional methods:**
   ❑ Describe the teaching techniques (eg: lecture, case study, small group discussion, private instruction, studio instruction, values clarification, games, journal writing, use of Blackboard, audio/video conferencing, etc.).
8. **Course calendar:**
   ❑ A schedule of class topics and assignments must be included. Be specific so that it is clear that the instructor has thought this through and will not be making it up on the fly (e.g. it is not adequate to say "lab". Instead, give each lab a title that describes its content). You may call the outline Tentative or Work in Progress to allow for modifications during the semester.
9. **Course policies:**
   ❑ Specify course rules, including your policies on attendance, tardiness, class participation, make-up exams, and plagiarism/academic integrity.
10. **Evaluation:**
    ❑ Specify how students will be evaluated, ❑ what factors will be included, ❑ their relative value, and ❑ how they will be tabulated into grades (on a curve, absolute scores, etc.) ❑ Publicize UAF regulations with regard to the grades of "C" and below as applicable to this course. (Not required in the syllabus, but may be a convenient way to publicize this.) Faculty Senate Meeting #171: http://www.uaf.edu/uafgov/faculty-senate/meetings/2010-2011-meetings/#171
11. **Support Services:**
    ❑ Describe the student support services such as tutoring (local and/or regional) appropriate for the course.
12. **Disabilities Services:** Note that the phone# and location have been **updated.**
    The Office of Disability Services implements the Americans with Disabilities Act (ADA), and ensures that UAF students have equal access to the campus and course materials.
    ❑ State that you will work with the Office of Disabilities Services (208 WHITAKER BLDG, 474-5655)to provide reasonable accommodation to students with disabilities.

Spring 20XX Syllabus **Revised 00/00/20xx**

MSL 660: Chemical Oceanography
Class meeting times: T, Th 09:45-11:15
Location: 138 Irving II

Prerequisites: Graduate standing
3 credits

Instructors:

Dr. Ana Aguilar-Islas School of Fisheries and Ocean Sciences 335A Irving II 474-1524 amaguilarislas@alaska.edu Office Hours: M, W 8:30-10:30	**Dr. Andrew McDonnell** School of Fisheries and Ocean Sciences 231 Irving II 474-7529 amcdonnell@alaska.edu Office Hours: Tues., Thurs. 2-3 pm

Course Description: An integrated study of the chemical, biological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Chemical oceanography is one of the four major fields of oceanography. We will examine the ocean as a chemical system by covering fluxes across boundaries with the land, atmosphere, sediments and hydrothermal vents, and by focusing on the internal cycling of elements driven by biological and physicochemical processes. Chemical oceanography is an essential part of the interdisciplinary knowledge necessary to understand the ocean. Students will be evaluated based on class participation, three homework assignments, a review paper and oral presentation, two midterm exams, and a final exam. Cross-listed with CHEM F660; Stacked with MSL F461

Course Goals: The ocean is central to the climate system and the natural resources of our planet. The goal of the course is to provide ocean literacy that will enable understanding of the ocean as a system and its intrinsic role in the biogeochemical cycling of elements. Additional goals include the improvement of critical thinking, and the improvement of written and oral science communication skills.

Learning Objectives:
1. Understand the roles of material input, output, and internal cycling of the chemical components in the ocean.
2. Identify physical, geological, chemical, and biological controls affecting the distribution and behavior of chemical species.
3. Become familiar with chemical oceanographic approaches to data collection and interpretation.
4. Understand and think critically about recent research in the field.

Expected preparation for the course: Undergraduate degree in science, or a background that includes similar undergraduate courses, is necessary. Competence in algebra is necessary; introductory calculus and differential equations are useful for some topics but are not required. One year of general chemistry and biology at the college level are necessary; organic chemistry, inorganic chemistry and biochemistry are helpful. Biological and physical oceanography are also helpful. If you have not taken a background course described as “helpful”, you will probably benefit from doing some extra reading to familiarize yourself with the basics. For example, an introductory general oceanography text will be useful for students who have not had this background.

Instructional Methods: Various instructional methods will be used during the course, including lectures, reading assignments, class discussion, hands-on practice through homework assignments, literature research, and student presentations**.** E-mail communication will be used to distribute class information, updates and changes. Distance delivery through video conferencing will be available to students located outside Fairbanks.

Note: This is a stacked 400/600 level course. The material covered will be the same for both versions of the course, but the grading will differ. To receive full credit, graduate students will be required to 1) answer all the parts of homework and exam questions; 2) write a 10 page synthesis paper; 3) present the topic of the synthesis paper orally to the class; 4) by the end of the course be able to understand and evaluate recent chemical oceanography research; and 5) attend and participate in class. While undergraduate level students will be required to 1) answer only the first three parts of homework and exam questions; and 2) attend and participate in class. Homework and exam questions will be written as 4-part questions. Answering the 4th part of each question will require greater understanding of the topic and scientific sophistication expected of students at the graduate level.

Grading:		
	Class Participation	5 %
	Homework (3 Assignments)	25 %
	Research paper/presentation	15%
	Midterm 1	15 %
	Midterm 2	15 %
	Final Exam	25%

≥90 %	=	A
80-89 %	=	B
70-79 %	=	C
60-69%	=	D
≤ 59 %	=	F

Grades for each category will be weighted to obtain an overall grade out of a possible 100 points.
There will be no extra credit assignments. Your overall grade will be rounded to the nearest whole percentage before final grades are assigned. Only whole letter grades will be assigned (no plus (+) and minus (-) grading system).

Text: Pilson, Michael E. Q. 2013. *An Introduction to the Chemistry of the Sea.* 2nd Edition, Prentice Hall.
Assigned readings from other texts/articles will be provided in class or via the library.
Additional texts you might find useful:

- Sarmiento, J. L., and N. G. Gruber. 2006. *Ocean Biogeochemical Dynamics.* Princeton University Press.
- Chester, R. and T. Jickells. 2012. *Marine Geochemistry, Third Edition*. Wiley, John & Sons, Inc.
- Libes, Susan. 2009. *An Introduction to Marine Biogeochemistry*, 2nd Edition, Academic Press

Course Policies: Lecture **attendance** and active **participation** in class is expected from all students. If you must be absent due to illness, field work, or other important reasons, please notify the instructor in advance (if possible) and arrange to make up missed material or assignments.

Lack of academic integrity including plagiarism is not acceptable and will result in a failed grade

Three **homework assignments** will be given. Homework sets consist of several (4 – 6) four-part questions that include a combination of quantitative and qualitative problems. Homework sets are design to enhance your understanding of complex oceanographic processes and to provide hands-on experience in calculating chemical parameters. Collaboration among students is encouraged. However, each student is expected to submit their own work. Homework assignments will not be accepted after the due date, unless arrangements have been made in advance with the instructor.

A **review paper** and **oral presentation** will be due at the end of the semester. The review paper (10 pages) will be based on three published articles on original research that inform about the oceanic cycle of a particular element. The oral presentation (15 minutes) will highlight the findings from the three papers.

Exams. There will be two midterms. The first will be a take home exam; the second will be completed during the normal class period. One final exam will be administered during its scheduled time (X May, X-Xam). Exams will require short-essay and diagramed answers, with some problem solving. The second midterm and final exams will be closed-book. The final exam will be comprehensive with an emphasis on material covered after the midterm.

Support and Disability Services: At UAF, the Office of Disability Services (203 WHIT; 474-5655; TTY 474-1827; fydso@uaf.edu) ensures that students with physical or learning disabilities have equal access to the campus and course materials. If you have specialized needs, please contact this office or the instructor to make arrangements.

Date	Topic	Reading	Assignment
1/16	Introduction, The ocean as a chemical system	Pilson, Chapter 1	
1/21	Properties of seawater	Pilson, Chapter 2	
1/23	Physical properties and circulation	Pilson, Chapter 6	
1/28	The hydrological cycle and weathering	Libes Chapter 2, section 2.2	
1/30	Major ions/Chemical transformations	Pilson, Chapters 3 & 4	
2/4	Isotopes as tracers	Pilson, Chapter 10, Appendix I	HW#1 Assigned
2/6	Atmosphere-seawater interface	Pilson Chapter 5 & 13.2	
2/11	Gas exchange	Pilson Appendix D	HW#1 Due
2/13	**MID-TERM EXAM #1**		
2/18	Redox reactions	Libes, Chapter 7; Pilson, Chapter 12	
2/20	Inorganic carbon chemistry	Pilson, Appendices E-G	
2/25	Nutrient distributions	Pilson, Chapter 8	
2/27	Trace elements I	Pilson, Chapter 9	
3/4	Trace elements II	Boyd et al., 2007	HW#2 Assigned
3/6	Primary Production	Pilson, Sections 11.1-11.3	
3/11	Particle flux	Pilson, Section 11.4 Epply and Peterson, 1979	HW#2 Due
3/13	**MID-TERM EXAM #1**		
SPRING BREAK			
3/25	Nitrogen cycle I	Libes Chapter 24	
3/27	Nitrogen cycle II	Sohm et al., 2011	
4/1	Phosphorous and Silicon Cycles	Paytan and McLaughlin, 2007; Libes Chapter 16	
4/3	Marine carbon cycle I	Pilson Chapter 7; Libes Chapter 26	
4/8	Marine carbon cycle II		Paper outline/references due
4/10	Sediment burial and diagenesis	Pilson Section 13.4; Libes Chapter 12	
4/15	Hydrothermal systems	Pilson Section 13.3, 13.5	HW#3 Assigned
4/17	Marine organic compounds	Pilson Section 11.7	
4/22	Coastal processes		HW#3 Due
4/24	Sea Ice	Sea ice Handout	
4/29	Observational methods in chemical oceanography		
5/1	Presentations/Review		Paper Due
5/8	**FINAL EXAM**		

Spring 20XX Syllabus **Revised 00/00/20xx**

MSL 461: Chemical Oceanography
Class meeting times: T, Th 09:45-11:15
Location: 138 Irving II

Prerequisites: Upper division standing, CHEM 106, BIOL 116.
3 credits

Instructors:

Dr. Ana Aguilar-Islas School of Fisheries and Ocean Sciences 335A Irving II 474-1524 amaguilarislas@alaska.edu Office Hours: M, W 8:30-10:30	**Dr. Andrew McDonnell** School of Fisheries and Ocean Sciences 231 Irving II 474-7529 amcdonnell@alaska.edu Office Hours: Tues., Thurs. 2-3 pm

Course Description: An integrated study of the chemical, biological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Chemical oceanography is one of the four major fields of oceanography. We will examine the ocean as a chemical system by covering fluxes across boundaries with the land, atmosphere, sediments and hydrothermal vents, and by focusing on the internal cycling of elements driven by biological and physicochemical processes. Chemical oceanography is an essential part of the interdisciplinary knowledge necessary to understand the ocean. Students will be evaluated based on class participation, three homework assignments, two midterm exams, and a final exam. Stacked with MSL F461

Course Goals:
The ocean is central to the climate system and the natural resources of our planet. The goal of the course is to provide ocean literacy that will enable understanding of the ocean as a system and its intrinsic role in the biogeochemical cycling of elements. Additional goals include the improvement of critical thinking, and the improvement of written and oral science communication skills.

Learning Objectives
1. Understand the roles of material input, output, and internal cycling of the chemical components in the ocean.
2. Identify physical, geological, chemical, and biological controls affecting the distribution and behavior of chemical species.
3. Become familiar with chemical oceanographic approaches to data collection and interpretation.

Expected preparation for the course: Undergraduate background in natural science is necessary. Competence in algebra is necessary; introductory calculus and differential equations are useful for some topics but are not required. One year of general chemistry and biology at the college level are necessary; organic chemistry, inorganic chemistry and biochemistry are helpful. An introductory oceanography course is also helpful. If you have not taken a background course described as “helpful”, you will probably benefit from doing some extra reading to familiarize yourself with the basics. For example, an introductory general oceanography text will be useful for students who have not had this background.

Instructional Methods: Various instructional methods will be used during the course, including lectures, reading assignments, class discussion, hands-on practice through homework assignments, literature research, and student presentations**.** E-mail communication will be used to distribute class information, updates and changes. Distance delivery through video conferencing will be available to students located outside Fairbanks.

Note: This is a stacked 400/600 level course. The material covered will be the same for both versions of the course, but the grading will differ. To receive full credit, graduate students will be required to 1) answer all the parts of homework and exam questions; 2) write a 10 page synthesis paper; 3) present the topic of the synthesis paper orally to the class; 4) by the end of the course be able to understand and evaluate recent chemical oceanography research; and 5) attend and participate in class. While undergraduate level students will be required to 1) answer only the first three parts of homework and exam questions; and 2) attend and participate in class.

Homework and exam questions will be written as 4-part questions. Answering the 4th part of each question will require greater understanding of the topic and scientific sophistication expected of students at the graduate level.

Grading:	Class Participation	10 %
	Homework (3 Assignments)	30 %
	Midterm 1	20 %
	Midterm 2	20 %
	Final Exam	20%

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Lack of academic integrity including plagiarism is not acceptable and will result in a failed grade

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1/21	Properties of seawater	Pilson, Chapter 2	
1/23	Physical properties and circulation	Pilson, Chapter 6	
1/28	The hydrological cycle and weathering	Libes Chapter 2, section 2.2	
1/30	Major ions/Chemical transformations	Pilson, Chapters 3 & 4	
2/4	Isotopes as tracers	Pilson, Chapter 10, Appendix I	HW#1 Assigned
2/6	Atmosphere-seawater interface	Pilson Chapter 5 & 13.2	
2/11	Gas exchange	Pilson Appendix D	HW#1 Due
2/13	**MID-TERM EXAM #1**		
2/18	Redox reactions	Libes, Chapter 7; Pilson, Chapter 12	
2/20	Inorganic carbon chemistry	Pilson, Appendices E-G	
2/25	Nutrient distributions	Pilson, Chapter 8	
2/27	Trace elements I	Pilson, Chapter 9	
3/4	Trace elements II	Boyd et al., 2007	HW#2 Assigned
3/6	Primary Production	Pilson, Sections 11.1-11.3	
3/11	Particle flux	Pilson, Section 11.4 Epply and Peterson, 1979	HW#2 Due
3/13	**MID-TERM EXAM #2**		
SPRING BREAK			
3/25	Nitrogen cycle I	Libes Chapter 24	
3/27	Nitrogen cycle II	Sohm et al., 2011	
4/1	Phosphorous and Silicon Cycles	Paytan and McLaughlin, 2007; Libes Chapter 16	
4/3	Marine carbon cycle I	Pilson Chapter 7; Libes Chapter 26	
4/8	Marine carbon cycle II		
4/10	Sediment burial and diagenesis	Pilson Section 13.4; Libes Chapter 12	
4/15	Hydrothermal systems	Pilson Section 13.3, 13.5	HW#3 Assigned
4/17	Marine organic compounds	Pilson Section 11.7	
4/22	Coastal processes		HW#3 Due
4/24	Sea Ice	Sea ice Handout	
4/29	Observational methods in chemical oceanography		
5/1	Presentations/Review		
5/8	**FINAL EXAM**		