

Fiscal Unit/Academic Org	School of Earth Sciences - D0656
Administering College/Academic Group	Arts and Sciences
Co-administering College/Academic Group	
Semester Conversion Designation	New Program/Plan
Proposed Program/Plan Name	Planetary Science Certificate
Type of Program/Plan	Undergraduate certificate program
Program/Plan Code Abbreviation	PLANETS
Proposed Degree Title	Certificate in Planetary Science

Credit Hour Explanation

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program				12	
Required credit hours offered by the unit	Minimum			12	
	Maximum			13	
Required credit hours offered outside of the unit	Minimum			0	
	Maximum			0	
Required prerequisite credit hours not included above	Minimum			17	
	Maximum			21	

Program Learning Goals

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

Program Learning Goals

- Upon completion of the academic certificate in Planetary Science, students will be better prepared to
 - (1) integrate geophysical and astrophysical datasets to test scientific hypotheses across planetary time- and length-scales.
 - (2) apply systems-level thinking to planetary-scale scientific questions.
 - (3) continue in the field of planetary science or planetary exploration, well prepared to adapt to the rapidly changing field.

Assessment

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

Is this a degree program (undergraduate, graduate, or professional) or major proposal? No

Program Specializations/Sub-Plans

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

Pre-Major

Does this Program have a Pre-Major? No

Attachments

- Certificate Proposal Planetary Science.pdf: program proposal, college letter, advising sheets

(Program Proposal. Owner: Panero,Wendy R)

Comments

- Note: The required credit hours table for "required credit hours offered by the unit" assumes credit hours in either Astronomy OR Earth Sciences *(by Panero,Wendy R on 10/14/2019 10:31 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Panero,Wendy R	10/14/2019 10:31 AM	Submitted for Approval
Approved	Panero,Wendy R	10/14/2019 10:31 AM	Unit Approval
Approved	Haddad,Deborah Moore	10/15/2019 03:24 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	10/15/2019 03:24 PM	ASCCAO Approval

Proposal Submission Guidelines for Establishing a New Certificate

1. Required Information

- Name of proposed certificate. Identify certificate type from certificate grid (e.g., Type 2, standalone post-bachelor undergraduate certificate).

Planetary Science, type 1 (undergraduate academic certificate, embedded)

- Indicate whether the certificate will be delivered wholly on-line, wholly in-person, a combination, or with all hybrid courses.

In person delivery.

- Proposed implementation date.

Spring 2020

- Academic units (e.g., department, college) responsible for administering the certificate program.

Earth Sciences and Astronomy, Arts and Sciences

2. Rationale

- Describe the rationale/purpose of the certificate.

Many students majoring in Earth Science, Astronomy, Physics, and Aeronautical Engineering arrive at Ohio State with an interest in space exploration.

Ohio State has a significant strength in planetary sciences, but no clear departmental or degree home. This certificate will clarify to students, grad schools, and employers that the student engaged in a coherent set of undergraduate coursework to prepare the student to pursue planetary sciences as a career or in graduate school.

- Identify a likely source of student demand for the proposed certificate, and provide one or two examples.

Students majoring in these programs will be able to indicate their focus on the planetary sciences with such a certificate with a minimum of extra courses.

For example, a student majoring in Earth Sciences (Geological Sciences or Geophysics tracks) or Astrophysics will be able to complete the certificate with 2 additional courses with strategic choices within the major.

- Provide the following statement: *Upon completion of the academic certificate in <specify title>, learners will be better prepared to. . .* <list a maximum of 3 outcomes>.

Upon completion of the academic certificate in Planetary Science, students will be better prepared to

(1) integrate geophysical and astrophysical datasets to test scientific hypotheses across planetary time- and length- scales.

(2) apply systems-level thinking to planetary-scale scientific questions.

(3) continue in the field of planetary science or planetary exploration, well prepared to adapt to the rapidly changing field.

3. Relationship to Other Programs / Benchmarking

- Identify any overlaps with other programs or departments within the university. Append letters of concurrence or objection from related units.

The certificate overlaps with the BS in Earth Sciences and the BS in Astronomy.

- Indicate whether this certificate or a similar certificate was submitted for approval previously.
This is a new proposal, no such certificate proposal has been submitted for approval previously.

Explain at what stage and why that proposal was not approved or was withdrawn.

- Identify similar programs at other universities in Ohio or in the United States and their levels of success.

There are no similar programs in Ohio.

4. Student Enrollment

- Indicate the number of students you anticipate will choose to pursue this certificate.
We anticipate initial enrollment to be modest, about 10. Growth will be facilitated with outreach to the relevant populations in both Earth Sciences and Astronomy, as well as students in engineering. The Undergraduate Studies Committees in both Earth Sciences and Astronomy will advertise the certificate during student visit days, communicate the opportunity to advisors and the career center.

5. Curricular Requirements

- Provide ASC certificate advising sheet (see Appendix 5).
- List the courses (department, title, credit hours, description) which constitute the requirements and other components of the certificate. If any courses have prerequisites, please indicate so. Indicate which courses are currently offered and which will be new. When new course requests are submitted through curriculum.osu.edu, indicate that those course requests are being submitted as part of a new certificate proposal. As much as possible, the curriculum committees will review the course requests in conjunction with the certificate proposal.

Each student completing the certificate will take an introductory class at the General Education level, a relevant disciplinary class, a class focused on data collection and interpretation in the planetary sciences/remote sensing, and complete a newly proposed, cross-listed and co-taught Planetary Science course.

Course Number	Course Name	Credit Hours	Prereqs.
Take <i>one</i> of the following INTRODUCTORY courses			
EARTHSC 2205	<i>The Planets:</i> Survey of the solar system's planets and moons with focus on surface environments, dynamics, and the ability to host life.	3	
ASTRON 1141	<i>Life in the Universe:</i> Potential for life elsewhere in the universe, based on discovery of extra-solar planets and nature of life on Earth; search strategies for such life.	3	
ASTRON 2291	<i>Basic Astrophysics and Planetary Astronomy:</i> Motions and physical nature of objects in the solar system; electromagnetic radiation, telescopes, and astronomical detectors.	3	Physics 1251 (133), or permission of instructor. Not open to students with credit for 291.

Course Number	Course Name	Credit Hours	Prereqs.
Take <i>one</i> disciplinary course from the following:			

EARTHSCI 5646	<i>Geodynamics</i> : Application of mathematical and physical methods to the solution of geologic problems in heat flow, plate tectonics, interior dynamics, mountain building, ground-water flow, river mechanics.	3	EARTHSC 4530/6530, MATH 1152, PHYSICS 1250
EARTHSCI 5680	<i>Deep Earth Geophysics</i> : Methods and techniques for study of Earth's crust and interior, involving potential fields, seismology, and heat flow.	3	MATH 1152, PHYSICS 1251
EARTHSCI 5550	<i>Geomorphology</i> : Investigation of the mechanics and chemistry of landscape development; interpretation of materials, processes, types, and evolution of landforms produced under diverse climates.	4	EARTHSC 1100, 1121, OR 1200; AND EARTHSC 1122 or 2122; or permission of instructor
GEODSCI 5781	<i>Geodesy and Geodynamics</i> : Crustal motion geodesy, reference frame realization and station trajectory analysis, plate motion and Euler's theorem, earthquake deformation cycle, elastic and viscoelastic responses to surface loading, numerical methods.	3	MATH 1152, 2174, 2568, or 5601, or PHYSICS 1251, or by permission of instructor

Course Number	Course Name	Credit Hours	Prereqs.
Take <i>one</i> of the following courses, with emphasis on techniques and/or data analysis			
EARTHSC 4560	<i>Applied Geophysics</i> : Methods and techniques of pure and applied geophysics; geological interpretation of geophysical data.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205, Math 1151 & Physics 1250
EARTHSC 5310	<i>Earth Observation (Remote Sensing in the Earth Sciences)</i> : The overall learning of geodetic (active) and passive remote sensing technologies and in-depth data analytics of their processing to apply to research in Earth sciences and engineering. This course is focused on students learning the theory and data processing methods to enable the use of contemporary satellite or airborne platform-equipped observations for science and engineering applications.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; and MATH 1141 or 1151 or above, and Physics 1250 or above; or grad standing; or permission of instructor
ASTRON 3350	<i>Methods of Astronomical Observation and Data Analysis</i> : Astronomical observational techniques and quantitative analysis of astronomical data; practical experience with modern astronomical instrumentation and computer-based reduction, analysis, and interpretation of astronomical data.	3	ASTRON 1162, 1162H, or 2292; MATH 1152; PHYSICS 1251
GEOG 5210	<i>Fundamentals of Geographic Information Systems</i> : Basic principles of geographic and land information systems and their use in spatial analysis and information management.	3	Not open to students with credit for 5220 (607), CRPlan 5001 (607), or CivilEn 5001(607)
GEOG 5225	<i>Geographic Applications of Remote Sensing</i> : Introduction to the fundamental principles, methods, and geographic applications of remote sensing.	3	Not open to students with credit for 5270

CIVILEN 5001	<i>Introduction to Geographic Information Systems:</i> Introduction to the basic principles of geographic information systems and their use in spatial analysis and information management.	4	CivEng 2050, for CivilEn and EnvEng majors only

Course Number	Course Name	Credit Hours	Prereqs.
All students must take:			
EARTHSC/ASTRO 5205	<i>Planetary Science:</i> The observation, description, and modeling of planets, including those of the Solar System and exoplanets in the Galaxy	3	Math 1152 or equivalent

- State the minimum number of credits required for completion of the certificate.

Total 12-14 hours. (Range due to the fact that some of the listed disciplinary and techniques courses are 4 credit hours)

- Indicate the number of semesters expected to complete the certificate. Confirm that courses are offered frequently enough and have the capacity to meet this expectation.

4 semesters, limited by initially offering Astro/EarthSc 5205 on alternate years. The prerequisites for this course are modest so that students may take the course after taking just one class for the certificate.

- If applicable, describe existing facilities, equipment, and off-campus field experience and clinical sites to be used. Indicate how the use of these facilities, equipment, etc., will impact other existing programs.

None.

- For interdisciplinary certificates, describe the way in which advising and other student support will be provided.

Astronomy and Earth Science Advisors will advise collaboratively, consulting with DUG's as necessary

- If applicable, describe additional university resources (including advisors and libraries) that will be required for the new certificate.

Advising and students support services are available through the department, college, and university, as is available to any student pursuing a program.

- Provide ASC completion sheet for certificates.
- Provide semester-by-semester sample program.

Earth Science Major

Year 1:

EarthSc 2205 (Spring); EarthSc 4560 (Spring, even years) or EarthSc 5205 (Spring, odd years)

Year 2:

GeodSci 5781 (fall, odd years) or EarthSc 5646 (fall, even years)

EarthSc 5205 (Spring, odd years) or EarthSc 4560 (Spring, even years)

Astronomy Major

Year 1:

Astro 2291 (Autumn)

EarthSc 4560 (Spring, even years) or Astron 5205 (Spring, odd years)

Year 2:

Astro 3350 (Autumn)

EarthSc 5205 (Spring, odd years) or EarthSc 4560 (Spring, even years)

The following tables outline how students may complete the requirements of the certificate, leveraging classes they are already taking for their majors. Both BS Earth Science, Geophysics subprogram, and BS Astrophysics students will be able to overlap their curriculum by 50%, as permitted by the rules of the certificate.

PATHWAY FOR GEOPHYSICS SUBPROGRAM STUDENTS	COURSE (CREDIT HOURS)	DESCRIPTION	PREREQUISITES
	EARTHSC/ASTRO 5205: <i>Planetary Science</i> (3)	The observation, description, and modeling of planets, including those of the Solar System and exoplanets in the Galaxy	Math 1152 or equivalent AND a GE data analysis course; OR permission of instructor
	EARTHSC 2205: <i>The Planets</i> (3)	Survey of the solar system's planets and moons with focus on surface environments, dynamics, and the ability to host life.	
	EARTHSCI 4560: <i>Applied Geophysics</i> (3)	Methods and techniques of pure and applied geophysics; geological interpretation of geophysical data.	1121, and Math 1141 or 1151 or above, and Physics 1250 or above.
	AND ONE MORE COURSE FROM THE FOLLOWING LIST:		
	EARTHSCI 5646: <i>Geodynamics</i> (3)	Application of mathematical and physical methods to the solution of geologic problems in heat flow, plate tectonics, interior dynamics, mountain building, ground-water flow, river mechanics.	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205 , Math 1151 & Physics 1250
	EARTHSC 5680: <i>Deep Earth Geophysics</i> (3)	Methods and techniques for study of Earth's crust and interior, involving potential fields, seismology, and heat flow.	MATH 1152, PHYSICS 1251
	EARTHSC 5550: <i>Geomorphology</i> (4)	Investigation of the mechanics and chemistry of landscape development; interpretation of materials, processes, types, and evolution of landforms produced under diverse climates	EARTHSC 1100, 1121, OR 1200; AND EARTHSC 1122 or 2122 ; or permission of instructor
	GEODSCI 5781: <i>Geodesy and Geophysics</i> (4)	Crustal motion geodesy, reference frame realization and station trajectory analysis, plate motion and Euler's theorem, earthquake deformation cycle, elastic and viscoelastic responses to surface loading, numerical methods.	MATH 1152, 2174, 2568, or 5601 or PHYSICS 1251 or by permission

PATHWAY FOR ASTRONOMY AND ASTROPHYSICS STUDENTS	COURSE (CREDIT HOURS)	DESCRIPTION	PREREQUISITES
	EARTHSC/ASTRO 5205: <i>Planetary Science (3)</i>	The observation, description, and modeling of planets, including those of the Solar System and exoplanets in the Galaxy	Math 1152 or equivalent AND a GE data analysis course; OR permission of instructor
	ASTRON 2291: <i>Basic Astrophysics and Planetary Astronomy (3)</i>	Motions and physical nature of objects in the solar system; electromagnetic radiation, telescopes, and astronomical detectors.	Physics 1251
	ASTRON 3350 (3 hours)	Astronomical observational techniques and quantitative analysis of astronomical data; practical experience with modern astronomical instrumentation and computer-based reduction, analysis, and interpretation of astronomical data.	ASTRON 1162, 1162H, or 2292; MATH 1152; PHYSICS 1251
	AND ONE MORE COURSE FROM THE FOLLOWING LIST:		
	EARTHSC 5680: <i>Deep Earth Geophysics (3)</i>	Methods and techniques for study of Earth's crust and interior, involving potential fields, seismology, and heat flow.	MATH 1152, PHYSICS 1251
	EARTHSCI 4560: <i>Applied Geophysics (3)</i>	Methods and techniques of pure and applied geophysics; geological interpretation of geophysical data.	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205 , Math 1151 & Physics 1250.
	GEODSCI 5781: Geodesy and Geophysics (4)	Crustal motion geodesy, reference frame realization and station trajectory analysis, plate motion and Euler's theorem, earthquake deformation cycle, elastic and viscoelastic responses to surface loading, numerical methods.	MATH 1152, 2174, 2568, or 5601 or PHYSICS 1251 or by permission

Additional Graduate School Guidelines

- Students must be admitted into a graduate certificate program.
- Admitted students must meet the minimum admission requirements of the Graduate School.
- Certificates are administered by a graduate studies chair and committee that are responsible for admission decisions.
- Proposals originate in a TIU following the TIU's curricular approval process. Once submitted in curriculum.osu.edu and approval by the college, proposals will be routed automatically to the Graduate School for review. Once approved by the Graduate School, proposals are review by the Council on Academic Affairs (CAA).
- A letter of support from the college dean or associate executive dean must accompany the proposal.
- *If a graduate non-degree student is admitted to a graduate certificate program, no more than four hours of semester graduate credit accumulated while in this non-degree classification may be counted toward the certificate.*

COLLEGE OF ARTS AND SCIENCES
THE OHIO STATE UNIVERSITY

TYPE 1B PLANETARY SCIENCE CERTIFICATE (PLANETS-CT)

Coordinating Advisor (Earth Sciences): Professor Ashley Griffith, 381 Mendenhall Labs, Columbus, OH 43210; griffith.233@osu.edu

Coordinating Advisor (Astronomy and Astrophysics): Professor Scott Gaudi, 4005 McPherson Laboratory, Columbus, OH 43210; gaudi.1@osu.edu

The 12-14 credit hour Planetary Science Certificate will prepare students to continue in the field of planetary science or planetary exploration. The certificate is designed to enhance both critical thinking and the technical skills for practicing planetary science.

Introductory course (3 credits):

- **EARTHSC 2205:** The Planets (3)
- **ASTRON 1141:** Life in the Universe (3)
- **ASTRON 2291:** Basic Astrophysics and Planetary Astronomy (3)

A disciplinary course (3-4 credits):

- **EARTHSC 5646:** Geodynamics (3)
- **EARTHSC 5680:** Deep Earth Geophysics (3)
- **EARTHSC 5550:** Geomorphology (4)
- **GEODSCI 5781:** Geodesy and Geodynamics (3)

A techniques/data course (3-4 credits):

- **EARTHSC 4560:** Applied Geophysics (3)
- **EARTHSC 5310:** Remote Sensing in the Earth Sciences (3)
- **ASTRON 3350:** Methods of Astronomical Observation and Data Analysis (3)
- **GEOG 5210:** Fundamentals of Geographic Information Systems (3)
- **GEOG 5225:** Geographic Applications of Remote Sensing (3)
- **CIVILEN 5001:** Introduction to Geographic Information Systems (4):

Required core course (3 credits):

- **EARTHSC/ASTRON 5205:** Planetary Science (3)

Planetary Science Certificate program guidelines

The following guidelines govern the Planetary Science Certificate. Required for certificate:

Credit hours required: 12-14 credit hours.

Overlap with a major

- Max 50% overlap with major program courses.

Grades required

- Minimum C- for a course to be listed on the certificate.
- Minimum 2.00 cumulative point-hour ratio required for the certificate.

X193 credits: Not permitted.

Certificate Completion: If the certificate is not complete on the DAR, the student must consult with the College of Arts and Sciences Coordinating Advisor.

Filing the certificate program form: The certificate program form must be filed at least by the time the graduation application is submitted to a college/school counselor.

Changing the certificate: Once the certificate program is filed in the college office, any changes must be approved by the College of Arts and Sciences Coordinating Advisor.

School of Earth Sciences undergraduate advisor
Dr. Karen Royce royce.6@osu.edu 614-292-6961

Astronomy and Astrophysics undergraduate advisor: Mr. David Zach, zach.11@osu.edu 614-292-1358

**COLLEGE OF ARTS AND SCIENCES
THE OHIO STATE UNIVERSITY**

TYPE 1B PLANETARY SCIENCE CERTIFICATE (PLANETS-CT)

Student: _____

Course	Credit Hours	Semester Completed	Overlap with major?
<i>Introductory course</i>			
<i>Disciplinary course</i>			
<i>Techniques/Data course</i>			
<i>Planetary Science Requirement</i>			
EARTHSC/ASTRON 5205	3		

Total Credit hours: _____ (minimum 12)

Credits double counted with major: _____ (maximum 50%)

Advisor's signature _____

Introductory course (3 credits):

- **EARTHSC 2205:** The Planets (3)
- **ASTRON 1141:** Life in the Universe (3)
- **ASTRON 2291:** Basic Astrophysics and Planetary Astronomy (3)

A disciplinary course (3-4 credits):

- **EARTHSC 5646:** Geodynamics (3)
- **EARTHSC 5680:** Deep Earth Geophysics (3)
- **EARTHSC 5550:** Geomorphology (4)
- **GEODSCI 5781:** Geodesy and Geodynamics (3)

A techniques/data course (3 credits):

- **EARTHSC 4560:** Applied Geophysics (3)
- **EARTHSC 5310:** Remote Sensing in the Earth Sciences (3)
- **ASTRON 3350:** Methods of Astronomical Observation and Data Analysis (3)
- **GEOG 5210:** Fundamentals of Geographic Information Systems (3)
- **GEOG 5225:** Geographic Applications of Remote Sensing (3)
- **CIVILEN 5001:** Introduction to Geographic Information Systems (4):

Required core course (3 credits):

- **EARTHSC/ASTRON 5205:** Planetary Science (3)



October 10, 2019

I am pleased to offer the College of Arts and Sciences' support for the proposed embedded undergraduate certificate in "Planetary Science," to be offered jointly by the School of Earth Sciences and the Department of Astronomy. Earth Sciences and Astronomy advisors will work collaboratively to guide students successfully through this certificate program. This is an innovative certificate that fills a gap in our curricular offerings and which should have considerable appeal as a complement to students majoring in Earth Sciences, Astronomy, Physics, and Aeronautical Engineering, among others. At this time, it is to be an embedded certificate (i.e., available to degree-seeking students at OSU), to be delivered via in-person delivery on campus.

Sincerely,

Steve Fink

Associate Executive Dean



October 1, 2019

To ASCC and CAA members:

I am writing to document the School of Earth Science's strong endorsement of five new certificate programs proposed as part of their substantial revision of the Earth Sciences BS program:

- Certificate in Natural History Museum Curation (certificate types 1, 2, and 3: embedded undergraduate; post-bachelor undergraduate; and graduate certificate (both embedded and stand-alone)).
- Certificate in Petroleum Geology (certificate types 1, 2, and 3, as above).
- Certificate in Hydrogeology (certificate types 1, 2, and 3, as above).
- Certificate in Marine Science (certificate types 1 and 3, as identified above).
- Certificate in Planetary Science (certificate type 1, as identified above).

All five of these certificates have been designed for in-person delivery at this time. Each certificate proposal (as well as the redesign of the Earth Sciences BS program) is the result of thoughtful and extensive assessment of the curriculum, student interest, and market appeal. These certificates are designed to complement a number of existing natural science programs (both graduate and undergraduate—so they utilize 5000-level dual-career courses), and they should also, in distinct ways, appeal to individuals who are in the workforce and have already earned Bachelor's degrees, to advance their careers and expand career opportunities.

Please feel free to contact me if you have any additional questions.

Sincerely,

Matthew R. Saltzman
Professor and Director
School of Earth Sciences



David Weinberg, Chair
Department of Astronomy
McPherson Laboratory
140 W. 18th Avenue
Columbus, OH 43210-1173
614-292-2022 Phone
weinberg.21@osu.edu

October 2, 2019

Dear Colleagues,

I am writing to document the Department of Astronomy's endorsement of the new program: Certificate in Planetary Science (certificate type 1, embedded undergraduate).

This certificate has been designed for in-person delivery. The certificate proposal is the result of thoughtful and extensive assessment of the curriculum, student interest, and market appeal. This certificate is designed to complement a number of existing natural science programs, most notably the Geophysics subprogram of the BS in Earth Science and the BS in Astronomy and Astrophysics. Such a certificate will advance the readiness for students to pursue graduate work and careers in the planetary sciences.

Please feel free to contact me if you have any additional questions.

Sincerely,

David H. Weinberg
Distinguished University Professor and Chair of Astronomy