THE UNIVERSITY OF ARIZONA®

New Academic Program Workflow Form

General

Proposed Name: Planetary Geoscience

Transaction Nbr: 00000000000167

Plan Type: Major

Academic Career: Undergraduate

Degree Offered: Bachelor of Science

Do you want to offer a minor? N

Anticipated 1st Admission Term: Fall 2023

Details

Department(s):

SCNC

DEPTMNT ID	DEPARTMENT NAME	HOST
0426	Planetary Sciences	Y

Campus(es):

MAIN

LOCATION	DESCRIPTION
TUCSON	Tucson

Admission application terms for this plan: Spring: Y Summer: Y Fall: Y

Plan admission types:

Freshman: Y Transfer: Y Readmit: Y Graduate: N

Non Degree Certificate (UCRT only): N

Other (For Community Campus specifics): N

Plan Taxonomy: 40.0203, Planetary Astronomy and Science.

Program Length Type: Program Length Value: 0.00

Report as NSC Program:

SULA Special Program:

Print Option:

Diploma: Y B.S. Planetary Geoscience

Transcript: Y Planetary Geoscience

Conditions for Admission/Declaration for this Major:

No criteria

Requirements for Accreditation:

N/A

Program Comparisons

University Appropriateness

The proposed PTGS B.S. aligns with several pillars within the UA strategic plan:
- Pillar 1 Wildcat Journey: The new PTGS major will prepare the next generation of students with unique skills and mindsets to lead in the 4th Industrial Revolution. It will recruit prospective high-potential undergraduate students and attract the best and brightest students from Arizona and around the world.
- Pillar 2 Grand Challenges: The UA is a global leader in space missions and identifies space and future Earth as Grand Challenges. Planetary Geoscientists graduating from the new program will be able to tackle critical problems at the edges of human endeavor in space exploration. They will be uniquely qualified to advance human and non-human space exploration, understand the origins and existence of life in space, develop space technologies in service of monitoring and supporting Earth from man-made and natural space threats, and define the future of space development.
- Pillar 3 Arizona Advantage: This program will build on [our] unique location by capitalizing on the strong ties between the departments of Geosciences and Planetary Sciences with Arizona's unique research facilities (e.g., Catalina Sky Survey and other telescopes), unique landscape providing a natural laboratory for study of rocky planetary surfaces (e.g., Meteor Crater, San Francisco Volcanic Field), and unique leadership role in planetary exploration (e.g., HiRISE camera at Mars, OSIRIS-REx mission to Bennu).
- Pillar 5 Institutional Excellence: The new PTGS B.S. will train a dynamic and high-caliber new generation of students who will be uniquely prepared for scientific exploration and innovation.

Arizona University System

NBR	PROGRAM	DEGREE	#STDNTS	LOCATION	ACCRDT

Peer Comparison

See attached peer comparison chart.
Undergraduate degrees in planetary science are relatively rare among our peer institutions. Comparable programs can be found at Purdue (BS in Planetary Sciences), UC Santa Cruz (PS in Earth Science with Planetary Science concentration), and Rutgers (BS in Earth and Planetary Science with planetary science track). These programs are comparable in requiring a foundation in basic math and physics, in addition to a solid grounding in the earth sciences. The upper level courses in our program (both the required 400-level PTYS courses and the advanced emphasis electives) reflect the unique breadth and depth of the Department of Planetary Science at the University of Arizona. Our tutorial in planetary science will also provide a unique perspective to our students.

Faculty & Resources

Faculty

Current Faculty:

INSTR ID	NAME	DEPT	RANK	DEGREE	FCLTY/%
01666703	Peter Decelles	1205	Professor	Doctor of Philosophy	1.00
06000338	Dante Lauretta	0426	Professor	Doctor of Philosophy	1.00
07207332	Joe Giacalone	0426	Professor	Doctor of Philosophy	1.00
22060118	Christopher Hamilton	0426	Assoc. Prof	Doctor of Philosophy	1.00
22073263	Jeffrey Andrews-Hanna	0426	Assoc. Prof	Doctor of Philosophy	1.00
22080703	Pranabendu Moitra	1205	Assit. Prof	Doctor of Philosophy	1.00

Additional Faculty:

None

Current Student & Faculty FTE

DEPARTMENT	UGRD HEAD COUNT	GRAD HEAD COUNT	FACULTY FTE
0426	0	46	28.00
1205	181	63	31.00

Projected Student & Faculty FTE

	UGRD HEAD COUNT			GRAD HEAD COUNT			FACULTY FTE		
DEPT	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3
0426	10	24	42	46	46	46	28.00	28.00	28.00

Library

Acquisitions Needed:

None

Physical Facilities & Equipment

Existing Physical Facilities:

Existing physical facilities are adequate. All courses already use existing facilities. Students also have access to a computing facility in the Geosciences department, in addition to university computer labs.

Additional Facilities Required & Anticipated:

None.

Other Support

Other Support Currently Available:

None.

Other Support Needed over the Next Three Years:

The program will need additional staff support, including an academic advisor (0.25 FTE) and administrative support (1.0 FTE).

Comments During Approval Process

12/16/2022 11:37 AM

MELANIECMADDEN

Comments
updated undergrad headcount per email from JCAHANNA

12/16/2022 11:39 AM

APBRENTON

Comments
Approved.

12/16/2022 11:40 AM

MELANIECMADDEN

Comments
Approved.

1/2/2023 6:31 PM

RGOMEZ

Comments
Approved.

THE UNIVERSITY OF ARIZONA

ACADEMIC PROGRAM – ADDITIONAL INFORMATION FORM

To be used once the preliminary proposal has been approved.

I. MAJOR REQUIREMENTS

UNDERGRADUATE

Total units required to complete the degree	120
Upper-division units required to complete the degree	42
Foundation courses	
Second language	2nd Semester Proficiency
Math	S-Strand
General education requirements	General Education: ENG 101/102 or ENGL 109H (3-6 units) Introduction to General Education (1 unit) Exploring Perspectives (12 units) Building Connections (9 units) GE Capstone (1 unit)
Pre-major? (Yes/No). If yes, provide requirements. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	No
List any special requirements to declare or gain admission to this major (completion of specific coursework, minimum GPA, interview, application, etc.)	None
Major requirements	
Minimum # of units required in the major (units counting towards major units and major GPA)	50
Minimum # of upper-division units required in the major (upper division units counting towards major GPA)	40
Minimum # of residency units to be completed in the major	18

Required supporting coursework (courses that do not count towards major units and major GPA, but are required for the major). Courses listed must include prefix, number, units, and title. Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	- MATH 122 (3) Calculus 1 - MATH 129 (3) Calculus 2 - PHYS 141 (4) Introduction to Mechanics - PHYS 142 (4) Introduction to Thermodynamics and Optics - Chem 151 (4) General Chemistry I Complete 1 of the following: - Math 223 (4) Calculus III - Math 254 (3) Differential equations - Math 263 (3) Statistics - Math 313 (3) Introduction to Linear Algebra
Major requirements. List all major requirements including core and electives. If applicable, list the emphasis requirements for each proposed emphasis*. Courses listed count towards major units and major GPA. Courses listed must include prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	- GEOS 251 (4) Physical Geology - PTYS 270 (3) Planetary Geoscience Complete 1 of the following: - GEOS 280 (3) Computing (Matlab) - GEOS 285 (3) Computing (Python) Complete 4 of the following: - GEOS 300 (3) Surface Processes - GEOS 302 (4) Sedimentology and Stratigraphy - GEOS 304 (4) Structural Geology - GEOS 306 (3) Mineralogy - GEOS 322 (3) Geophysics - GEOS 356 (4) Petrology Complete each of the following: - PTYS 403 (3) Physics of the Solar System - PTYS 407 (3) Chemistry of the Solar System

	- PTYS 411 (3) Geology and Geophysics of the Solar System **Complete 9 units of advanced emphasis courses (must include at least 6 units of PTYS courses)** ASTR 475 Planetary Astrobiology PTYS 413 Planetary Materials PTYS 414 Introduction to Plasma Physics PTYS 416 Asteroids, Comets and Kuiper Belt Objects PTYS 418 Astronomical Instrumentation PTYS 423 Moons PTYS 442 Mars PTYS 450 Origin of the Solar System and Other Planetary Systems GEOS 400 Introduction to Geochemistry GEOS 408 Tectonic Petrology GEOS 410 Microbial Biogeochemistry and Global Change GEOS 412A Ocean Sciences GEOS 415 Geologic Hazards GEOS 417 Sedimentary Basin Analysis GEOS 419 Physics of the Earth GEOS 422 Critical Zone Science & Management GEOS 423 Regional Structural Geology GEOS 424A Space Geodesy GEOS 425 Regional Tectonics GEOS 427 Orogenic Systems GEOS 430 The Chemical Evolution of Earth GEOS 432 Introduction to Seismology GEOS 434A Introduction to Exploration Seismology

	GEOS 436 Earthquakes and Volcanic Systems: Processes and Hazards GEOS 437 Introduction to Earth-System Modeling GEOS 440 Geodynamics GEOS 442 Mars GEOS 446 Economic Mineral Deposits GEOS 447 Global and Regional Climatology GEOS 448 Geophysical Exploration and Engineering GEOS 450 Geomorphology and Landscape Evolution GEOS 453 Glacial and Quaternary Geology GEOS 456 Thrust Belts and Synorogenic Sediments GEOS 460 Characterization and Identification of Minerals GEOS 466 Stable Isotope Geochemistry and Paleoclimate GEOS 469 Seismic Data Processing GEOS 470L Volcanology: Laboratory and Field Methods GEOS 470R Volcanology: Physical Processes and Petrologic Applications GEOS 474A Geochronology and Thermochronology GEOS 477 Active Tectonics GEOS 478 Global Change GEOS 479 Introduction to Climate Dynamics GEOS 482 Paleoclimatology GEOS 483 Modes of Climate Variability GEOS 484 The Coevolution of Earth and the Biosphere

	GEOS 486 Organic Geochemistry GEOS 487 Physical and Dynamical Oceanography GEOS 489 Quaternary Geochronology GEOS 490 Remote Sensing for the Study of Planet Earth GEOS 496E Topics in Structure and Tectonics
Internship, practicum, applied course requirements (Yes/No). If yes, provide description.	Yes. Complete 3 units: - PTYS 395 Tutorial in Planetary Science
Senior thesis or senior project required (Yes/No). If yes, provide description.	Yes. Complete 6 units of capstone research and/or field experience: - PTYS 498 Capstone research - PTYS 4XX (3) Planetary Field Studies - GEOS 414 (6) Field Camp - Other courses with a substantial field component or field camps run by other universities with permission.
Additional requirements (provide description)	None
Minor (specify if optional or required)	Optional
Any double-dipping restrictions (Yes/No)? If yes, provide description.	Yes, major core courses not permitted to double-dip

II. CURRENT COURSES

Course prefix and number (include cross-listings)	Units	Title	Pre-requisites	Modes of delivery (online, in-person, hybrid)	Typically Offered (F, W, Sp, Su)	Dept signed party to proposal? (Yes/No)

Math 122 or MATH 125	3	Calculus I	Math 120R, or MATH 122 plus MATH 111, with a grade of C or higher, or appropriate math placement	In-person	F,Sp	No
Math 129	3	Calculus II	MATH 122B or MATH 125 with a grade of C or higher	In-person	F,Sp	No
Math 223	4	Vector Calculus	MATH 122B or MATH 125 with a grade of C or higher	In-person	F,Sp	No
Math 254	3	Differential Equations	MATH 129 or 223	In-person	F,Sp	No
Math 263	3	Statistics and Biostatistics	MATH 112	In-person	F,Sp	No
Math 313	3	Introduction to Linear Algebra	MATH 129	In-person	F,Sp	No
Chem 151	4	General Chemistry I	MATH 112 or Math placement level, Calc 65+	In-person	F,Sp	No
PHYS 141	4	Introductory Mechanics	Math 122; CR: Math 129	In-person		No
PHYS 142	3	Introductory Optics and Thermodynamics	PHYS 141, MATH 129	In-person		No
PTYS 270	3	Planetary Geoscience	GEOS 251	In-person	?	Yes
GEOS 251	4	Physical Geology		In-person	F,Sp	Yes
GEOS 280	3	Programming and Data Analysis in the Earth Sciences	GEOS majors and minors only (*This will be changed to accommodate PTGS majors)*	In-person	F	Yes
GEOS 285	3	Introduction to Python in Geoscience	GEOS 251	In-person	Sp	Yes
GEOS 300	3	Earth Surface Processes	GEOS 251	In-person	Sp	Yes
GEOS 302	4	Principles of Stratigraphy and Sedimentation	GEOS 251, CHEM 151, PHYS 102 or 141	In-person	F	Yes
GEOS 304	4	Structural Geology	GEOS 251, PHYS 102 or 141	In-person	Sp	Yes
GEOS 306	3	Mineralogy	GEOS 251, CHEM 151	In-person	Fa	Yes
GEOS 322	3	Introduction to Geophysics	GEOS 251, MATH 122B or 125	In-person	Fa	Yes
GEOS 356	4	Petrology	GEOS 306, MATH 122B, PHYS 102 or 141	In-person	Sp	Yes
PTYS 403	3	Physics of the Solar System	PHYS 142 or PHYS 251	In-person	Sp	Yes
PTYS 407	3	Chemistry of the Solar System	CHEM 104, MATH 129	In-person	F	Yes

PTYS 411	3	Geology and Geophysics of the Solar System		In-person	Sp	Yes
PTYS 498	variable	Capstone research		In-person	F,Sp	Yes
GEOS 414	6	FIELD CAMP	GEOS 251, GEOS 302, GEOS 304	In-person	Su	Yes

III. NEW COURSES NEEDED

Course prefix and number (include cross-listings)	Units	Title	Pre-requisites	Modes of delivery (online, in-person, hybrid)	Status*	Anticipated first term offered	Typically Offered (F, W, Sp, Su)	Dept signed party to proposal? (Yes/No)	Faculty members available to teach the courses
PTYS 4XX	3	Planetary field studies	GEOS 251, PTYS 270, at least 2 of GEOS 300, 302, 304, or 322	In-person	D	Spring 2025	F, W, Su	Yes	Peter DeCelles (GEOS) John Holt (PTYS/GEOS) Paul Kapp (GEOS) Pranabendu Moitra (GEOS)
PTYS 395	1	Planetary sciences tutorial	PTYS 270	In-person	D	Fall 2024	F, Sp	Yes	Christopher Hamilton (PTYS)

*In development (D); submitted for approval (S); approved (A)

IV. FACULTY INFORMATION

Faculty Member	Involvement	UA Vitae link or Box folder link
Jeffrey Andrews-Hanna	Faculty advisor	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e
Peter DeCelles	Faculty advisor, teaches GEOS 414	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e
Christopher Hamilton	Teaches PTYS 411	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e
Joe Giacalone	Teaches PTYS 403	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e
Dante Laurette	Teaches PTYS 407	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e
Pranabendu Moitra	Teaches PTYS 270	https://arizona.box.com/s/rplb4dj58z0ccbvi62vbgy9pjxnsrn8e

V. GRADUATION PLAN –

Semester 1		Semester 2		Semester 3		Semester 4	
Course prefix and number	Units	Course prefix and number	Units	Course prefix and number	Units	Course prefix and number	Units
Math 122	3	MATH 129	3	MATH 223	4	CHEM 151	4
Second Language	4	PHYS 141	4	PHYS 142	4	GEOS 300	3
UNIV 101	1	GEOS 251	4	PTYS 270	3	GEOS 304	4
ENGL 101	3	Second language	4	GEOS 285	3	PTYS 395	1
Expl. Persp.	6	ENGL 102	3	Expl. Persp.	3	Expl. Persp.	3
Total	17	Total	18	Total	17	Total	15

Semester 5		Semester 6		Semester 7		Semester 8	
Course prefix and number	Units	Course prefix and number	Units	Course prefix and number	Units	Course prefix and number	Units
GEOS 302	4	PTYS 403	3	PTYS 407	3	PTYS 411	3
GEOS 322	3	PTYS 395	1	PTYS 498	1	PTYS 498	2
PTYS 395	1	Adv. emphasis opt.	3	Adv. emphasis opt.	3	Adv. emphasis opt.	3
Bldng. Conn.	6	Free elective	3	PTYS 4xx (field)	3	UNIV 301	1
		Bldng. Conn.	3	Free elective	3	Free elective	4
Total	14	Total	13	Total	13	Total	13

VI. Curriculum Map and Assessment Map

Program: BS Planetary Geoscience

Learning Outcome #1: Identify the planets and classes of minor objects and describe key features associated with them
Concepts: Basic properties of the planets and classes of minor objects, basic processes governing planetary evolution
Competencies: Students will demonstrate a familiarity with all planets and classes of minor objects Solar System.
Assessment Methods: This outcome will be assessed in the homework and exams in PTYS 270.
Measures: Instructor grading of homework and exams, using rubrics.
Learning Outcome #2: Explain the physical processes governing solar system dynamics
Concepts: Gravity, orbital dynamics, tides, atmospheric dynamics, magnetic fields
Competencies: Students will demonstrate a quantitative knowledge of processes governing the dynamics of planetary motions and atmospheres
Assessment Methods: This outcome will be assessed in homework and exams of PTYS 403
Measures: Instructor grading of homework, exams, and papers, using rubrics
Learning Outcome #3: Relate the chemical makeup of planetary bodies to the formation and evolution of the solar system.
Concepts: Cosmochemistry, geochemistry, origin of the elements, isotopes, radioactive nuclides, chemical fractionation, meteorites, solar system chronology
Competencies: Students will be able to interpret data related to the composition of solar system materials, including isotope plots, phase diagrams, and elemental abundance patterns
Assessment Methods: This outcome will be assessed in homework and exams in PTYS 407
Measures: Instructor grading of homework and exams in PTYS 407, using rubrics
Learning Outcome #4: Solve quantitative problems related to the geological processes that have shaped planetary landscapes.
Concepts: Tectonics, aeolian processes, volcanism, impact cratering, weathering and erosion, ices
Competencies: Students will solve quantitative problems relating to the processes at work on planetary surfaces and interiors.
Assessment Methods: This outcome will be assessed in homework and exams in PTYS 411
Measures: Instructor grading of homework, exams, and final papers in PTYS 411, using rubrics.
Learning Outcome #5: Collect, analyze, and interpret data through research or field work.
Concepts: Scientific method, research practices, scientific reporting, field observations and interpretations
Competencies: Students will apply their knowledge and skills in a guided research project or field work
Assessment Methods: This outcome will be assessed based on the student's work in either a capstone research project or field course
Measures: Instructor grading of senior capstone project or field course, using rubrics.

	Learning Outcome #1: Identify the planets and classes of minor objects and describe key features associated with them	**Learning Outcome #2**: Explain the physical processes governing solar system dynamics	**Learning Outcome #3:** Relate the chemical makeup of planetary bodies to the formation and evolution of the solar system	**Learning Outcome #4:** Solve quantitative problems related to the geological processes that have shaped planetary landscapes.	**Learning Outcome #5:** Collect, analyze, and interpret data through research or field work.
PTYS 270 PTYS 403 PTYS 407 PTYS 411 PTYS 395 PTYS 498 or field course	I,P,A	I P,A	I P,A	I P,A	 I P,A

I=Introduced; P=Practiced; A=Assessed

12/2/22, 10:28 AM Curriculum Map - Courses and Activities Mapped to BS Planetary Geoscience

University of Arizona AMS » Sandboxes

Ingrid Novodvorsky Playspace

BS Planetary Geoscience

Courses and Activities Mapped to BS Planetary Geoscience

	Outcome				
	Outcome 1: Identification Identify the planets and classes of minor objects and describe key features associated with them.	Outcome 2: Explain Explain the physical processes governing solar system dynamics.	Outcome 3: Chemistry Relate the chemical makeup of planetary bodies to the formation and evolution of the solar system.	Outcome 4: Problem-Solving Solve quantitative problems related to the geological processes that have shaped planetary landscapes.	Outcome 5: Research/Field Work Collect, analyze, and interpret data through research or field work.
Courses and Learning Activities					
PTYS 270 Planetary Geoscience	IPA	I	I	I	
PTYS 403 Physics of the Solar System		P/A			
PTYS 407 Chemistry of the Solar System			P/A		
PTYS 411 Geology and Geophysics of the Solar System				P/A	
PTYS 395 Planetary Sciences Tutorial					I
PTYS 498 (or Field Course)					P/A
Exit Survey Indirect Measure	A	A	A	A	A

Legend : I Introduced; P Practiced; A Assessed; I/P Introduced/Practices; P/A Practiced/Assessed

Last Modified: 12/02/2022 10:27:54 AM

Created with watermark

VII. PROGRAM ASSESSMENT PLAN

Assessment Measure	Source(s) of Evidence	Data Collection Point(s)
Length of time to graduate	Internally generated statistics	Every year
Student program assessment	Senior exit survey	Every year
Job Placement Statistics	Student/Alumni Survey	At graduation and as part of alumni survey
Academic Program Review	Reviewers' responses	Every 7 years

VIII. ANTICIPATED STUDENT ENROLLMENT-

5-YEAR PROJECTED ANNUAL ENROLLMENT					
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Number of Students	10	24	42	50	54

Data/evidence used to determine projected enrollment numbers:

In a survey of 67 College of Science undergraduate students polled, (a) 56% responded that they would have been very or extremely interested in pursuing a rigorous bachelor's degree in Planetary Geoscience as incoming Freshmen, and (b) 21.5% would probably or definitely consider switching their major to Planetary Geoscience. Tucson-area high school student also responded favorably to the prospect of obtaining a degree in Planetary Geoscience. Out of 239 Tucson-area high school students polled, 6.3% responded that they would be very (4.2%) or extremely (2.1%) interested in pursuing a rigorous bachelor's degree in Planetary Geoscience, demonstrating the general interest of potential incoming freshmen. We also note that the existing Planetary Science minor has experienced steady growth over the years, with enrollment more than doubling from an average of 11 students in 2012 to 28 students in 2022. We anticipate enrollment numbers similar to the Astronomy major (~19 per year) while somewhat smaller than the Geosciences major (~38 per year). Based on this data, assuming steady growth in the first three years of the program, we expect 10 new students in the first year, 14 new students in the second year, and 18 new students per year thereafter.

IX. ANTICIPATED DEGREES AWARDED-

PROJECTED DEGREES AWARDED ANNUALLY					
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Number of Degrees	0	0	9	13	17

Data/evidence used to determine number of anticipated degrees awarded annually:

The projected number of degrees awarded annually is based upon the projected annual enrollment, assuming that students enroll in their

sophomore year and a typical total time to complete the degree (including freshman year) of 4 years. We have accounted for an attrition rate of 5%. As a more technical and specialized major, we expect to attract a higher caliber of students and have a graduation rate higher than the university average.

X. **PROGRAM DEVELOPMENT TIMELINE-** describe plans and timelines for 1) marketing the major and 2) student recruitment activities.

Marketing and student recruitment will begin in Spring 2023. Marketing will be done through dissemination of information and flyers to Arizona high schools, and through the Planetary Geoscience major website. Student recruitment will be done through announcements in related introductory classes (GEOS 251, PTYS 270, PTYS 206, and other introductory ASTR and PTYS courses), and through flyers posted in the host buildings of Geosciences (Gould-Simpson) Planetary Science (Kuiper), and Astronomy (Steward). The University of Arizona already makes extensive use of planetary science in their marketing ("Space is Wildcat Country"), which will attract potential Planetary Geoscience majors to the university.

XI. **Program Fees and Differential Tuition (PFDT) Request** – For implementation of fees, you must work with University Fees. The annual deadline is December 1. For any questions, please contact the University Fees Program Manager.

No program fees are required. Field and laboratory courses may have their own fees.

THE UNIVERSITY OF ARIZONA

ACADEMIC PROGRAM – ADDITIONAL INFORMATION FORM

To be used once the preliminary proposal has been approved.

Appendix C. ABOR Form

Request to Establish New Academic Program in Arizona

Please complete all fields. Boxes may be expanded to accommodate longer responses. Clarifying field descriptions can be found below. Should you have any questions or concerns, please email Helen Baxendale, Director of Academic Affairs and Policy at helen.baxendale@azregents.edu

University: The University of Arizona

Name of Proposed Academic Program: Planetary Geosciences
Academic Department: Department of Geosciences and Department of Planetary Science will jointly administer this program.
Geographic Site: The University of Arizona main campus, Tucson, AZ
Instructional Modality: In-person
Total Credit Hours: 120
Proposed Inception Term: Fall 2023
Brief Program Description: The B.S. in Planetary Geoscience will prepare students for science and industry careers in the rapidly expanding field of planetary science and exploration (including Earth and its Moon, the planets, their satellites, and myriad minor bodies in the solar system; as well as exoplanetary systems). The curriculum will build on a foundation of mathematics, physics and chemistry; it will comprise fundamental training in Earth materials, structures, and processes; and it will provide advanced study of the physical and chemical evolution of the Solar System and advanced course options focused on particular planetary bodies and planetary topics. The curriculum will culminate in a capstone research experience and

advanced fieldwork in relevant Earth settings. Students will take courses from faculty in two internationally recognized, top-rated departments—Planetary Science and Geosciences—with opportunities for transdisciplinary mentorship and advisement.

Learning Outcomes and Assessment Plan:

Learning Outcome #1: Identify the planets and classes of minor objects and describe key features associated with them
Concepts: Basic properties of the planets and classes of minor objects, basic processes governing planetary evolution
Competencies: Students will demonstrate a familiarity with all planets and classes of minor objects Solar System
Assessment: This outcome will be assessed in the homework and exams in introductory courses, using rubrics.

Learning Outcome #2: Explain the physical processes governing solar system dynamics
Concepts: Gravity, orbital dynamics, tides, atmospheric dynamics, magnetic fields
Competencies: Students will demonstrate quantitative knowledge of processes governing dynamics of planetary motions and atmospheres
Assessment: This outcome will be assessed in homework and exams in advanced course PTYS 403, using rubrics.

Learning Outcome #3: Relate the chemical makeup of planetary bodies to the formation and evolution of the solar system
Concepts: Cosmochemistry, geochemistry, origin of the elements, isotopes, radioactive nuclides, chemical fractionation, meteorites, solar system chronology
Competencies: Students will be able to interpret data related to the composition of solar system materials, including isotope plots, phase diagrams, and elemental abundance patterns
Assessment: This outcome will be assessed in homework and exams in PTYS 407, using rubrics.

Learning Outcome #4: Solve quantitative problems related to the geological processes that have shaped planetary landscapes.
Concepts: Tectonics, aeolian processes, volcanism, impact cratering, weathering and erosion, major rock types and ices
Competencies: Students will solve quantitative problems relating to the processes at work on planetary surfaces
Assessment: This outcome will be assessed in homework and exams in PTYS 411, using rubrics.

Learning Outcome #5: Collect, analyze, and interpret data through research or field work.
Concepts: Scientific method, research practices, scientific reporting, field observations and interpretations
Competencies: Students will apply their knowledge and skills in a guided research project or field work
Assessment: This outcome will be assessed based on the student's work in either a capstone research project or field course, using rubrics.

Projected Enrollment for the First Three Years:

Please provide anticipated enrollment numbers for each of the first three years of the proposed program

9, 13, 17 (new enrollment in each year, for cumulative enrollment of 9, 22, 39)

Evidence of Market Demand:

Results of our survey: Out of 67 College of Science undergraduate students polled, (a) 56% responded that they would have been very or extremely interested in pursuing a rigorous bachelor's degree in Planetary Geoscience as incoming Freshmen, and (b) 21.5% would probably or definitely consider switching their major to Planetary Geoscience. Tucson-area high school student also responded favorably to the prospect of obtaining a degree in Planetary Geoscience. Out of 239 Tucson-area high school students polled, 6.3% responded that they would be very (4.2%) or extremely (2.1%) interested in pursuing a rigorous bachelor's degree in Planetary Geoscience, demonstrating the general interest of potential incoming freshmen. We also note that the existing Planetary Science minor has experienced steady growth over the years, with enrollment more than doubling from an average of 11 students in 2012 to 28 students in 2022.

Within the next decade (2018-2028), the U.S. Bureau of Labor Statistics estimates that employment will increase 5.8% for geoscientists and 8.0% for atmospheric and space scientists. There is not yet a separate category for the field of planetary geoscience, which provides an exciting prospect for the UA.

The field of Planetary Geoscience is on the rise (Hodges and Schmitt, 2019). Of NASA's 2022 budget of $24.0 bn, $3.3 bn is devoted to planetary science, with a large share of the remainder focused on planetary exploration. NASA's Planetary Science budget has nearly doubled during the past decade. Comparable expenditures are projected by China, the European Space Agency, the Japan Aerospace Exploration Agency, several other national space agencies, and a growing number of private companies (e.g., SpaceX, Airbus Defense and Space, among others).

In cooperation with international governmental agencies and commercial partners, NASA has formulated an ambitious plan for a new "era of sustainable human spaceflight and discovery… with cutting-edge research and technology development to enable human and robotic exploration of the Moon and Mars." NASA's stated primary goal is to continue pushing boundaries of human knowledge and deliver on the promise of U.S. leadership in space; this includes the 2025 landing of astronauts at the Lunar South Pole in the first steps toward establishing a permanent forward launch platform on the Moon for further exploration of the entire solar system, beginning with Mars. In addition to these remote missions, NASA will continue to launch missions into near-Earth orbit for observation and study of Earth. NASA's activities are in concert with international governmental and commercial partners. All of this activity, and more, projects a growing need for a highly trained Planetary Geosciences workforce.

The proposed degree curriculum is designed such that students will gain foundational skills that will prepare them for a wide range of science-related careers, including graduate programs in any physical science, traditional jobs in the geosciences, and jobs in rapidly growing private sector companies involved in space-based approaches and technologies to help governments and businesses solve problems on Earth and beyond (e.g., Earth-I, Maxar, Capella Space, Spire, Planet Labs, many others).

NASA is actively collaborating with privately owned and industrial spaceflight companies, and this is paving the way for private sector investments. As a result, funding and investment in "New Space" companies is accelerating (https://www.cbinsights.com/research/space-tech-startups-market-map/).

Market data gathered by UArizona from EMSI BurningGlass indicates 19,760 job postings nationwide in the field of Planetary Astronomy and Science (CIP 40.0203) in the last 12 months, comprising 0.13% of all job postings requiring a bachelor's degree. Employment in this field has increased 17% between 2017 and 2020, with projected growth of another 2.45% over the next 10 years. Students with bachelor's degrees in this field have a median starting salary of $80K (compared to a median salary for all UArizona graduates with a bachelor's degree of $37.9K in 2020 – ABOR report). Although there is high demand in Arizona for graduates of these programs, demand is higher in states such as California and Texas, and thus the new major is expected to attract a significant number of out-of-state students, with associated revenue benefits to the university. The international reputations of the departments of Planetary Sciences and Geosciences are further expected to attract out-of-state students.

Similar Programs Offered at Arizona Public Universities:

ASU SESE: BS in Astronomical and planetary sciences (online only) – This program is focused on astronomy and planetary science, without a geoscience focus

ASU SESE: BS in Earth and Space Exploration (in person) – The broader Earth and Space Exploration major includes upper division electives in the geosciences and planetary sciences, but these are not required parts of the program. The Geological Sciences focus area requires the core geoscience classes and a number of geoscience advanced electives, but does not include advanced planetary science courses as either requirements or electives. The Astrophysics focus area includes a small amount of planetary science but no geoscience or advanced planetary science courses.

NAU: BS in Astronomy – This program includes one required planetary science class, several planetary electives, but no geoscience classes

NAU: BS in Geology – This program includes core geoscience classes with no planetary science.

FOR CURRICULAR AFFAIRS USE ONLY

Objection(s) Raised by Another Arizona Public University? YES NO

Has another Arizona public university lodged a written objection to the proposed program with the proposing university and the Board of Regents within seven days of receiving notice of the proposed program?

If Yes, Response to Objections:

Please provide details of how the proposing university has addressed the objection. If the objection remains unresolved, please explain why it is in the best interests of the university system and the state that the Board override it.

New Resources Required? (i.e., faculty and administrative positions; infrastructure, etc.):

Resources required: 4.5 TA lines per year, 0.25 FTE academic advisor, 1.0 FTE administrative support

Estimated total expected cost: $138,480

Budget		
TA Support	.50 FTE (1 semester)	
Stipend:	$	11,434.00
ERE	$	1,486.42
Tuition:	$	6,174.00
Total:	$	19,094.42
4.5 - TAs	**$**	**85,924.89**
Advisor:	.25 FTE	
Salary	$	12,000.00
ERE	$	3,828.00
Total	**$**	**15,828.00**
Administrative Support	1.00 FTE	
Salary (Split 50% with LPL)	$	30,000.00
ERE	$	9,570.00
Total	**$**	**39,570.00**
GRAND TOTAL	**$**	**141,323.00**

Plan to Request Program Fee/Differentiated Tuition? NO

Estimated Amount: $0

Program Fee Justification:

N/A

Specialized Accreditation? NO **Accreditor:** N/A

THE UNIVERSITY OF ARIZONA

BUDGET PROJECTION FORM

Name of Proposed Program or Unit:

	Projected		
Budget Contact Person:	1st Year 20 23_- 20 24	2nd Year 2024 - 20 _25__	3rd Year 20 25 - 20 26
METRICS			
Net increase in annual college enrollment UG	5	12	21
Net increase in college SCH UG	600	2,268	4,053
Net increase in annual college enrollment Grad	-	-	-
Net increase in college SCH Grad	-	-	-
Number of enrollments being charged a Program Fee	-	-	-
New Sponsored Activity (MTDC)	-	-	-
Number of Faculty FTE			
FUNDING SOURCES			
Continuing Sources			
UG AIB Revenue	132,000	342,144	646,652
Grad AIB Revenue	-	-	-
Program Fee Revenue (net of revenue sharing)	-	-	-
F and A AIB Revenues	-	-	-
Reallocation from existing College funds (attach description)			
Other Items (attach description)			
Total Continuing	$ 132,000	$ 342,144	$ 646,652
One-time Sources			
College fund balances			
Institutional Strategic Investment			
Gift Funding			
Other Items (attach description)			
Total One-time	$ -	$ -	$ -
TOTAL SOURCES	$ 132,000	$ 342,144	$ 646,652
EXPENDITURE ITEMS			
Continuing Expenditures			
Faculty	-	-	-
Other Personnel (Advisor .25 and Admin Support 1.00)	55,398	55,398	55,398
Employee Related Expense			
Graduate Assistantships	85,925	85,925	85,925
Other Graduate Aid			
Operations (materials, supplies, phones, etc.)			
Additional Space Cost			
Other Items (attach description)			
Total Continuing	$ 141,323	$ 141,323	$ 141,323
One-time Expenditures			
Construction or Renovation			
Start-up Equipment			
Replace Equipment			
Library Resources			
Other Items (attach description)			
Total One-time	$ -	$ -	$ -
TOTAL EXPENDITURES	$ 141,323	$ 141,323	$ 141,323
Net Projected Fiscal Effect	$ (9,323)	$ 200,821	$ 505,329

FY23 Undergraduate $/Metric

Metric	n Campu	Summer/ Winter	Online	Distance[2]	Global Direct
$/Degree	$ 3,000		$ 4,000	$ 3,000	$ 500
$/Enrollm	$ 350	$ -	$ 275	$ 180	$ 100
$/SCH	$ 185	$ -	$ 250	$ 175	$ 185

SCH Value: 185

UG SCH: we multiply t

UG Degrees: we multi

FY24 Undergraduate $/Metric

Metric	n Campu	Summer/ Winter	Online	Distance[2]	Global Direct
$/Degree	$ 3,000		$ 4,000	$ 3,000	$ 500
$/Enrollm	$ 350	$ -	$ 275	$ 180	$ 100
$/SCH	$ 189	$ -	$ 255	$ 179	$ 189

FY25 Undergraduate $/Metric

Metric	n Campu	Summer/ Winter	Online	Distance[2]	Global Direct
$/Degree	$ 3,060		$ 4,080	$ 3,060	$ 510
$/Enrollm	$ 357	$ 357	$ 281	$ 184	$ 102
$/SCH	$ 193	$ 193	$ 260	$ 183	$ 193

ply the number of degrees awarded in an IPEDS Fiscal Year by the $/Degrees on the Sources & Levers tab to est

timate Activity Allocation $

TA Salary	One Semester	
.50 FTE	$ 11,434.00	
ERE	$ 1,486.42	
Tuition	$ 6,174.00	
Total Cost	$ 19,094.42	$ 85,924.89

	One Semester
.25 FTE	$ 5,717.00
ERE	$ 743.21
Tuition	$ 3,087.00
Total Cost	$ 9,547.21

THE UNIVERSITY OF ARIZONA

New Academic Program
PEER COMPARISON

Select three peers (if possible/applicable) for completing the comparison chart from ABOR-approved institutions, AAU members, and/or other relevant institutions recognized in the field. The comparison programs are not required to have the same degree type and/or title as the proposed UA program. Information for the proposed UA program must be consistent throughout the proposal documents. Minors and Certificates may opt to include only 2 peer comparisons.

Program name, degree, and institution	Proposed UA Program	Peer 1	Peer 2	Peer 3
Current number of students enrolled	[redacted]	Purdue	UCSC	Rutgers
Program Description	BS in Planetary Geosciences	BS in Planetary Sciences from Dept. of Earth, Atmospheric, and Planetary Sciences	BS in Earth Science, with Planetary Science concentration	BS in Earth & Planetary Science, with Planetary Science track
Target Careers	Scientists working on earth and planetary topics (universities, NASA, govt. labs, private sector space industry), remote sensing, astrobiology. Other physical science careers, science communication, teaching.	Astronauts, planetary surface geology, remote sensing, planetary chemistry, space exploration, education, astrobiology	Interdisciplinary study of planets and their satellites	Research scientists at universities, museums, NASA
Emphases? (Yes/No) List, if applicable	NA	NA	NA	NA
Minimum # of units required	120 credits total; 18 courses,	120 credits total; 18 courses,	Qtr system units are different;	18 courses, humanities, gen eds.

	Foreign language, humanities, gen eds.	Foreign language, humanities, gen eds.	19 courses, humanities, gen eds.	
Level of Math required (if applicable)	Calculus 1 and 2 and one additional class (linear algebra, vector calculus, differential equations, or statistics)	Linear algebra Diff. Eqtns.	Vector calculus	Calculus III Diff. Eqtns.
Level of Second Language required (if applicable)	Two semesters	Required, proficiency variable	Required, proficiency variable	Required, proficiency variable
Pre-Major? (Yes/No) If yes, provide requirements.	No	2 Math courses (Min. C-), 2 chemistry courses, 1 physics course	2 Math courses, 1 chemistry course	2 Math courses, 1 chemistry course, 1 physics course
Special requirements to declare/gain admission? (i.e. pre-requisites, GPA, application, etc.)	None	Min. C- in math courses; complete 16-18 units of pre-reqs Min. 2.0 GPA to graduate	Min grade of C in Introductory geology	Min grade of C in Introductory geology
Internship, practicum, or applied/experiential requirements? If yes, describe.	Summer field camp (3); Capstone research (3); Practicum (3)	No field requirement	Capstone=Summer field camp, or GIS, or Senior thesis	Summer field camp(3)

Additional questions:

1. How does the proposed program align with peer programs? Briefly summarize the similarities between the proposed program and peers, which could include curriculum, overall themes, faculty expertise, intended audience, etc.

The proposed program is rooted in programmatic distinctions at the University of Arizona: Both the Planetary Science and Geosciences departments at UA feature top-5 nationally ranked programs, composed of faculties with mutually complementary expertise and research interests. The UA is ideally positioned to leverage recent increases in funding for planetary geoscience research and exploration, and there is a growing demand for students trained in this nascent field. The program we propose would include

elements of peer institution programs, including courses in both planetary science and geoscience, but with added emphasis on integration of topics. New courses in Introductory Planetary Geoscience, Planetary Geoscience Fieldcamp, and the Capstone Practicum will be explicitly focused on this new student body.

2. How does the proposed program stand out or differ from peer programs? Briefly summarize the differences between the proposed program and peers, which could include curriculum, overall themes, faculty expertise, intended audience, etc.

The proposed program is actually unique among our peer institutions and most others as well. The following tables summarize what is available at our peers (Table 1) and at an additional 60 AAU institutions (Table 2). Many Earth Science, Geoscience, or Environmental Science departments offer tracks or concentrations in "planetary science," but none of these is truly integrated as the program that we are proposing. A number of departments include the word "Planetary" in their name, but do not offer a B.S. in Planetary Science or Planetary Geology. Some programs simply offer a conventional geoscience curriculum augmented with a few courses (usually very general) in planetary science or astronomy. In addition to these programs, a number of schools offer Astronomy or Astronomy and Planetary Science degrees that do not incorporate the geosciences into the coursework.

Table 1. PEER INSTITUTIONS

University of California-Davis *Nothing comparable:* Earth and Planetary Sci.: BS in Geology, Marine and Coastal Science, Natural Sciences (none in planetary)

University of California-Los Angeles Earth, Planetary & Space: website not working

U. Florida *Nothing comparable:* Geological Sciences: Geology, Marine Sciences, Environmental Geo

U. Illinois at Urbana-Champaign *Nothing comparable:* Geology: Geology

U. Iowa *Nothing comparable:* Earth and Environmental: Geoscience, Environmental

U. Maryland-College Park *Nothing comparable:* Geology: Geology

Nothing comparable: Astronomy: BS Astronomy; Planetary Science minor

Michigan State Univ. *Nothing comparable:* Earth and Environmental: Geology, Environmental

U. Minnesota-Twin Cities *Nothing comparable:* Earth Sciences: Earth Science; Environmental Science

U. N. Carolina Chapel Hill *Nothing comparable:* Geological Sciences:

Ohio State U.-Main Campus *Nothing comparable:* Earth Sciences

Pennsylvania State U.- Main Campus *Nothing comparable:* Geosciences

Nothing comparable: Astronomy & Astrophysics: Planetary Sci & Astronomy- geared toward students wanting to pursue career immediately after graduation

Texas A & M *Nothing comparable:* Geology & Geophysics: Geology, Geophysics

UT Austin *Nothing comparable:* Geosciences: Geological Sciences, Geosystems Engineering & Hydrogeology, Environmental.

U. Washington-Seattle *Nothing comparable:* Earth & Space sci: 4 foci: Geology, Biology, Physics, or Environmental

U. Wisconsin-Madison *Nothing comparable:* Geosciences:

Washington U. Earth and Planetary Sci: *Nothing comparable:* Earth and Planetary Sci: BS in geology, geochemistry, geophysics, & environmental; minor in earth & planetary sci. Lots of planetary emphasis in faculty. 500-level courses.

minor in Earth and Planetary Sciences: does not require any planetary courses (just part of electives)

Table 2. AAU UNIVERSITIES (60; only most relevant)

Brown *Nothing comparable*: Earth, Environmental & Planetary: Geological Sciences; Geology-Biology; Geology-Chemistry; Geology-Physics/Math

Carn. Mellon *Nothing comparable*

Case W. Reserve *Nothing comparable*: Earth, Environmental, and Planetary Sciences: Geological Sciences; Environmental Geology, No BS major or minor related to Planetary

Columbia U. *Nothing comparable*: Earth and Environmental: Earth Science; Environmental Science

Cornell *Nothing comparable*: Earth and Atmospheric Sciences

Duke *Nothing comparable*: Earth and Ocean Sciences

Emory *Nothing comparable*

Georgia Tech *Nothing comparable*: Earth and Atmospheric Sciences

Indiana U. *Nothing comparable*: Earth and Atmospheric Science

Iowa State U. *Nothing comparable*: Geological and Atmospheric Science

McGill *Nothing comparable*: Earth and Planetary Sciences: Geology major; Honours in Planetary Sciences. Only requires one extra-Earth course (Cosmochemistry); similar to classical Geology degree.

NYU *Nothing comparable*

Northwestern *Nothing comparable*: Earth & Planetary- general BS, flexible. Too flexible for comparison. Total of 4 courses offered in Planetary & difficult to take all of them.

Princeton *Nothing comparable*: Geosciences, Astrophysical Sciences

Rice *Nothing comparable*: Earth, Environmental and Planetary: BS/BA in Earth Science; Environmental Science

Stanford *Nothing comparable*: Geological Sciences

Stony Brook *Nothing comparable*: Earth and Space Sci: BA. Diverse science background. broad education and those interested in secondary school teaching. Lacks rigor and depth

Tulane *Nothing comparable*: Earth and Environmental: Geology, Environmental Earth Science

U at Buffalo *Nothing comparable*: Geology

UC Irvine *Nothing comparable*: Earth System Science

UC San Diego *Nothing comparable*: Inst of Geophys & Planetary Physics: graduate program only

UC Sta. Barbara *Nothing comparable*: Earth Science; Astronomy: Minor in Astronomy and Planetary Science

U. Chicago *Nothing comparable*: Geophysical sciences: *Nothing comparable*: Astronomy and Astrophysics

U Colorado Boulder *Nothing comparable*: Geological Sciences: Geology, Geophysics
Nothing comparable: Astrophysical and Planetary: BA Astronomy

U Illinois *Nothing comparable*: Earth, Society, and Environment: *Nothing comparable*: Astronomy

U. Iowa *Nothing comparable*: Earth and Environmental: *Nothing comparable*: Physics and Astronomy: graduate degree in planetary science

U. Kansas *Nothing comparable*: Geology *Nothing comparable*: graduate program planetary

U. Maryland *Nothing comparable*: minor in planetary science. PhD via Astronomy

U. Michigan *Nothing comparable*: Earth and Environmental: *Nothing comparable*: Atmospheric, Oceanic, and Space. graduate only

U. Minnesota *Nothing comparable*: Earth Sciences

U. Oregon *Nothing comparable*: Earth Sciences

U. Penn *Nothing comparable*: Earth and Environmental

U. Pittsburgh *Nothing comparable*: Geology and Environmental

U. Rochester *Nothing comparable*: Earth and Environmental
USC *Nothing comparable*: Earth Sciences:
U. Toronto *Nothing comparable*: Earth Sciences: *Nothing comparable*: Earth, Atmospheric, and Planetary Physics
U. Virginia *Nothing comparable*: Astronomy
Vanderbilt *Nothing comparable*:
Yale *Nothing comparable*: Geology and Geophysics
U Tennessee, Knoxville *Nothing comparable*: Geology and Environmental Studies

3. How do these differences make this program more applicable to the target student population and/or a better fit for the University of Arizona?

The proposed new major in Planetary Geoscience is an outgrowth of collaboration between two independent top-ranked programs. Seven faculty members in these two departments hold joint appointments in both programs. The Department of Geosciences has ~240 undergraduate majors (B.S.). Planetary Science offers an undergraduate minor but no major degree. Graduate school candidates in Planetary Science commonly do not have rigorous training in both Geoscience and Planetary Science (as indicated under question 2). Thus, a need exists for better qualified students at extant graduate programs in Planetary Science. The UA is well positioned to populate such a program, because of the strong traditions of Astronomy, Lunar and Planetary Science, and Geosciences.

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
COLLEGE OF MEDICINE TUCSON
Chemistry
& Biochemistry

Craig Aspinwall, Ph.D.
Professor and Department Head
Chemistry & Biochemistry (CBC)
aspinwal@email.arizona.edu

1306 East University Blvd.
Biosciences West 368
Tucson, AZ 85721-0041
Tel: (520) 621-5672

November 18, 2022

Dr. Barbara Carrapa
Professor and Department Head
Department of Geosciences
Gould-Simpson Building
Tucson, AZ 87521-0077

Dear Dr. Carrapa,

The Department of Chemistry & Biochemistry supports the inclusion of our general chemistry course CHEM 151 as the one semester chemistry course in the proposed B.S. in "Planetary Geoscience" major. These courses are offered every academic year and currently have the capacity to accommodate enrollments associated with this degree.

If there are any questions, please feel free to contact me directly.

Sincerely,

Craig Aspinwall, Ph.D.

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

617 N. Santa Rita Avenue
Tucson, Arizona 85721
www.math.arizona.edu

November 21, 2022

Barbara Carrapa, Head, Department of Geosciences
Mark Marley, Director, Lunar and Planetary Laboratory
University of Arizona

RE: Bachelor of Science in Planetary Geosciences

Dear Drs. Carrapa and Marley,

I am writing to express the support of the Department of Mathematics for the proposed new Bachelor of Science degree in Planetary Geoscience to be offered by your departments. In particular, the Math Department supports the inclusion of the following courses as requirements for the new degree:

MATH 122A (Functions for Calculus)
MATH 122B (First-Semester Calculus)
MATH 125 (Calculus I)
MATH 129 (Calculus II)
MATH 223 (Vector Calculus)
MATH 254 (Introduction to Ordinary Differential Equations)
MATH 263 (Introduction to Statistics and Biostatistics)
MATH 313 (Introduction to Linear Algebra).

We expect to offer these course each fall and spring, and if, as projected, there are at most 15 students per cohort, we expect to be able to accommodate the additional students without any difficulties. Normal prerequisites and registration priorities will apply.

Sincerely,

D L Ulmer

Douglas Ulmer
Professor and Head

THE UNIVERSITY OF ARIZONA

Department of Physics
College of Science

1118 E. Fourth Street
P.O. Box 210081
Tucson, Arizona 85721
Tel: (520) 621-6820
Fax: (520) 621-4721
www.physics.arizona.edu

November 18, 2022

To: Professor Barbara Carrapa, Head, Geosciences
and Professor Mark Marley, Director, LPL

Dear Barbara and Mark:

The Department of Physics will support your BS in Planetary Geosciences. Students pursuing their majors in this new program will be able to enroll in PHYS 141 and 142.

Sincerely,

Sumit Mazumdar
Professor and Head
Department of Physics