THE UNIVERSITY OF ARIZONA

New Academic Program Workflow Form

General

Proposed Name: The Science of Cannabis

Transaction Nbr: 00000000000182

Plan Type: Specialization

Academic Career: Undergraduate

Degree Offered: Undergraduate Certificate

Do you want to offer a minor? N

Anticipated 1st Admission Term: Sprg 2024

Details

Department(s):

AGSC

DEPTMNT ID	DEPARTMENT NAME	HOST
1230	Biosystems Engineering	Y
1238	School of Plant Science	N

Campus(es):

MAIN

LOCATION	DESCRIPTION
TUCSON	Tucson

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

Plan admission types:

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

Non Degree Certificate (UCRT only): N

Other (For Community Campus specifics): Y

Continuing undergraduate students

Plan Taxonomy: 01.0304, Crop Production.

Program Length Type: Program Length Value: 0.00

Report as NSC Program:

SULA Special Program:

Print Option:

Diploma: N

Transcript: Y Specialization in The Science of Cannabis

Conditions for Admission/Declaration for this Major:

Students will need to complete an application, which will be reviewed mid-Fall by the admissions committee. To be accepted to the program, students must have a minimum overall GPA of 2.0, their class standing must be Sophomore or higher, and they must be able to articulate a convincing motivation for the subject.

Requirements for Accreditation:

N/A

Program Comparisons

University Appropriateness

This certificate program is aimed to help better prepare students for employment and advancement in the growing Cannabis industry, including that in Arizona. As such, it is consistent with the "Wildcat Journey" and "Arizona Advantage" pillars of the UA strategic plan and one of the missions of the College of Agriculture and Life Sciences, which is "To educate students and communities in ways that enable their future success in the regional and global economies."

The University of Arizona is the most appropriate location within the Arizona University System for this program because of our existing strength in controlled environment agriculture (i.e., agriculture in locations such as greenhouses or other indoor locations and using specialized growth systems including hydroponics and artificial lighting). Since a lot of Cannabis for recreational and medical use is grown in controlled environments, the UA is ideally primed to teach students about the science behind growing Cannabis in these conditions.

Arizona University System

NBR	PROGRAM	DEGREE	#STDNTS	LOCATION	ACCRDT
1	Business of Cannabis Certifica		0	UA Continuing & Professional E	N
2	Cannabis Healthcare and Medici		0	UA Continuing & Professional E	N
3	Cannabis Compliance		0	UA Continuing & Professional E	N

NBR	PROGRAM	DEGREE	#STDNTS	LOCATION	ACCRDT
	and Risk M				

Peer Comparison

Please see attached file for comparison to non-Arizona University System programs. The three certificates noted in the AZ University System comparison are for non-degree-seeking students and are not related to the science or growth of Cannabis, so are not good comparisons, but are included to alert reviewers to their existence.

Resources

Library

Acquisitions Needed:

None.

Physical Facilities & Equipment

Existing Physical Facilities:

We currently have a greenhouse that has been designated for hemp research for the last two years, but it will need some upgrades as noted in the next section. We will work to get the greenhouse registered for use as a classroom for the Cultivation of Cannabis Lab.

Additional Facilities Required & Anticipated:

We will need to add LED lighting and update the sensors and monitoring equipment in the greenhouse, where the Cannabis laboratory class will be held. We will also need to purchase some equipment for extraction and analysis of hemp (see budget).

Other Support

Other Support Currently Available:

Daniel Jimenez-Flores, an academic advisor for the BS in Sustainable Plant Systems and BS in Applied Biotechnology programs, will be the academic advisor for this proposed certificate.

Other Support Needed over the Next Three Years:

N/A

Comments During Approval Process

9/1/2023 2:21 PM

MKACIRA

Comments
Approved.

10/10/2023 9:55 AM

MELANIECMADDEN

Comments
Uploaded updated Additional Information form

10/10/2023 9:56 AM

MELANIECMADDEN

Comments
Approved.

10/10/2023 3:12 PM

DHERRING

Comments
All LOs are approved.

10/10/2023 3:12 PM

DHERRING

Comments
All LOs are approved.

10/10/2023 3:54 PM

ORCHARD

Comments
Approved.

10/11/2023 9:51 AM

JEH

Comments
Approved.

I. CERTIFICATE DESCRIPTION–

The Science of Cannabis Undergraduate Certificate guides students to understand the biology of plants in the *Cannabis* genus and to learn the science behind the techniques used in their cultivation. Students will examine how fundamental aspects of plant growth under various environmental conditions affect plant biochemistry, crop yield, and disease and pest resistance, and will consider how this information can be applied to a grower's advantage. Scaffolded learning within each core course builds towards more specialized information about *Cannabis*, including how its cannabinoid compounds and secondary metabolites interact with human body. Optional coursework in hydroponics or other applied sciences allows students to round out their experience depending on their interests. Finally, students have an opportunity to get practical experience with plants in the genus, either through a formal lab course or through an internship focused on the biological aspects of *Cannabis*.

II. NEED FOR THE CERTIFICATE/JUSTIFICATION -

The genus *Cannabis* is currently grown to provide hemp (fiber, grain, and seeds), marijuana, and derivatives such as cannabidiol (CBD). Arizona has an active industrial hemp agricultural industry (see https://agriculture.az.gov/plantsproduce/industrial-hemp-program) and it has been legal to sell marijuana in the state since the start of 2021. The Arizona Department of Revenue reports (https://azdor.gov/reports-statistics-and-legal-research/marijuana-tax-collection) that marijuana sales in Arizona for legal, non-medical adult use have averaged over 61 million dollars a month in the 24 months between its first legal sales in January 2021 and through December 2022, generating an average of over 5 million dollars a month in tax revenue for this state. This is in addition to an average of 53 million dollars a month in medical marijuana sales and 4.4 million dollars in tax revenue over the same period. However, Arizona has a relatively low level of *Cannabis* production compared to other states with similar sales, as reported by Arizona Public Media (https://news.azpm.org/s/95772-c-you-later-cannabis-sales-soar-but-dont-threaten-arizonas-5-cs-yet/). By increasing local production, we could potentially bring more plant growth jobs to Arizona.

A survey was administered in Spring 2022 to undergraduate students via the campus advising network, to assess the level of student interest in this potential certificate. The students were in a variety of majors but primarily within the College of Agricultural Sciences, with the most common majors being Natural Resources (22 of 83 responses), "Other biology-related major" (20 of 83 responses), Biosystems Engineering (13 of 83 responses), and "Other non-biology-related major" (10 of 83 responses). In one of the questions, the students were provided with an earlier version of the certificate description, above, and asked to report "how likely would [they] be to add 'Science of Cannabis' as an Undergraduate Certificate", if such a certificate were available. As shown in the graph below (Figure 1), 33 students out of 68 who answered the question said they were "extremely likely" to add it, and an additional 19 students reported being "moderately likely" to add it.

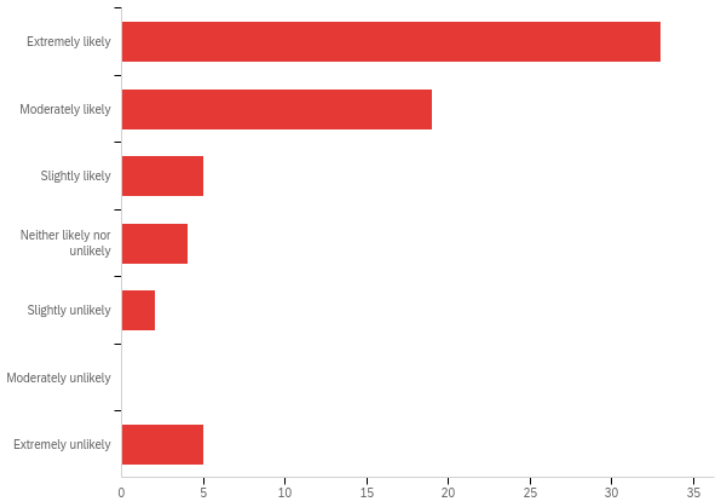

Figure 1: Student responses (68 total) to the question “how likely would you be to add "The Science of Cannabis" as an Undergraduate Certificate” based on the description provided.

III. PROGRAM AFFILIATION-

The Science of Cannabis undergraduate certificate will be shared by the School of Plant Sciences and the Department of Biosystems Engineering. The certificate will strongly dovetail with the existing BS degree programs in *Plant Sciences*, *Biosystems Engineering*, and our successfully shared *Sustainable Plant Systems* (and especially the latter’s Controlled Environment Agriculture emphasis). The University of Arizona does not currently offer a directly affiliated program in Cannabis to degree-seeking students; however, the Continuing and Professional Education program offers certificates via a third party (Green Flower) in The Business of Cannabis, Cannabis Compliance and Risk Management, and Cannabis Healthcare and Medicine. These certificates differ from the one being proposed because of their target audience (non-degree-seeking versus degree-seeking students) and their topic (business/healthcare vs. biology/science).

IV. CERTIFICATE REQUIREMENTS–

UNDERGRADUATE CERTIFICATE

Minimum total units required	14
Minimum upper division units	10
Total transfer units that may apply to the certificate. *Note: A minimum of six (6) units used to complete the certificate must be University credit.*	6
Pre-admissions expectations (i.e., academic training to be completed prior to admission)	Complete an application, which will be reviewed mid-Fall and mid-Spring by the admissions committee. To be accepted to the program, students must have a minimum overall GPA of 2.0, their

	class standing must be Sophomore or higher, and they must be able to articulate a convincing motivation for the subject.
Certificate requirements. List all certificate requirements including core and electives. Courses listed must include **course prefix, number, units, and title**. **Mark new coursework (New)**. Include any limits/restrictions needed. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	<u>Complete 12 units of core coursework:</u> • BE 217 (3) Intro to Hydroponics (Fall) • PLS 302 (3) The Science of Cannabis (Spring) • PLS 475A (3) Applied Plant Physiology (Spring) • BE 420/520 [NEW] (3) Cultivation of Cannabis (Fall)
Internship, practicum, applied course requirements (Yes/No). If yes, provide description.	<u>Take at least 1 credit from:</u> • PLS/BE 393 or 493 (1) Internship; must be hemp-oriented; opportunities vary <u>Take 1 additional credit from:</u> • PLS/BE 393 or 493 (1) Internship; must be hemp-oriented; opportunities vary • PLS/BE 392 or 492 (1) Directed research; must be hemp-oriented; instructors vary • BE 217L (1) Lab: Introduction to Hydroponics • BE 420/520L NEW (1) Cannabis cultivation lab
Any double-dipping restrictions (Yes/No)? If yes, provide description. *A maximum of 6 units may double-dip with a degree requirement (major, minor, General Education) or second certificate.	Students may apply 6 units towards a major, minor, General Education, second certificate, or previously awarded degree program.
Additional requirements (provide description)	None

V. CURRENT COURSES–

Course prefix and number (include cross-listings)	Units	Title	Pre-requisites	Modes of Delivery (online, in-person, hybrid)	Campus and Location Offered	Dept signed party to proposal? (Yes/No)
PLS 302	3	The Science of Cannabis	MCB 181R or instructor approval	in-person	Main (Spring)	yes
BE 420/520	3	NEW: Cultivation of Cannabis	Adv. Standing Engineering or Junior Senior status.	In-person	Main (Fall)	yes
PLS 475A	3	Applied Plant Physiology	An introductory plant physiology course [includes PLS 240]	in-person, online	Main, Distance (Spring)	yes
BE 217	3	Introduction to Hydroponics	None	in-person	Main (Fall)	yes
BE 217L	1	Lab: Introduction to Hydroponics	BE 217	in-person	Main (Fall)	yes
BE 420/520L	1	NEW: Cannabis Cultivation Lab	BE 420/520 lecture or concurrent		Main (Spring)	yes

VI. Learning Outcomes -

Learning Outcome #1: **Explain** key characteristics of plants in the genus *Cannabis* and **identify** aspects of plant physiology that could be manipulated in culture.
Concepts: Comprehension and Analysis
Competencies: Students will demonstrate comprehension of foundational biology topics related to *Cannabis* and analyze how that foundational knowledge can be applied.
Learning Outcome #2 Appraise different methods for growing plants in the genus *Cannabis* and **predict** what the effects will be of different growth conditions on the resulting crop.
Concepts: Critical Analysis and Application

Competencies: Critical analysis skills related to the methods of growing plants in the genus *Cannabis* and the applications of those methods, especially in the areas of hydroponics and controlled environment agriculture.
Learning Outcome #3: Demonstrate how to successfully grow plants in the genus *Cannabis.*
Concepts: Practical Application
Competencies: Students will apply plant cultivation and biosystems engineering concepts to *Cannabis* production.

LO1:

- Introduced and Practiced: PLS 302 *The Science of Cannabis* and PLS 475A *Applied Plant Physiology*
- Assessment events: PLS 302 *The Science of Cannabis* and PLS 475A *Applied Plant Physiology*
- Measures: Questions on a final exam or a component of a summative evaluation (e.g., presentation, essay) will be used to specifically assess this LO.
- Acceptable outcome: 80% of the students in this certificate program will achieve a B (≥ 80%) or higher on the measure.
- Ideal outcome: 100% of the students in this certificate program will achieve an A (≥ 90%) on the measure.

LO2:

- Introduced and Practiced: BE 217 *Introduction to Hydroponics* and BE 420 *Cultivation of Cannabis*
- Assessment events: BE 420 *Cultivation of Cannabis*
- Measures: A final project or a component of a summative evaluation (e.g., presentation, essay) will be used to specifically assess this LO.
- Acceptable outcome: 80% of the students in this certificate program will achieve a B (≥ 80%) or higher on the measure.
- Ideal outcome: 100% of the students in this certificate program will achieve an A (≥ 90%) on the measure.

LO3:

- Introduced and Practiced: BE 420 *Cultivation of Cannabis* and Internship.
- Assessment event and Measure: Report by internship supervisor to Director of Undergraduate Studies for this certificate.
- Acceptable outcome: 80% of the students in this certificate program will be reported to be 'competent' or 'highly competent' in their ability to grow plants in the genus *Cannabis*.
- Ideal outcome: 100% of the students in this certificate program will be reported to be 'competent' or 'highly competent' in their ability to grow plants in the genus *Cannabis*.

VII. CONTACTS AND ADMINISTRATION

UNDERGRADUATE (delete if n/a)

a. List the name and contact information for the primary point of contact for the certificate:

Matthew "Rex" Recsetar (msrecs@arizona.edu) is the main point of contact during the proposal stage (alternative contact: Samantha Orchard (orchard@arizona.edu). Daniel Jimenez Flores

(jimenez@arizona.edu), academic advisor, will be the primary point of contact for students once the certificate is launched.

b. List the name and contact information for the person or persons who will serve in the role of Director of Undergraduate Studies (DUS) for the certificate:

Matthew "Rex" Recsetar (msrecs@arizona.edu)

c. If known, list the members of the certificate oversight committee for this certificate.

Matthew "Rex" Recsetar (msrecs@arizona.edu)

Triston Hooks, (tristonh@arizona.edu)

[Faculty representative from School of Plant Sciences *to be decided*]

Daniel Jimenez Flores [academic advisor for Sustainable Plant Systems major] will serve as an academic advisor for this certificate and will participate on this committee in an *ex officio* capacity.

VIII. REQUIRED SIGNATURES

Program Director/Main Proposer (print name and title): Matthew Recsetar, Assistant Professor in Biosystems Engineering

Program Director/Main Proposer signature: Matthew Recsetar
Date: Sep 21, 2023

Department Head (print name and title): Murat Kacira, Interim Department Head of Biosystems Engineering

Department Head's signature:
Date:

Department Head (print name and title): David Galbraith, Interim Director of School of Plant Sciences

Department Head's signature:
Date:

Associate/Assistant Dean (print name):

Associate/Assistant Dean's signature:
Date:

Dean (print name):

Dean's signature:
Date:

For use by Curricular Affairs (Undergraduate):

Committee	Approval date
APS	
Undergraduate Council	
Undergraduate College Academic Administrators Council	

Signature: Matthew Recsetar (Sep 21, 2023 19:01 PDT)
Email: msrecs@arizona.edu

Signature:
Email: mkacira@arizona.edu

Signature:
Email: galbraith@arizona.edu

Signature:
Email: statenm@arizona.edu

THE UNIVERSITY OF ARIZONA

BUDGET PROJECTION FORM

Name of Proposed Program or Unit: The Science of Cannabis (undergraduate certificate)

Budget Contact Person: Matthew Recesetar or Samantha Orchard	Projected 1st Year 2023- 2024	2nd Year 2024 - 2025	3rd Year 2025 - 2026
METRICS			
Net increase in annual college enrollment UG	10	10	10
Net increase in college SCH UG	60	140	140
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	0.15		
FUNDING SOURCES			
Continuing Sources			
UG AIB Revenue	11,340	27,020	27,530
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	**$ 11,340**	**$ 27,020**	**$ 27,530**
One-time Sources			
College fund balances	-	-	-
Institutional Strategic Investment	-	-	-
Gift Funding	10,000	5,000	5,000
Other Items (attach description)			
Total One-time	**$ 10,000**	**$ 5,000**	**$ 5,000**
TOTAL SOURCES	**$ 21,340**	**$ 32,020**	**$ 32,530**
EXPENDITURE ITEMS			
Continuing Expenditures			
Faculty	18,430		
Other Personnel			
Employee Related Expense			
Graduate Assistantships			
Other Graduate Aid			
Operations (materials, supplies, phones, etc.)	-	-	-
Additional Space Cost	5,800	5,800	5,800
Other Items (**see below**)	3,000	3,000	3,000
Total Continuing	**$ 27,230**	**$ 8,800**	**$ 8,800**
One-time Expenditures			
Construction or Renovation	10,700		
Start-up Equipment	7,300		
Replace Equipment			
Library Resources			
Other Items (attach description)	-	-	-
Total One-time	**$ 18,000**	**$ -**	**$ -**
TOTAL EXPENDITURES	**$ 45,230**	**$ 8,800**	**$ 8,800**
Net Projected Fiscal Effect	**$ (23,890)**	**$ 23,220**	**$ 23,730**

THE UNIVERSITY OF ARIZONA

New Academic Program
PEER COMPARISON

[Note: only one ABOR peer institution has a similar program for undergraduates (UIUC, which is also an AAU member and a land-grant institution; see table below). Two ABOR peer institutions have graduate certificates on pharmacology/medical aspects (*i.e.*, University of Florida and University of Maryland, College Park), but given their different topic and audience, they were not included in this comparison. The University of Rhode Island is not an ABOR or AAU peer institution but is included to provide a second comparison program.]

Program name, degree, and institution	**The Science of Cannabis; Certificate; University of Arizona**	**Cannabis Production & Management; Certificate; University of Illinois Urbana-Champaign [UA peer per ABOR]** https://cropsciences.illinois.edu/academics/certificates/cannabis-production-management-certificate	**Cannabis Studies; Certificate; University of Rhode Island Online** https://web.uri.edu/online/programs/certificate/certificate-in-cannabis-studies/
Current number of students enrolled	[redacted]	Average Spring and Fall enrollment for 2022 and 2023: 28 students; Summer: 5	Unknown
Program Description	The Science of *Cannabis* Undergraduate Certificate guides students to understand the biology of plants in the *Cannabis* genus and to learn the science behind the techniques used in their cultivation. Students will examine how fundamental aspects of plant growth under various environmental conditions affect plant biochemistry, crop yield, and disease and pest resistance, and will consider how this information can be applied to a grower's advantage. Scaffolded learning within each core course builds towards more specialized information about *Cannabis*, including how its cannabinoid compounds and secondary metabolites interact with	The Cannabis Certificate program will help you build a foundation of cannabis production skills from classification to physiology to production management. This cannabis certificate program will help students become equipped with knowledge for cannabis indoor, outdoor, and large-scale field production; classification of subspecies and varieties, biology, propagation, planting, pest management, and harvesting of target compounds and products. This program is open to undergraduate, graduate, and non-degree seeking students.	The Undergraduate Certificate in Cannabis Studies is taught by world-renowned faculty and experts in areas including medicinal plants, natural product development, and formulation research in the pharmaceutical and nutraceutical industry. Students will access state-of-the-art equipment for cannabis chemistry analysis and testing of cannabis related products through virtual laboratory experiences. Students will also be provided with a unique online learning advantage, applying knowledge from URI's College of Pharmacy to the rapidly growing cannabis industry.

	human body. Optional coursework in hydroponics or other applied sciences allows students to round out their experience depending on their interests. Finally, students have an opportunity to get practical experience with plants in the genus, either through a formal lab course or through an internship focused on the biological aspects of *Cannabis*.	All course credits from the Certificate Program are transferable academic credits from the Certificate Program.	
Target Careers	[With additional education/training] Greenhouse manager; Horticulturist; Consultant to *Cannabis* industry and/or government.	Specific careers are not listed but website states: "The online Cannabis Certificate is designed to provide students with an understanding of the cannabis classification system, including subspecies and varieties, and proper management practices for target compounds and products. Understanding cannabis biology and taxonomic classification is critical for proper management practices for the production of essential oils, psychoactive compounds, fiber, and seed oil and protein, and applications of those products. Discrepancies between scientific and vernacular names of cannabis and the inconsistency of vernacular names mislead producers and consumers."	Specific careers are not listed. This program is only available to students who are *not* enrolled in another academic program at URI.
Minimum # of units required	14	11	12
Special requirements to declare/gain admission? (i.e. pre-	Yes. Minimum GPA of 2.0; sophomore standing or higher; application to program, including providing a	No	Yes. • Must be 18 years of age or older;

requisites, GPA, application, etc.)	statement for why they are motivated to complete the certificate.		• Submission of transcripts (college or high school/GED);
			• Show completion of the recommended general science coursework (basic H.S. level or above);
			• Two letters of recommendation;
			• Resume/CV and personal essay (300-500 words) discussing:
			  • Interest in the cannabis field
			  • Relevant work experience
			  • Reasons for applying to the online program at URI
			  • Professional goals, as well as plans for achieving these goals

Internship, practicum, or applied/experiential requirements? If yes, describe.	Yes; 1 credit of internship required. Additional 1 credit must be laboratory or internship.	No	No

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 UIUC program does not include the focus on hydroponics that the UA proposed program includes but otherwise is similar in that they are both programs are intended for undergraduates (the UIUC program is additionally available to non-degree-seeking students) and they both cover the science and growth of *Cannabis*. The courses offered [complete 11 credits from this list] in the UIUC program are:

   a. HORT 100 Introduction to Horticulture (3 credits)
   b. *Or* HORT 106 The Sustainable Home Garden (3 credits)
   c. CPSC 180 Medical Plants and Herbology (3 credits)
   d. [REQUIRED] CPSC 480 Cannabis Classification and Management (3 credits)

e. CPSC 499 Cannabis Phytochemistry (3 credits)
f. CPSC 499 Cannabis Flower Production (2 credits)

The URI program focuses more on pharmacological aspects and is not intended for degree-seeking students. The courses required are:

a. BPS 206 Foundations of Cannabis Studies (3 credits) [Pre-requisite for all other courses]
b. BPS 316 Cannabis Product Development (3 credits)
c. BPS 312 Cannabis Chemistry and Pharmacognosy (3 credits)
d. BPS 314 Cannabis Therapeutics (3 credits)

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.

   Most courses in the UIUC program and all the courses in the URI program are only offered online (2 of the UICU courses are also offered in person) and do not include the internship/practical experience requirement that the proposed UA program has. The UA courses will initially be offered in person.

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?

   Due to the practical learning aspect of our proposed program, our students should be better equipped to perform hands-on growth activities with plants in the *Cannabis* genus. The UA is highly regarded for its Controlled Environment Agriculture (CEA) program and our BS in Sustainable Plant Systems degree with an emphasis in CEA already attracts many students who are interested in working in the *Cannabis* industry. This certificate should complement that degree well and provide the additional specific education in *Cannabis*-specific content to help satisfy student interest in this field and better prepare them to work in this growing industry.

No departments have a similar/same target audience and/or curriculum.

All courses are internal to the participating departments.