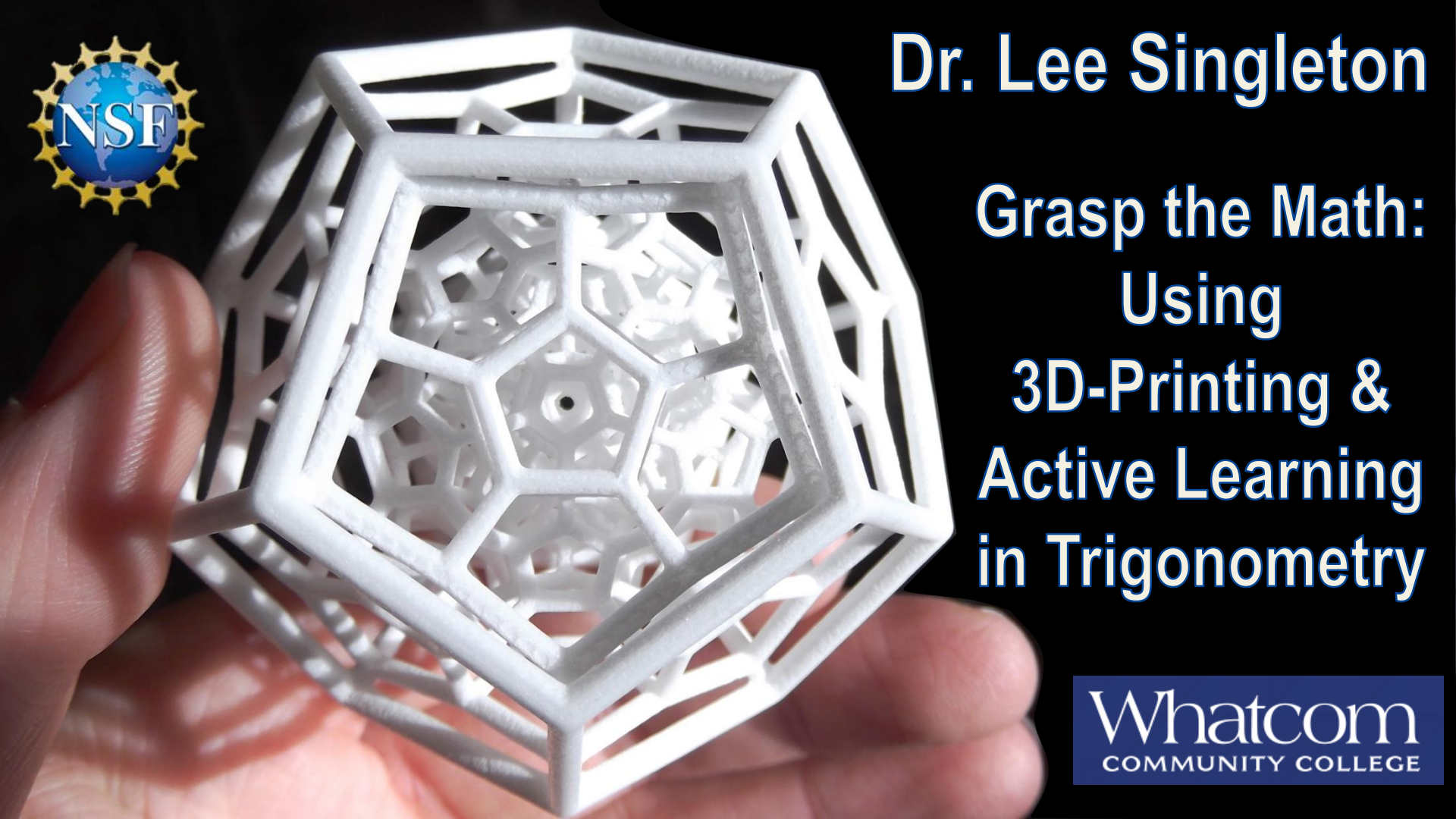
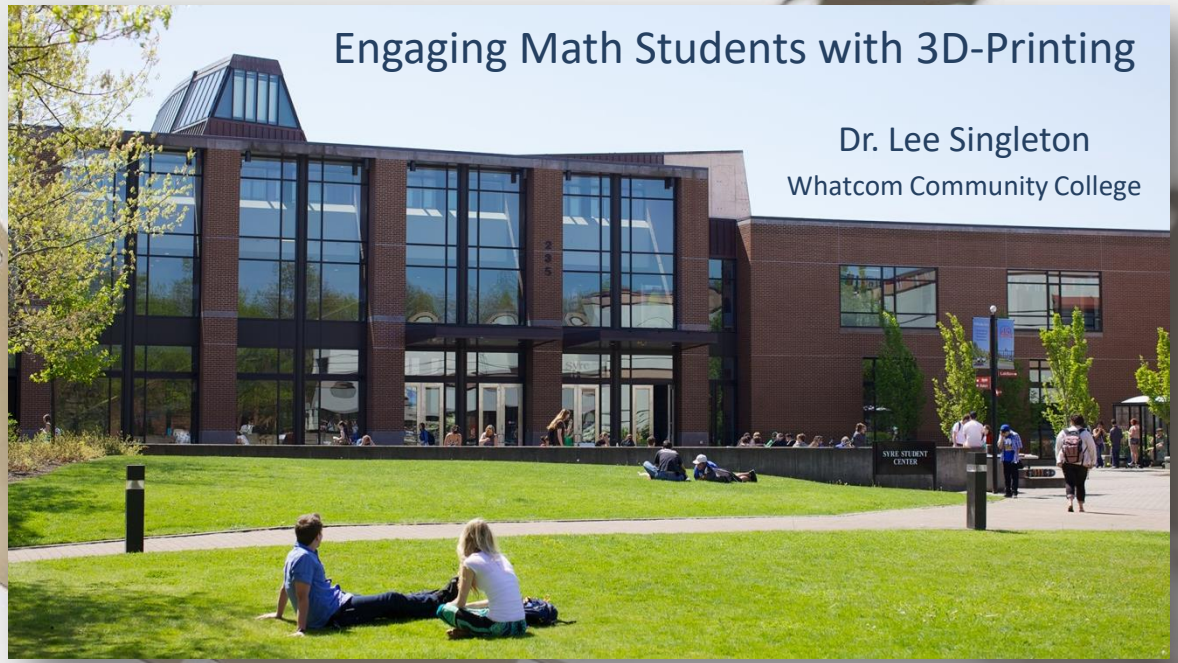

NSF
Dr. Lee Singleton
Grasp the Math:
Using
3D-Printing &
Active Learning
in Trigonometry
Whatcom
COMMUNITY COLLEGE

EAGER: MAKER: Engaging Math Students with 3D-Printing for STEM Success (DRL #1623405)

- Improve Success Rates of Students in Precalculus II (Math& 142)
- Improve Retention of students in STEM
- Improve Retention of Precalculus information through Calculus

- https://atecentral.net/r32228

https://youtu.be/UK5FxETSq9A



Sample Activities

Demonstration:

Linear & Angular Speed

Active Learning:

Graphing Sine & Cosine

A Tale of Two (Types of) Classes

3D-Printed Active Learning Classes:

- Q&A over homework at the beginning of class
- Mini-Lecture after Q&A
- Groupwork Handouts with 3D-Printed manipulatives
- Online & Textbook Homework
- Predator/Prey Modeling group assignment before Exam 2

Interactive Lecture Classes:

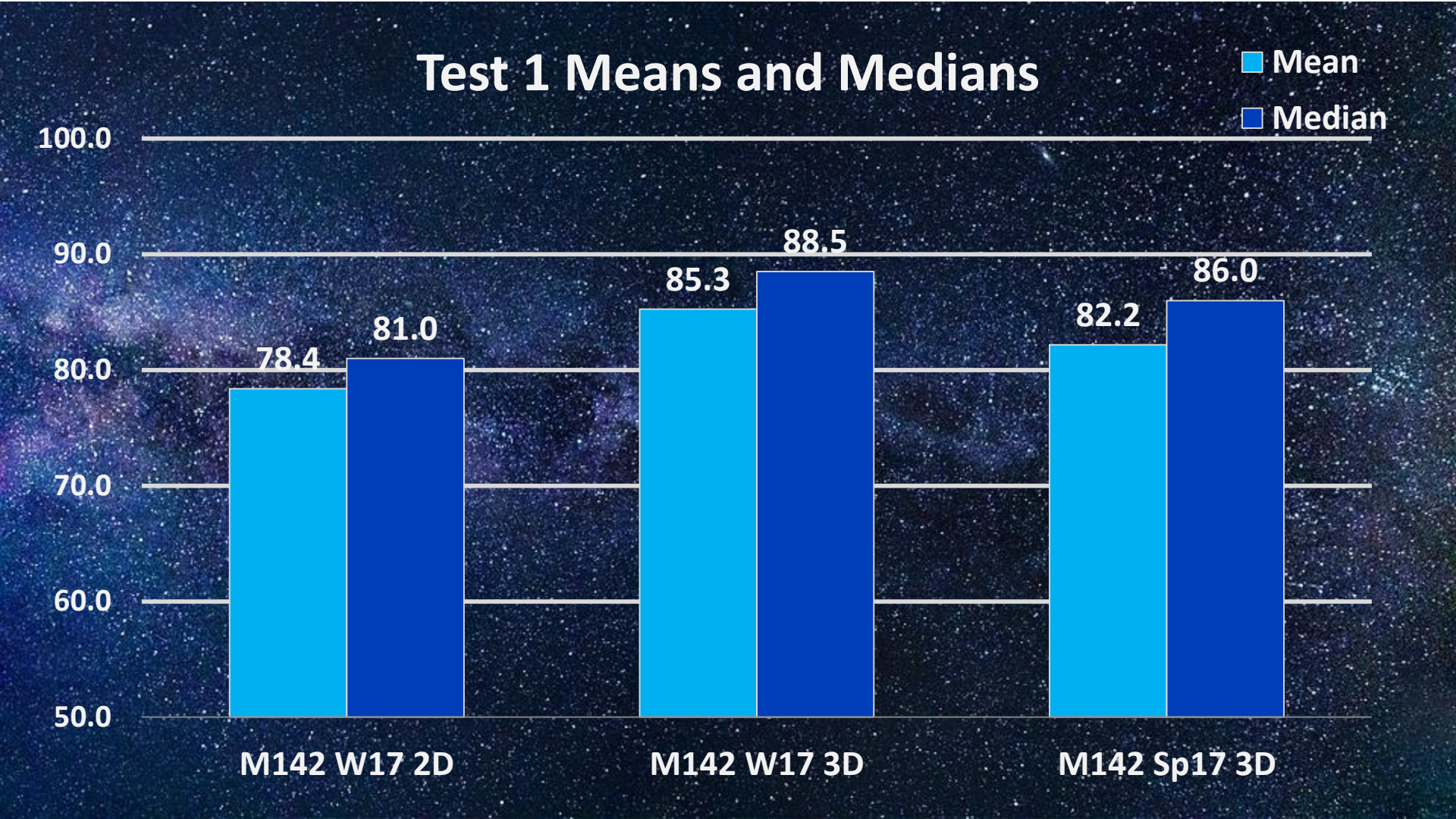
- Q&A over homework at the beginning of class
- Full-Lecture after Q&A
- Whole-group feedback and interaction during lecture
- Online & Textbook Homework
- Predator/Prey Modeling group assignment before Exam 2

Test 1 Topics

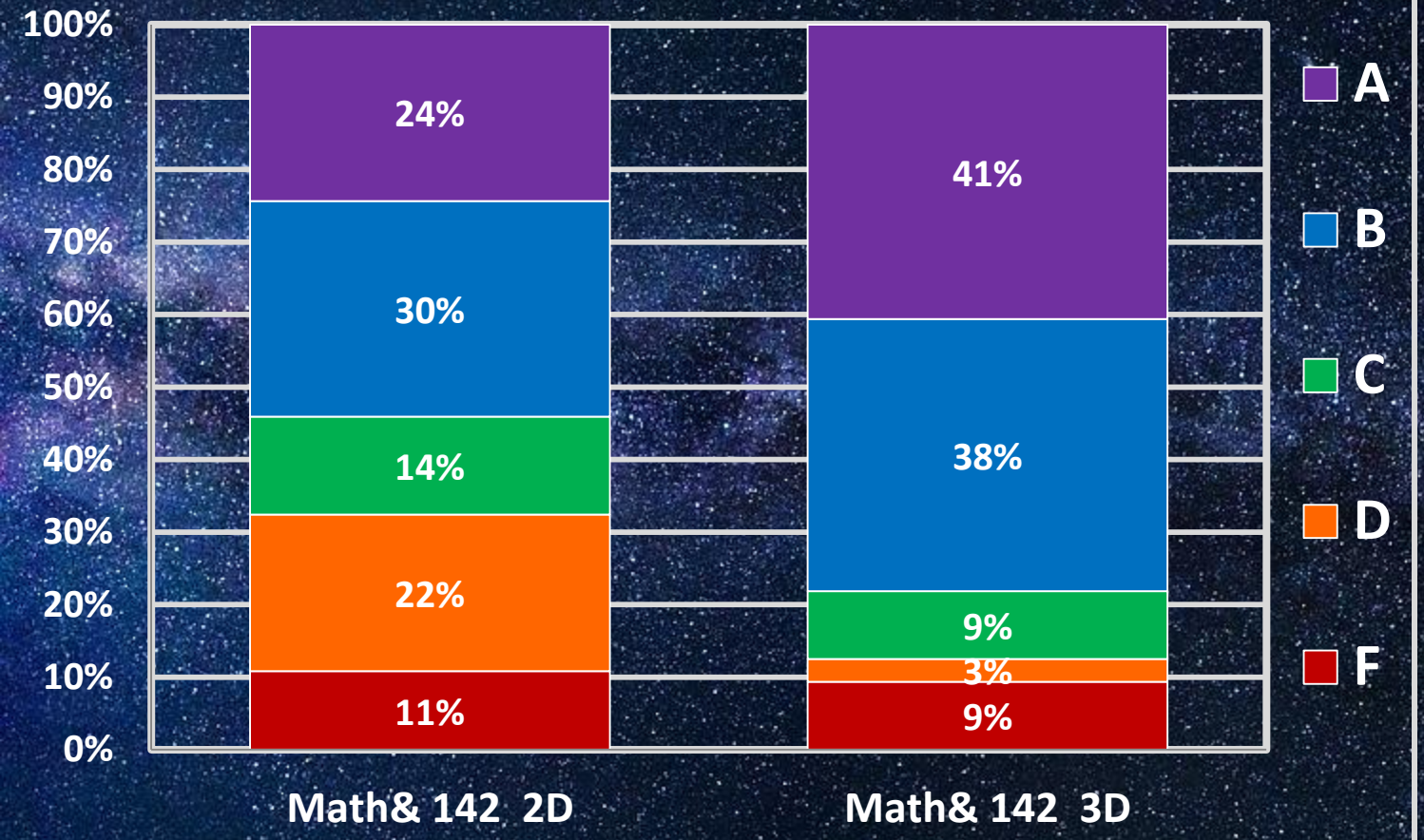
- Right Triangle Trig
- Coterminal and Reference Angles (degrees)
- Trig functions of any angle (degrees)
- Law of Sines
- Law of Cosines

Test 2 Topics

- Radians, Arclength, Linear & Angular Speed
- Unit Circle
- Coterminal and Reference Angles (radians)
- Trig functions of any angle (radians)
- Trig Graphs
- Inverse Trig Functions


Test 1 Means and Medians
Mean
Median
100.0
90.0
80.0
70.0
60.0
50.0
78.4
81.0
85.3
88.5
82.2
86.0
M142 W17 2D
M142 W17 3D
M142 Sp17 3D

Test 1 Grades by Class Type



T-test Values

All Data

p-val = .051

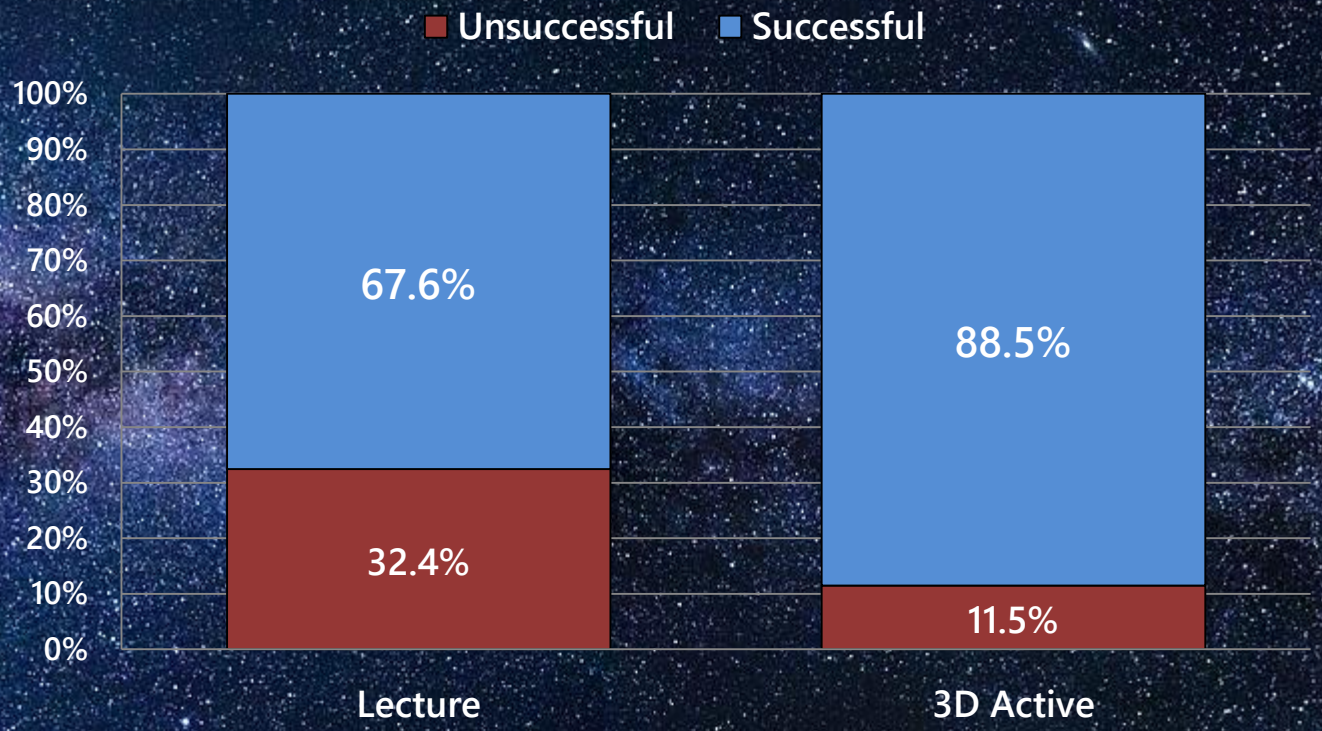
Data: 9 -> 49

p-val = .026

Data -1 Outlier

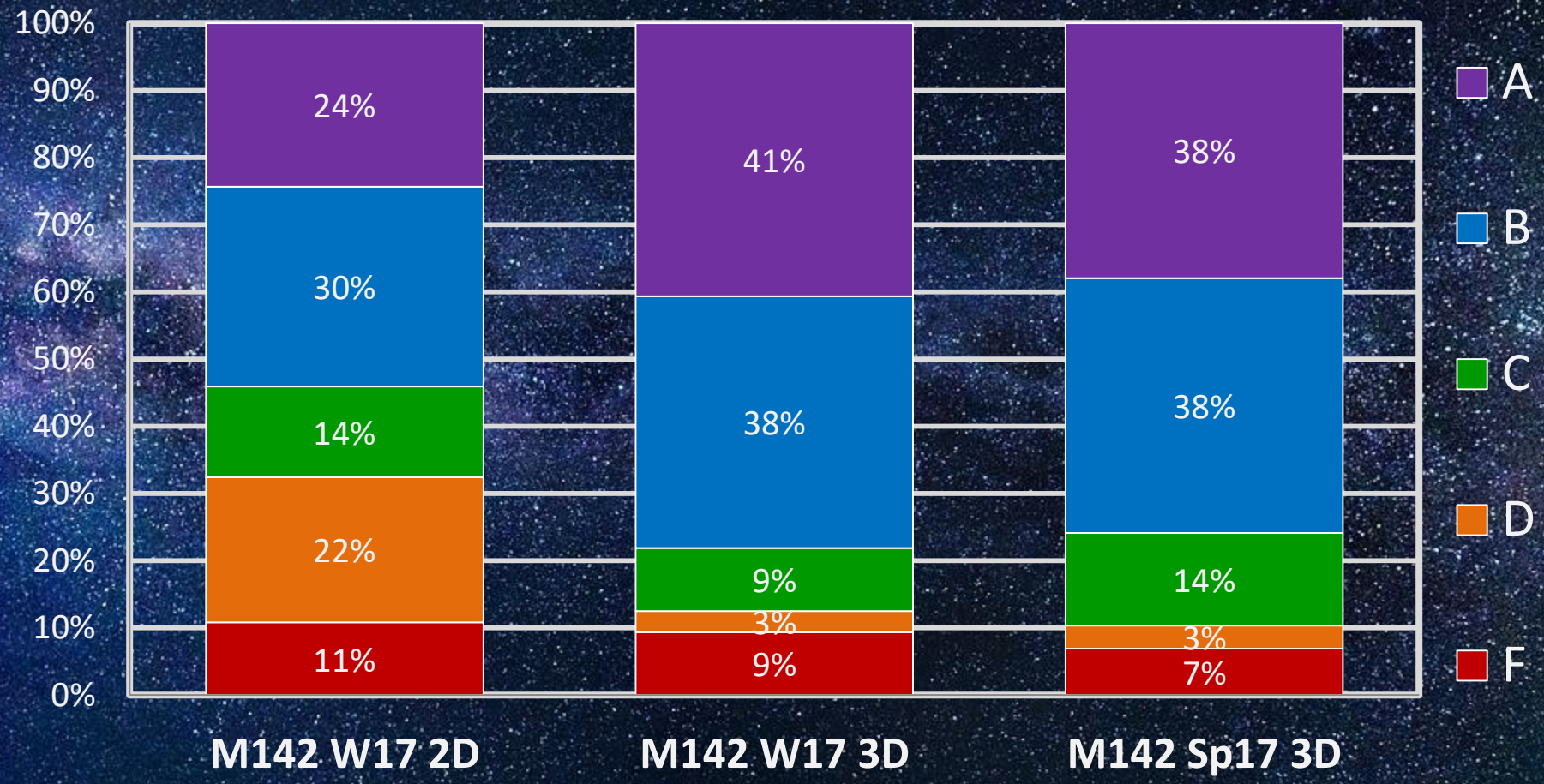
p-val = .016

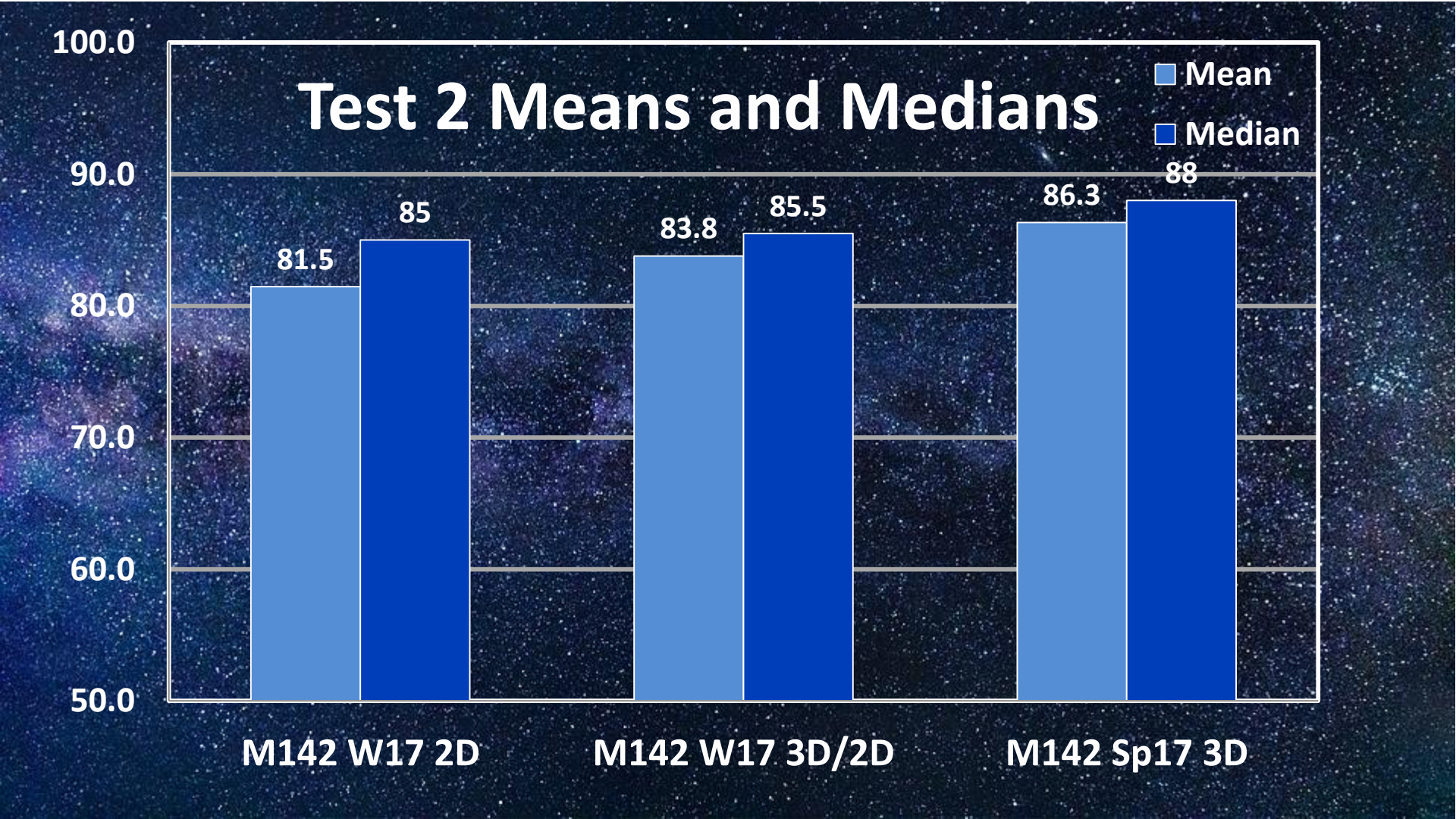
PreCalculus II Test 1 Success Rates



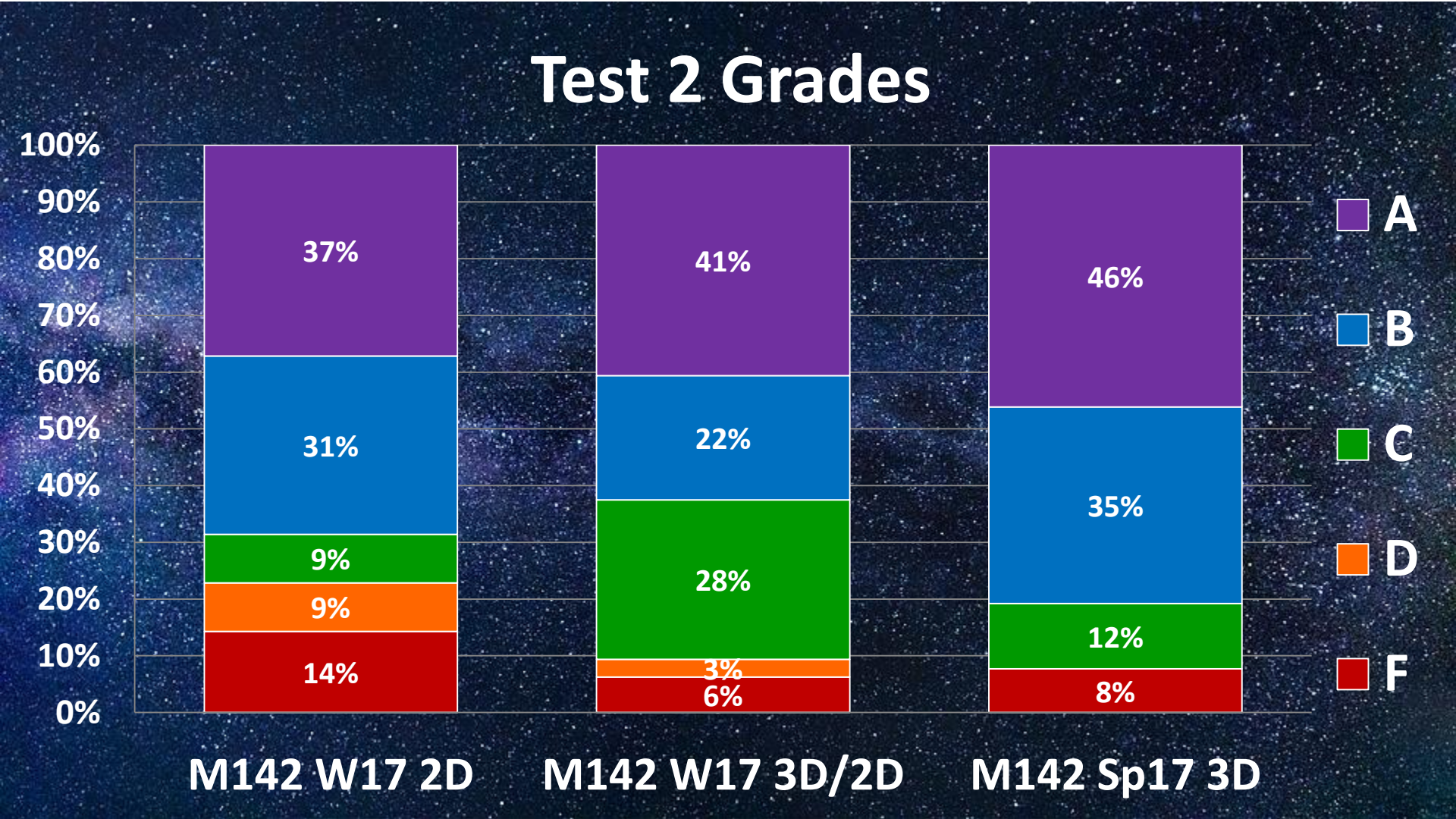
Notes:
Lecture Population = 37, Winter Quarter 2017
3D-Active Population = 61 Winter and Spring Quarter 2017
Successful = A,B, or C; Unsuccessful = D or F

Test 1 Grades

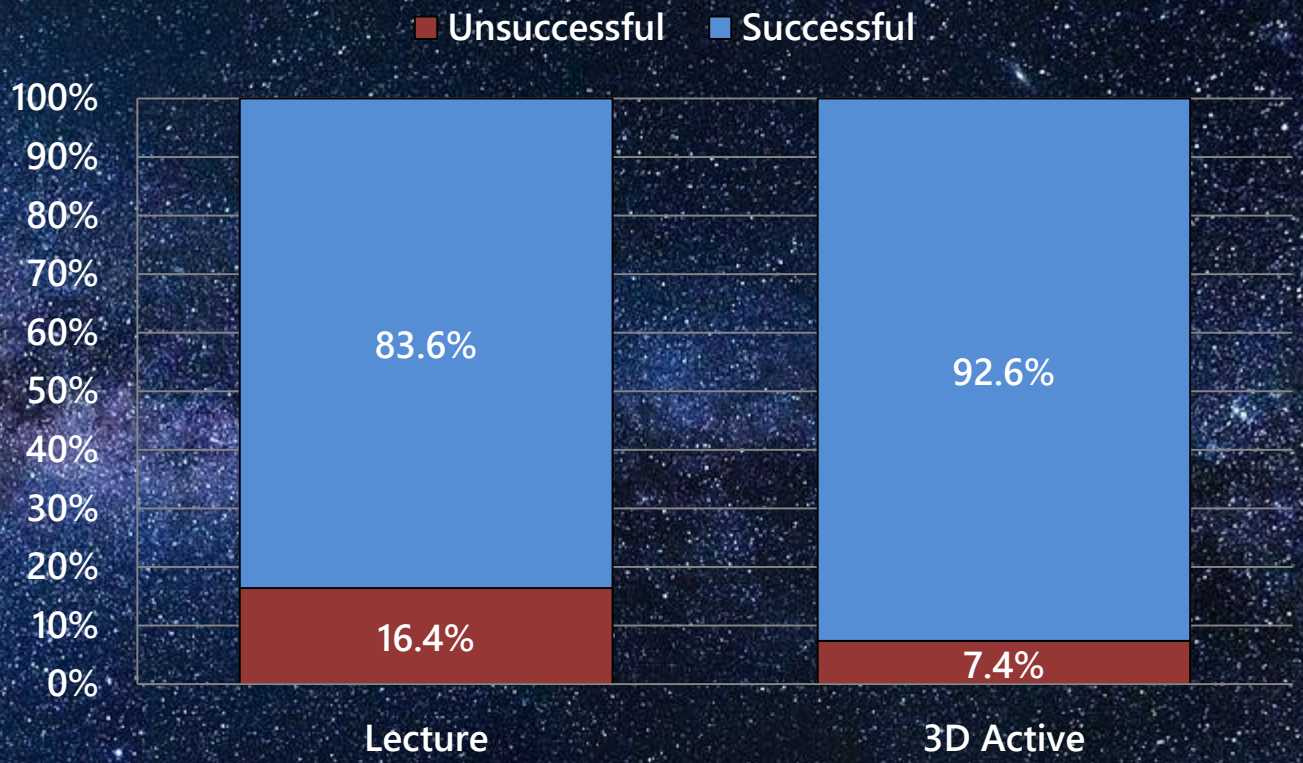



Test 2 Means and Medians
Mean
Median
100.0
90.0
80.0
70.0
60.0
50.0
81.5
85
83.8
85.5
86.3
88
M142 W17 2D
M142 W17 3D/2D
M142 Sp17 3D

Test 2 Grades



Precalculus II Test 2 Success Rates

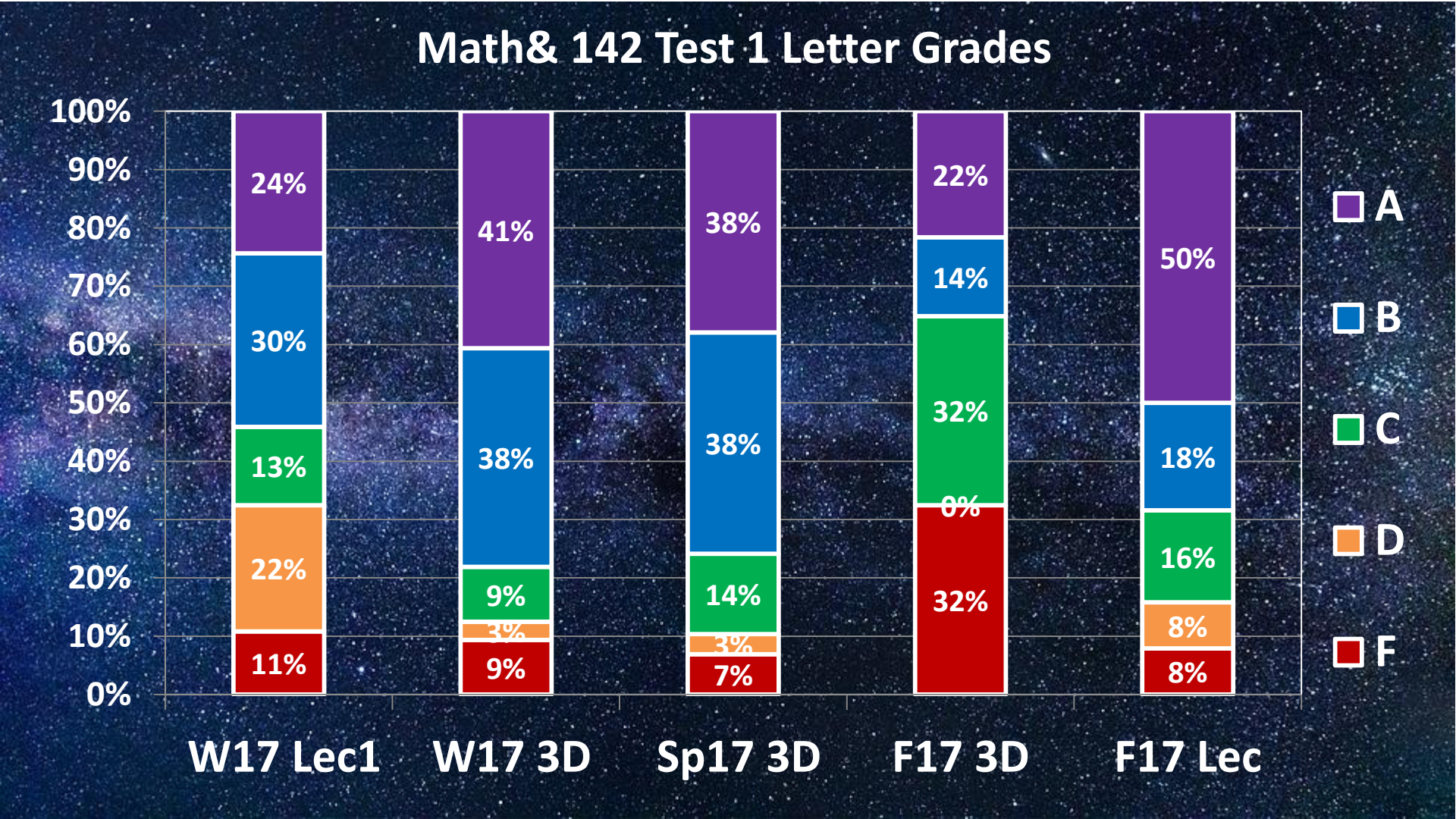


Notes:
Lecture Population = 67, Winter Quarter 2017
3D-Active Population = 27 Spring Quarter 2017
Successful = A,B, or C; Unsuccessful = D or F

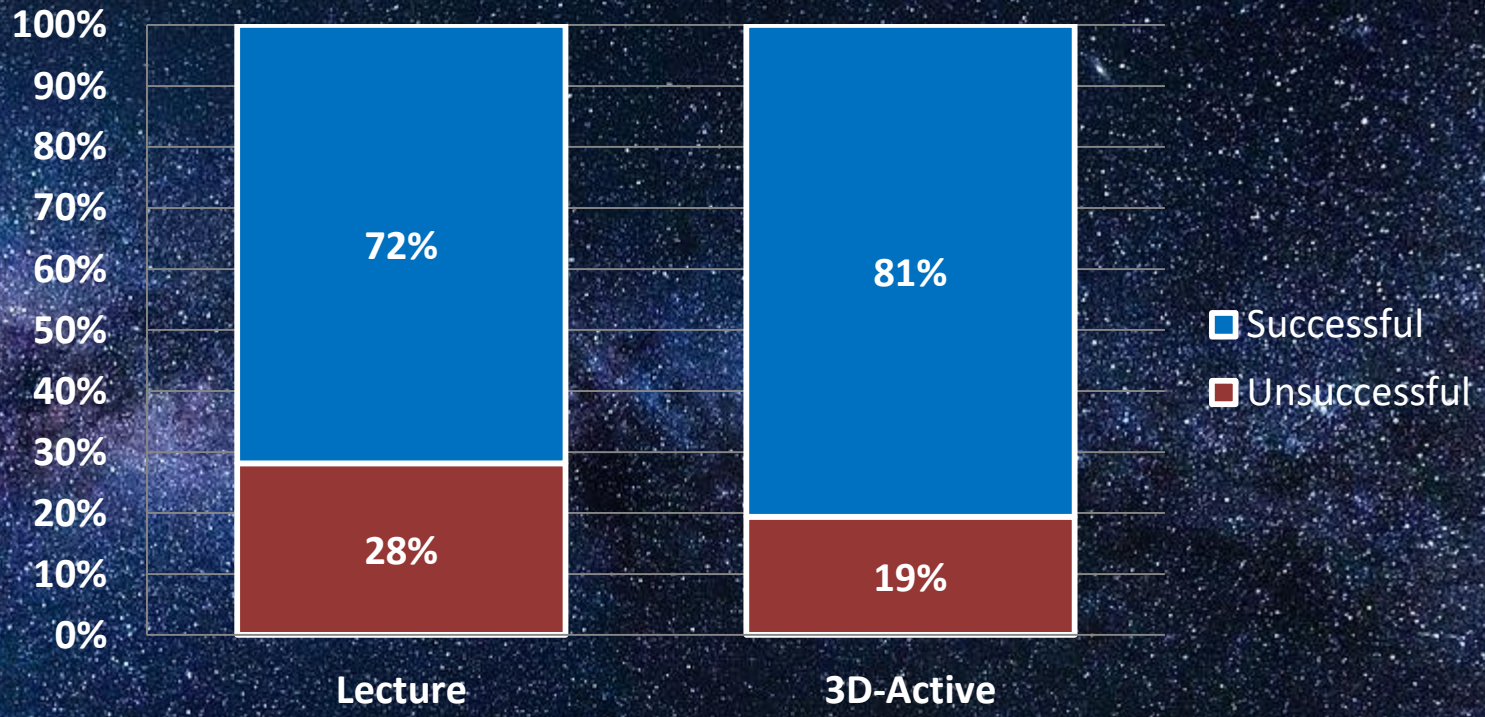
Test 2 Observations

- All groups had predator-prey activity groupwork after graphing sine and cosine
- All groups had “Unit Circle warning”
- Need to refine the inverse function activity

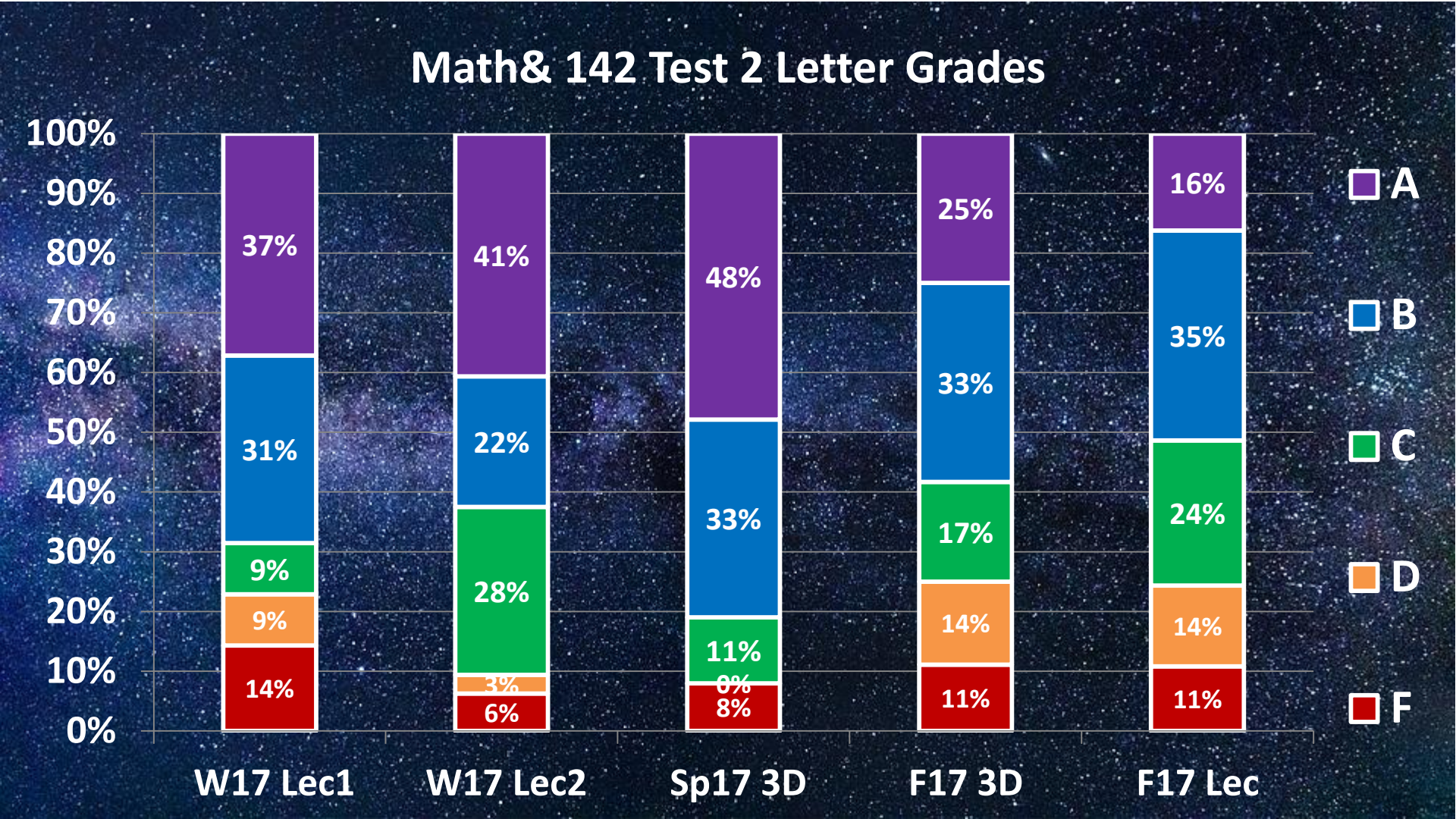
FALL '17


Math& 142 Test 1 Letter Grades
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
24%
30%
13%
22%
11%
41%
38%
9%
3%
9%
38%
38%
14%
3%
7%
22%
14%
32%
0%
32%
50%
18%
16%
8%
8%
W17 Lec1
W17 3D
Sp17 3D
F17 3D
F17 Lec
A
B
C
D
F

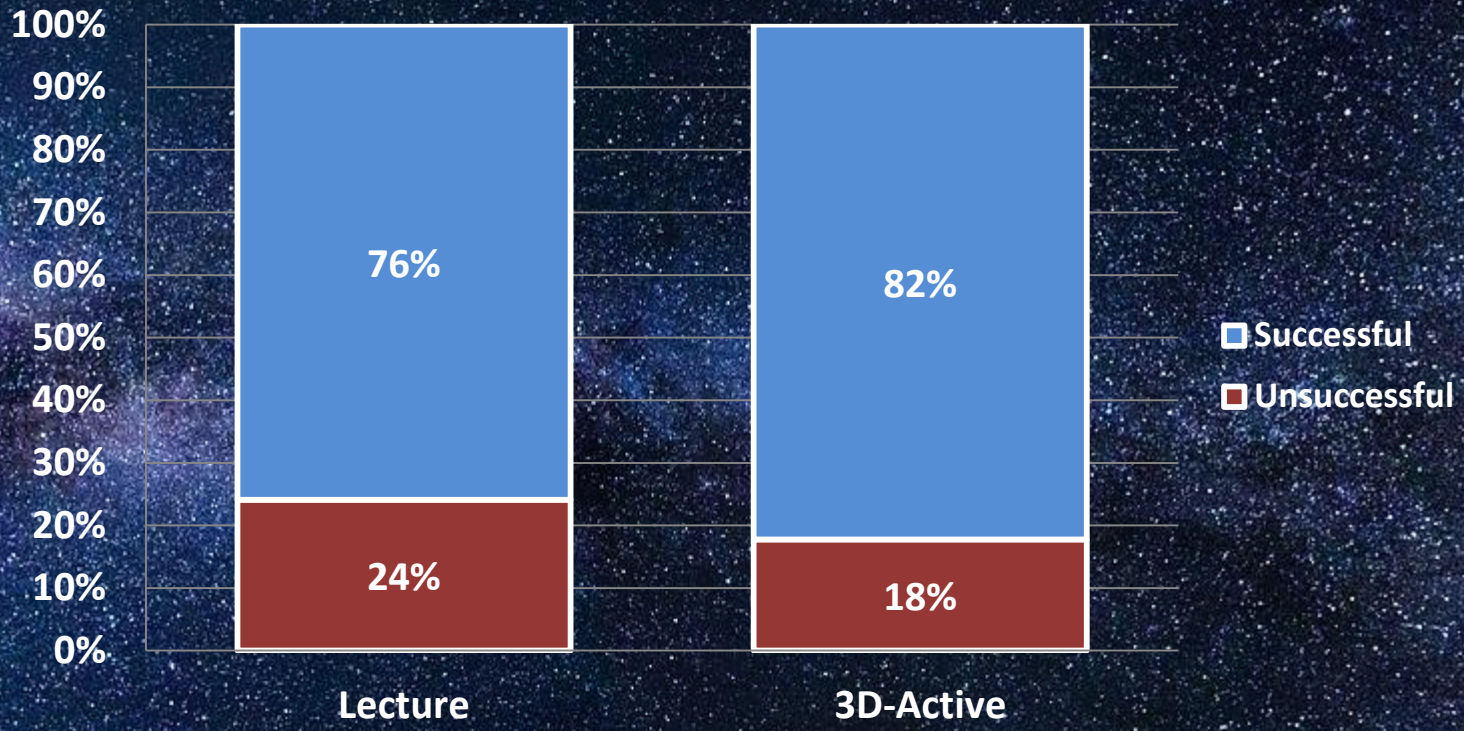
Math& 142 Test 1 Success Rates



Notes:
Lecture Population = 67, Winter & Fall Quarter 2017
3D-Active Population = 27 Winter, Spring, & Fall Quarter 2017
Successful = A,B, or C; Unsuccessful = D or F


Math& 142 Test 2 Letter Grades
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
37%
31%
9%
9%
14%
41%
22%
28%
3%
6%
48%
33%
11%
0%
8%
25%
33%
17%
14%
11%
16%
35%
24%
14%
11%
W17 Lec1
W17 Lec2
Sp17 3D
F17 3D
F17 Lec
A
B
C
D
F

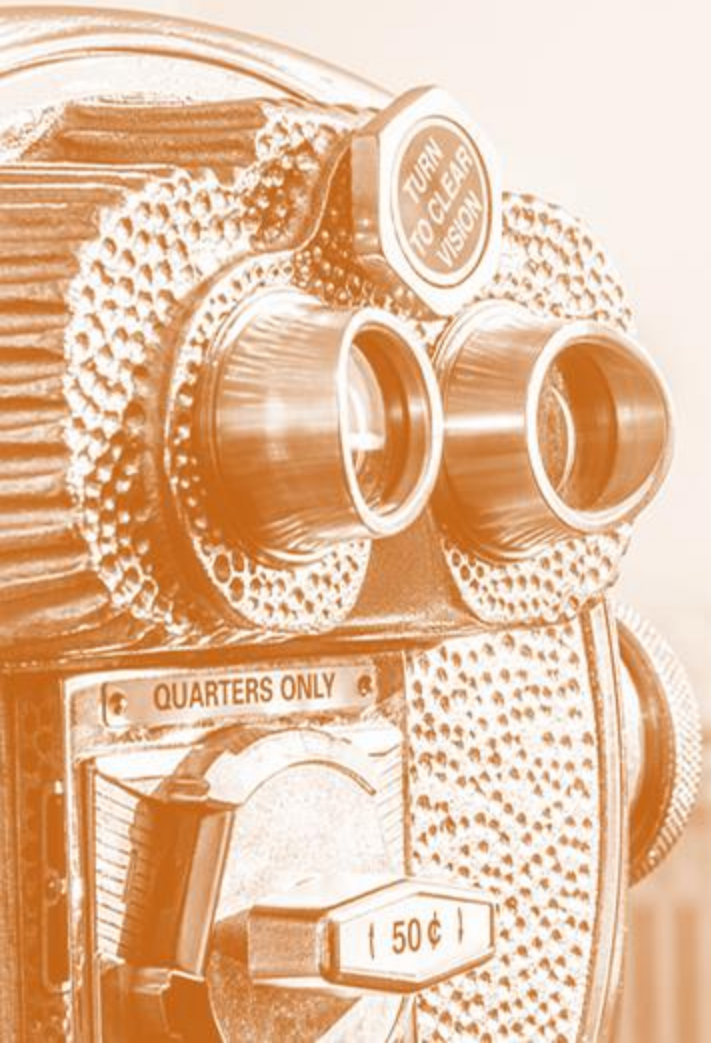
Math& 142 Test 2 Success Rates



Notes:
Lecture Population = 60, Winter & Fall Quarter 2017
3D-Active Population = 94 Spring & Fall Quarter 2017
Successful = A,B, or C; Unsuccessful = D or F

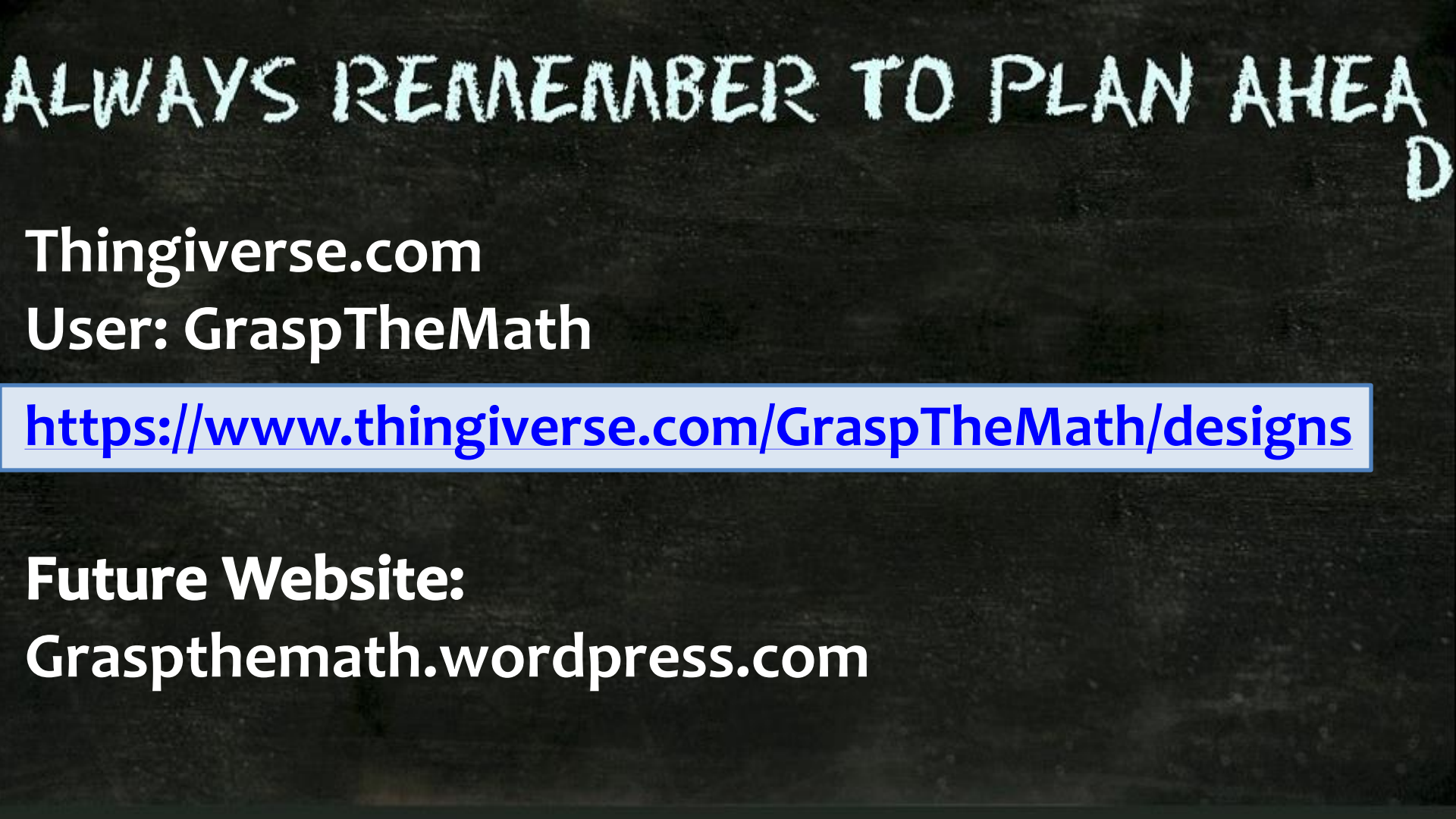
What about the time?

Do you measure the Speed of Coverage or Speed of Learning?



Other Observations

- Attendance not greatly affected
- Pods vs. Rows – difficult to see anything conclusive, but Pods seem to contribute to more student discussions
- Some classes ask really good questions, others…



Thingiverse.com
User: GraspTheMath

https://www.thingiverse.com/GraspTheMath/designs

Future Website:
Graspthemath.wordpress.com

MATH 175

Grasp the Math: Intro to 3D-Printing

Starting Fall 2017

2 Credit Class
Requires concurrent or prior enrollment in Math&142 or Math&151 or higher.

Design Software

Wolfram Mathematica

OpenSCAD

SOLIDWORKS

TINKERCAD

SketchUp

Onshape

3 MAX

AUTODESK

Rhinoceros 5

AUTODESK MESHMIXER

Slicing Software

Cura

- Refining lessons
- Tracking students through Calculus (I, II, III)
- Tracking student persistence in STEM

- Making lessons and objects available for download.
- Trying this in other classes!

- Feel free to look at other lessons and objects!