Surveying Unit Plan

# Introduction

Basic survey skills and land measurement skills are used in many jobs. This lesson is designed to provide instructional materials for general instruction and for the agricultural mechanics CDE (state and national). These topics will lay a foundation for more advanced surveying skills such as the use of RTK GPS and Total Stations.

# Teacher Preparation

For teachers unfamiliar with surveying, we suggest the resources below be reviewed before teaching in addition to the videos provided with this curriculum. Teachers should practice the provided activities.

## Pr**in**t Materials

Agricultural Technical Systems and Mechanics, 2nd Edition, 2019 (surveying chapter)

Agricultural Mechanics and Technical Systems, 2017 (Chapter 13)

Land Measurement Practices for Agricultural. University of Arizona, 1990

Land Measurement Practices for Agricultural Student Workbook. University of Arizona, 1990

(Available at: <http://www.agedweb.org/AgMechanics/index.htm>)

## Web Sites

<https://contourmapcreator.urgr8.ch/> (Contour Map Creator)

<https://www.wikihow.com/Use-a-Dumpy-Level> (Use of a level)

## Other Videos

<https://youtu.be/SPCewaAfqPA> (How Surveying Works

<https://youtu.be/tNRZPHLwC7k> (Leveling 1)

<https://youtu.be/m52vUijOypE> (leveling 2)

<https://youtu.be/Xtcu3YGS4g4> (Leveling 3)

<https://youtu.be/8WRnDsfdah0> (leveling 4)

<https://youtu.be/00FuUMqs9Lk> (leveling 5)

<https://youtu.be/L6FbV0LiA_k> (contour lines)

## Teacher Notes

* Files are organized by type in folders as described under “Resources”. Files are editable and teachers are encouraged to customize as needed.
* The unit plan is designed in small topics so the instructor can combine to fit into their curriculum.
* Time estimates include classroom instruction and activities. These are estimates and should be used as a guide only. Teaching methods, period scheduling, class size, and the ability to leave an activity setup can impact the instructional time greatly.
* While PowerPoint is useful teachers are to use hands on instruction wherever possible using actual equipment.
* Survey Instruments start at about $150 for optical levels and $400 for laser levels. Kits can be purchased with a tripod and grade rod starting at about $300. (2022 pricing)
* Multiple instruments and rods will give you more flex in activities.

## Teaching Methods

* Some activities may have limited equipment (like the number of levels available). Consider rotating through activities concurrently. Activity rotations can be designed to allow for more students to participate simultaneously. For example, pacing-right angle setup-differential leveling.
* Use actual tools rather than PowerPoints when possible.
* Do hands on demos instead of videos when possible.
* Look to develop examples at your school. For example what is the grade of the apron into the shop or what is the slope of the parking area. Seeing expels in the “real world” will make concepts more concrete.

## Required Equipment (minimum)

* Fiberglass Tape – 100’ (2)
* Tripod
* Builder’s Level
* Rod

## Interest Approach

Many jobs include some survey skills. Can you name a few? Tie to local employers such as contractors, irrigation companies, and engineering firms. Surveying is really about measurement on a large scale. Compare a shop project you do that involves measurement and determining square to these same activities required to layout a building.

# Math Skills

* Pacing – Computing averages
* Area measurement – Computing areas and volumes
* Right Triangle – Geometry of right triangles
* Setting grade / Differential Leveling

# Student Learning Outcomes

At the completion of the unit the student should be able to:

* Identify common tools use in land surveying
* Properly setup a level
* Read a (grade) rod
* Set grade for concrete forms
* Perform differential leveling
* Calculate soil and concrete volumes
* Calculate land areas
* Check forms for square
* Use pacing to estimate distances

# Unit Plan

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Time (hours) | PPT | Assessment | Activity | Video | Resources |
| 1. Surveying Introduction | .5 | X |  |  |  |  |
| 1. Surveying Tools | .5 | X | X |  |  |  |
| 1. Pacing | 2 | X |  | X |  | Problems |
| 1. Right Triangle Layout | 3 | X |  | X |  |  |
| 1. Area (volume) Measurement | 2 | X |  | X |  | Problems |
| 1. Level Setup | 2 | X |  | X | X |  |
| 1. Rod Reading | .5 | X |  |  | X |  |
| 1. Setting Grade | 3 | X |  | X | X |  |
| 1. Differential Leveling | 4 | X |  | X | X | Excel “book”, Problems |
| 1. Topographic Mapping | 4 | X |  | X |  |  |
|  | 22.5 |  | X |  |  |  |

# Instructional Resources:

## PowerPoint

01-Introduction.pptx

02-Survey Tools.pptx

03-Pacing.pptx

04-Right Angle Layout.pptx

05-Determining Field Area.pptx

06-Level Setup.pptx

07-Rod Reading.pptx

08-Setting Grade.pptx

09-Differential Leveling.pptx

10-Topographic Mapping.pptx

## Activities

03-Pacing Activity.docx

04-Right Angle Layout Activity.docx

06-Instrument Setup.docx

08-Setting Form Grade Activity.docx

09-Differential Leveling Activity.docx

10-Topo Map Activity.docx

## Assessments

Survey Tool ID.docx

Survey Unit Test.docx

## Guided Notes

01-Introduction Notes.docx

02-Survey Tools Notes.docx

03-Pacing Notes Notes.docx

04-Right Angle Layout Notes.docx

05-Determining Field Area Notes.docx

06-Level Setup Notes.docx

07-Rod Reading Notes.docx

08-Setting Grade Notes.docx

09-Differential Leveling Notes.docx

10-Topographic Mapping Notes.docx

## Videos

|  |  |  |
| --- | --- | --- |
| **File** | **Description** | **Length** |
| Survey Instrument Setup.mp4 | Demonstrates the setup of a three screw builders’ level and builder’s and Philadelphia rod reading. | 8:17 |
| Laser Level.mp4 | Demonstrates the setup and use of a laser level |  |
| 4 screw level.mp4 | Demonstrates the leveling of a 4 screw dumpy level. |  |
| Reading Phili Rod | Demonstrates the reading of a Philadelphia rod (100ths of feet). Short narrated PowerPoint. | 3:41 |
| Reading Builder’s Rod | Demonstrates the reading of a Builder’s rod (feet/inches). Short narrated PowerPoint. | 3:20 |

## Other

DifferentLevelingBook.xlsx

Topo Worksheet.xlsx

Differential Leveling Problems.docx

Area-Volume Angle Problems.docx

Pacing Problems.docx

## Lesson Outlines

Detailed outlines can be found in the PowerPoint slide decks. To print choose File | Print then select Outline. Some slides also contain notes. These can be viewed with the slide or printed as notes pages.

# Standards and Skills:

## Oregon ANFR:

AGPT01.02.02 Demonstrate use of measurement tools.

AGPT01.02.03 Demonstrate use of hand tools and instruments used for service, construction, and fabrication.

AGPT04.04.06 Construct wood or metal building frames.

AGFP09.0.08 Use land survey and coordinate system; determine percent (%) slope.

AGEV05.01.02 Apply surveying and mapping principles to make site measurements.

AGNR01.02.08 Use land survey and coordinate system.

## Oregon Ag Mechanics CDE:

**AGRICULTURAL CONSTRUCTION AND SOIL AND WATER CONSERVATION**

2. Soil and Water Conservation

a. Set up and level the instrument.

b. Record field notes for differential leveling.

## National FFA CDE Skills:

* Read and interpret maps including conservation, land use, soils, topographic, aerial, and remote sensing and geological surveys.
* Conduct land surveying practices
* Describe and/or calculate surface and subsurface drainage and irrigation techniques.
* Determine land shaping and grading requirements.
* Lay out grade stakes for cuts/fills.
* Lay out and map contour lines.