



# THE SCIENCE BEHIND TRADITIONAL KNOWLEDGE

AN IN-FIELD MEDICINAL PLANTS BIOASSAY  
METHOD BOOSTS SCIENCE ENGAGEMENT OF  
NATIVE AMERICAN STUDENTS

D. Barry Croom, Joshua J. Kellogg, Nathalie Plundrich  
& Mary Ann Lila - NC State University  
Brittany Graf & Ilya Raskin - Rutgers University

# A PROBLEM

- Less than 1% of Native Americans attend college
- A disconnect persists between what AN/Al students are learning in their schools and their perceived world around them.
- Typical European-American classrooms are incongruent with AN/Al cultural heritage.



# THE NATIVE SCIENCE PARADOX

- Native Americans employ the scientific method, but not in the same fashion taught in European-American Schools.
- Historically, Native Americans were the first scientists on the North American Continent.
- Native Americans have a rich appreciation and deep understanding of the natural sciences.
- Native Americans have used endemic plants and other biological resources for subsistence foods, and to ward off infection and disease.

# STUDIES

- Guiffrida
  - There is a relationship between culture and academic success.
  - Studies have validated the need for minority college students to retain and nurture connections to their cultural heritage (Gonzalez, 2000; Guiffrida, 2003, 2005; Padilla et al., 1997)
- Deci and Ryan (2000)
  - Students do well in activities that mirror their personal interests and values.
  - Students need effective interaction in environment.

DNA-protective

antiviral

antimicrobial

antiadhesin

free-radical scavenging

**ADD-therapeutic**

**UTI-inhibition**

**antidiabetic**

**cancer-chemopreventive**

# Medicinal plant foods

**cardioprotective**

**anti-osteoporosis**

**neuroprotective**

estrogen antagonism

enzyme activating/inhibiting

antiproliferative

neuronal signaling

iron chelating

membrane-modulating

antioxidant

anti-inflammatory



# STUDIES

- Guiffrida
  - There is a relationship between culture and academic success.
  - Studies have validated the need for minority college students to retain and nurture connections to their cultural heritage (Gonzalez, 2000; Guiffrida, 2003, 2005; Padilla et al., 1997)
- Deci and Ryan (2000)
  - Students do well in activities that mirror their personal interests and values.
  - Students need effective interaction in environment.

# Bioprospecting

## BioExploration, not Bioprospecting

- Legal framework
- Ethnobotanical leads
- Sustainability

Screens to Nature  
(not nature to screens)









# SCREENS TO NATURE- NORTH DAKOTA



# SCREENS-TO-NATURE (STN) SYSTEM

- Portfolio of qualitative field bioassays
- Medium-throughput techniques
- Participatory research tool
- Primary indicators of bioactivity



# STN CHARACTERISTICS

- Field-deployable
- Colorimetric/visual indicators
- Accessible to all science backgrounds
- Accurate, reproducible assay techniques
- Engaging, inclusive methodology for working with communities

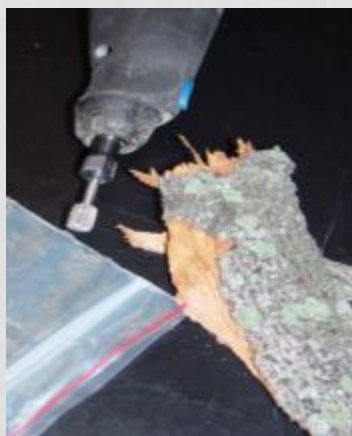
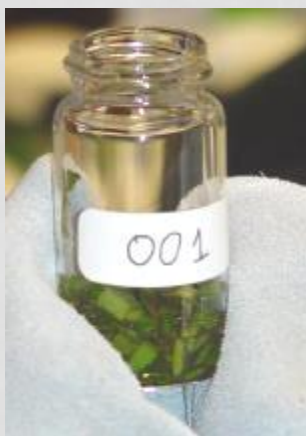








# GIBEX MANUAL - AN EFFECTIVE TOOL FOR TECHNOLOGY TRANSFER



# ANTIOXIDANT SCREEN

## Targets: Chronic diseases:

Cancer, Diabetes, Heart disease, Alzheimer's disease, and Parkinson's disease

### MATERIALS

1 x 96 well plate

3.5 mg ABTS

(2,2 Azino-bis (3-ethylbenzo-thiazoline-6-sulfonic acid) diammonium salt ) - ATBS

0.5 mg Potassium persulfate (K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>)

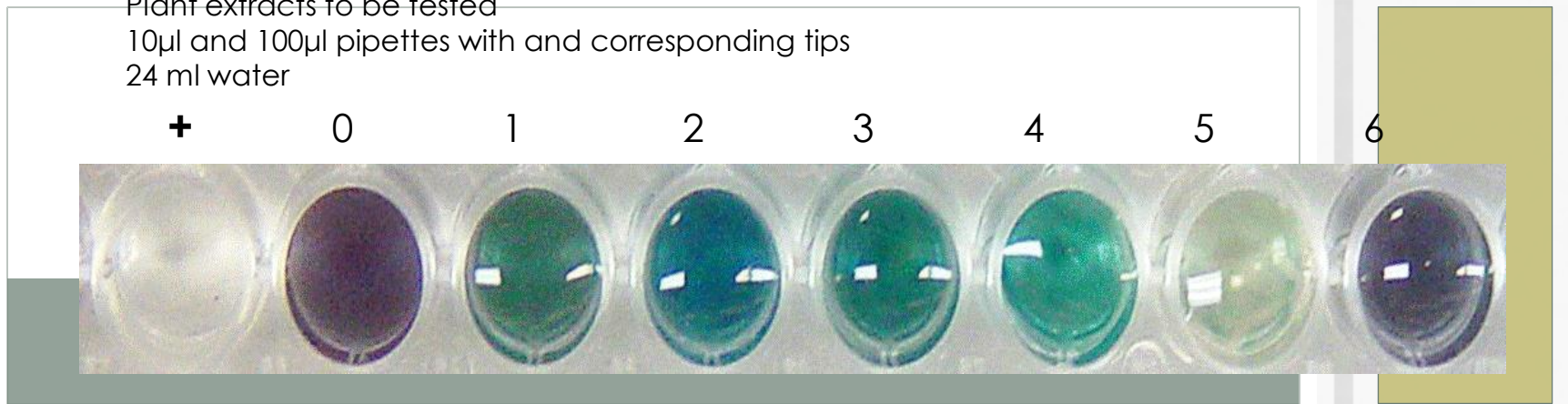
1mM ascorbic acid solution (17.6 mg/ml) or known antioxidant

Permanent marker

Plant extracts to be tested

10 $\mu$ l and 100 $\mu$ l pipettes with and corresponding tips

24 ml water



Sample 5 would be recorded as "3"; Samples 1- 4 would be recorded as "1";  
Sample 6 would be recorded as "0"



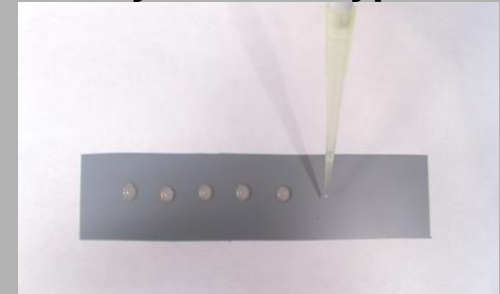
# Dual Assay for Protease Inhibitors and Proteases Using X-Ray Film

Targets: HIV / AIDS, parasitic diseases, metabolic disorders

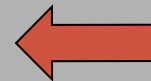
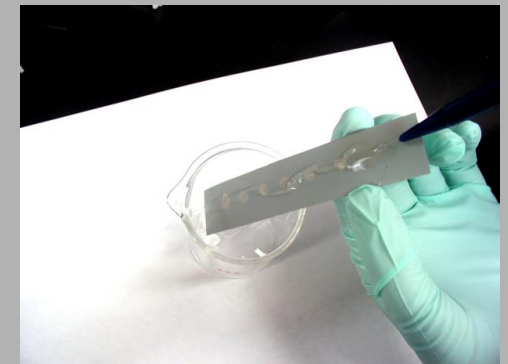
Squeeze or extract juice



Place on surface of x-ray film +/- trypsin



Incubate for 15 min, wash with water



Trypsin - positive control

Protease (source: pineapple juice)

Negative control

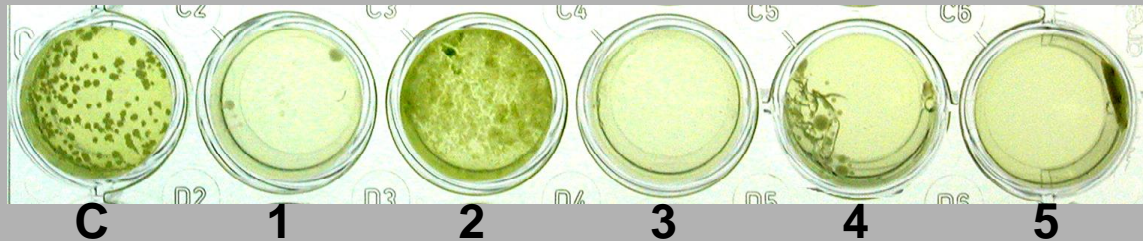


Protease inhibitor (source: potato juice with trypsin)

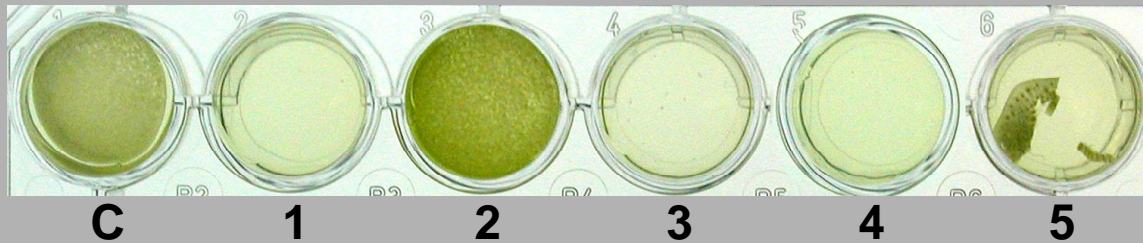
# ANTIMICROBIAL ASSAY WITH HUMAN SALIVA

Targets: Bacterial tropical diseases

Diluted human saliva



*Staphylococcus aureus* sterile culture grown for 2 d at 37°C

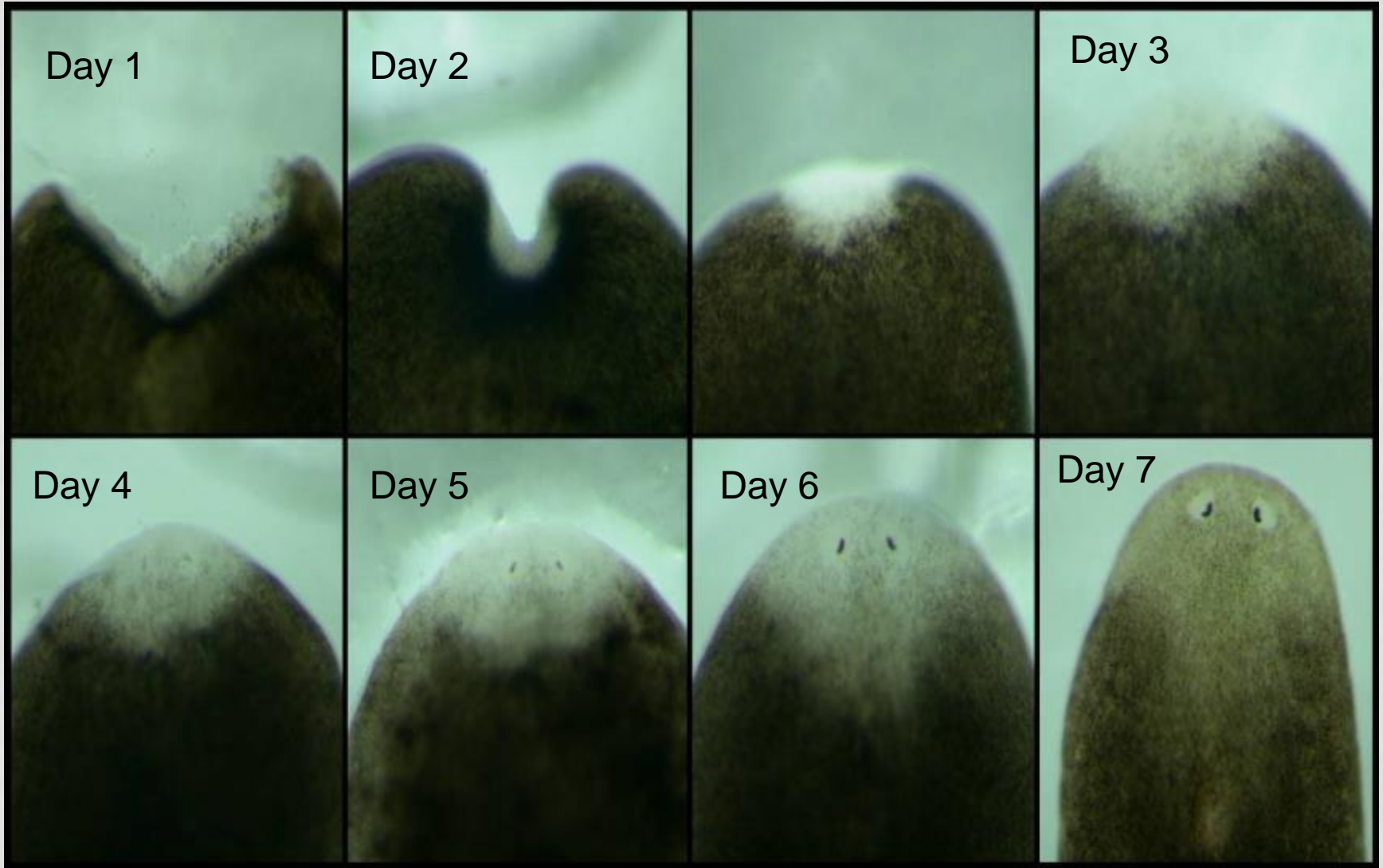


- (C) Saliva or *Staphylococcus aureus* control
- (1) Kanamycin
- (2) Tobacco extract
- (3) Garlic extract applied on the surface
- (4) Garlic extract added to the medium
- (5) A slice of garlic clove was included in the medium

# Planaria Regeneration Assay







# BERRIES & ANTI-DIABETIC ACTIVITY





# S2N - ALASKA





# BRIDGING WESTERN SCIENCE WITH CULTURE AND TEK









TEK + biosciences|  
the complementarity of  
different knowledge systems  
They reinforce each other  
--Mailhot 1994





Resources STAY

Knowledge STAYS

IP STAYS

TEK validated;  
Youth are engaged



# PURPOSE

- Does Screens to Nature Method of Instruction have a positive effect on Native American student engagement in high school agricultural and life sciences?
  - Are Native American students are engaged in applied science lessons?



# STROBE METHOD (O'MALLEY ET AL., 2003)

- Background
- Advantages
  - Direct observation (vs. survey)
  - Unobtrusive method of capturing engagement
  - Does not interfere with learning time
- Using STROBE
  - At-risk youth workshop
  - Gifted youth workshop
  - College student workshop



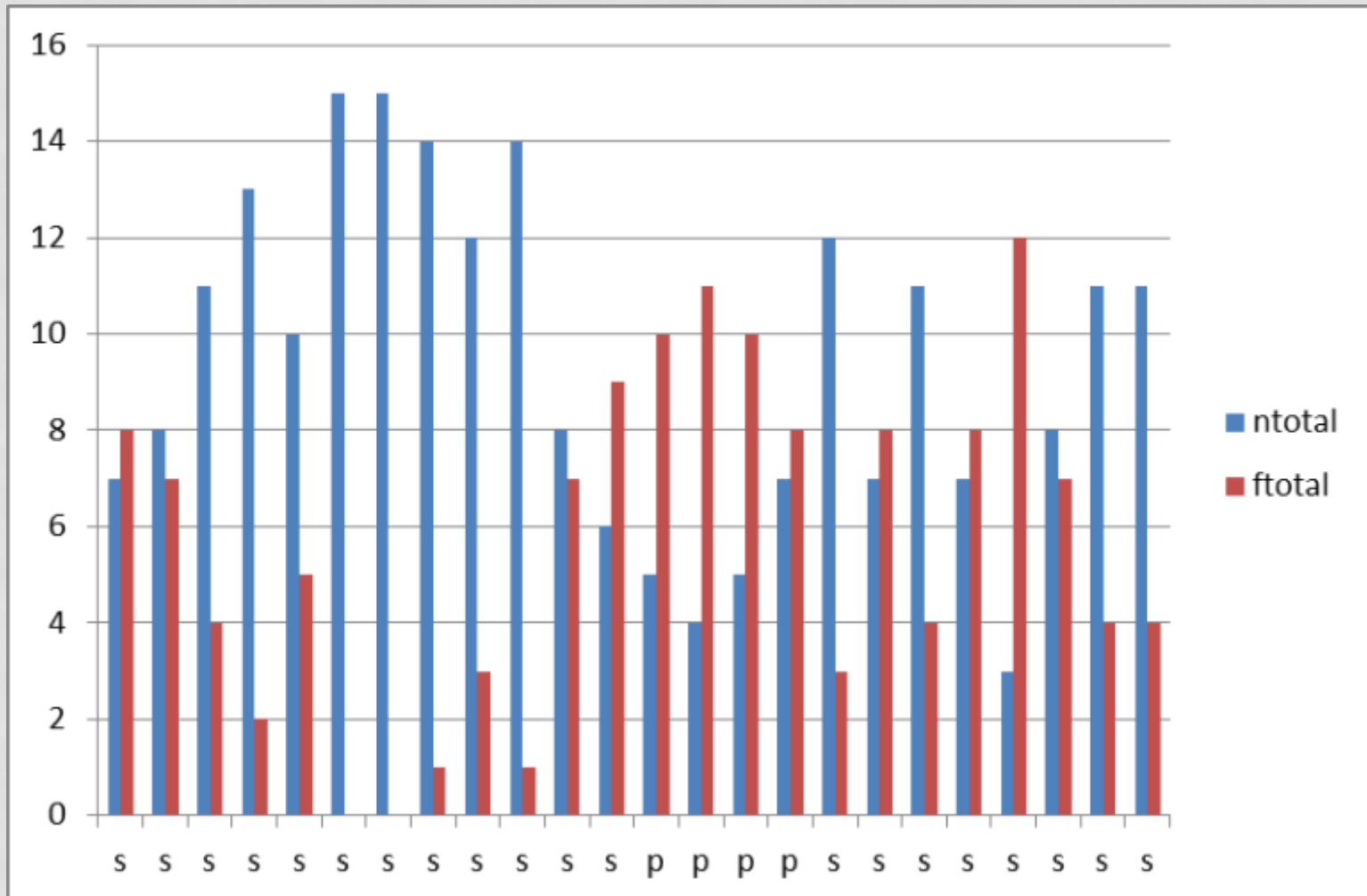


# STROBE

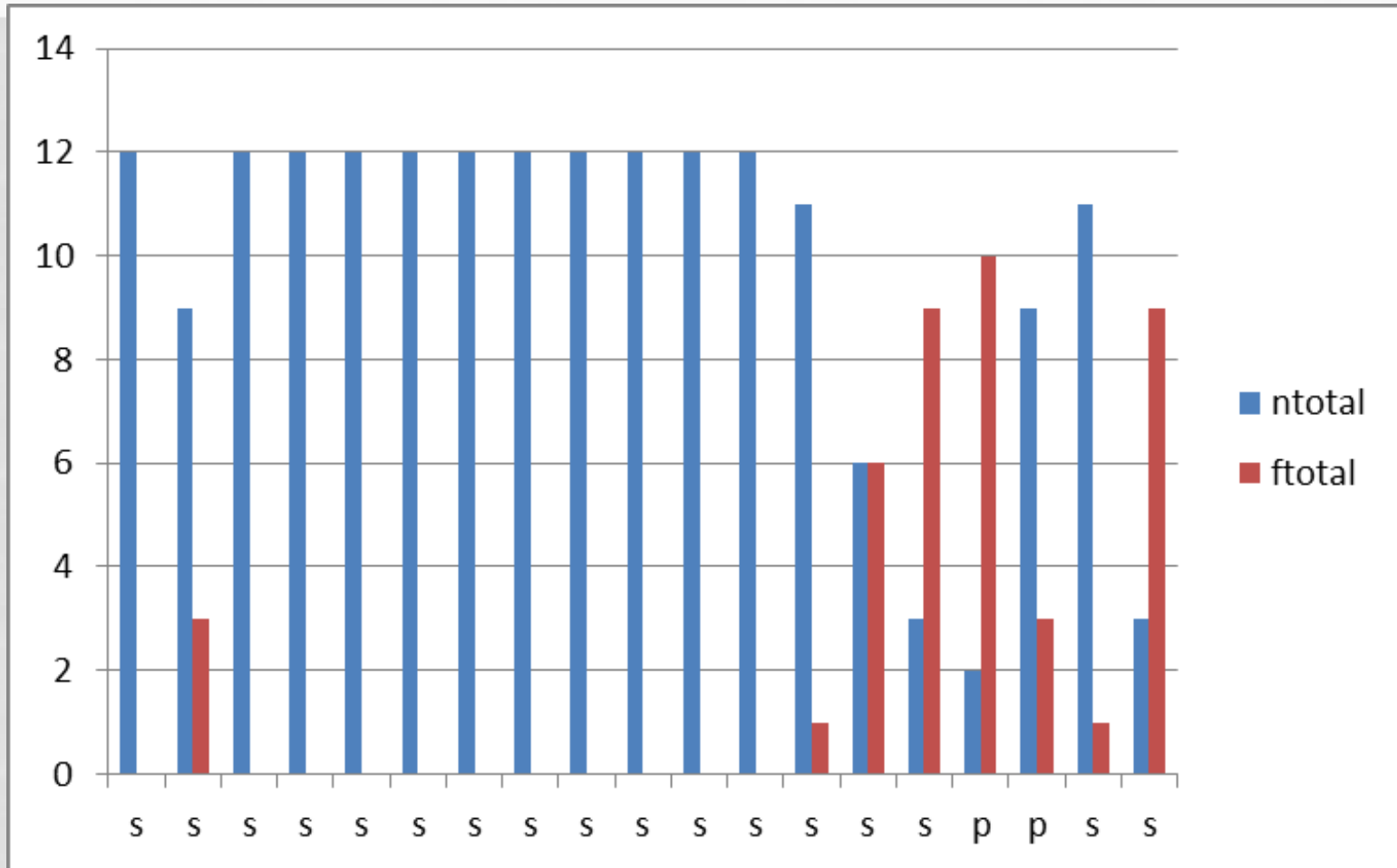


- Indicators of Engagement
  - Reading and writing
  - Observing
  - Performing tasks
- Indicators of Disengagement
  - Passive disengagement (daydreaming)
  - Active disengagement (talking to neighbors)
- Other coding
  - S for science-based discussion
  - C for discussion of culture
- Five minute intervals

# RESULTS - AT RISK YOUTH

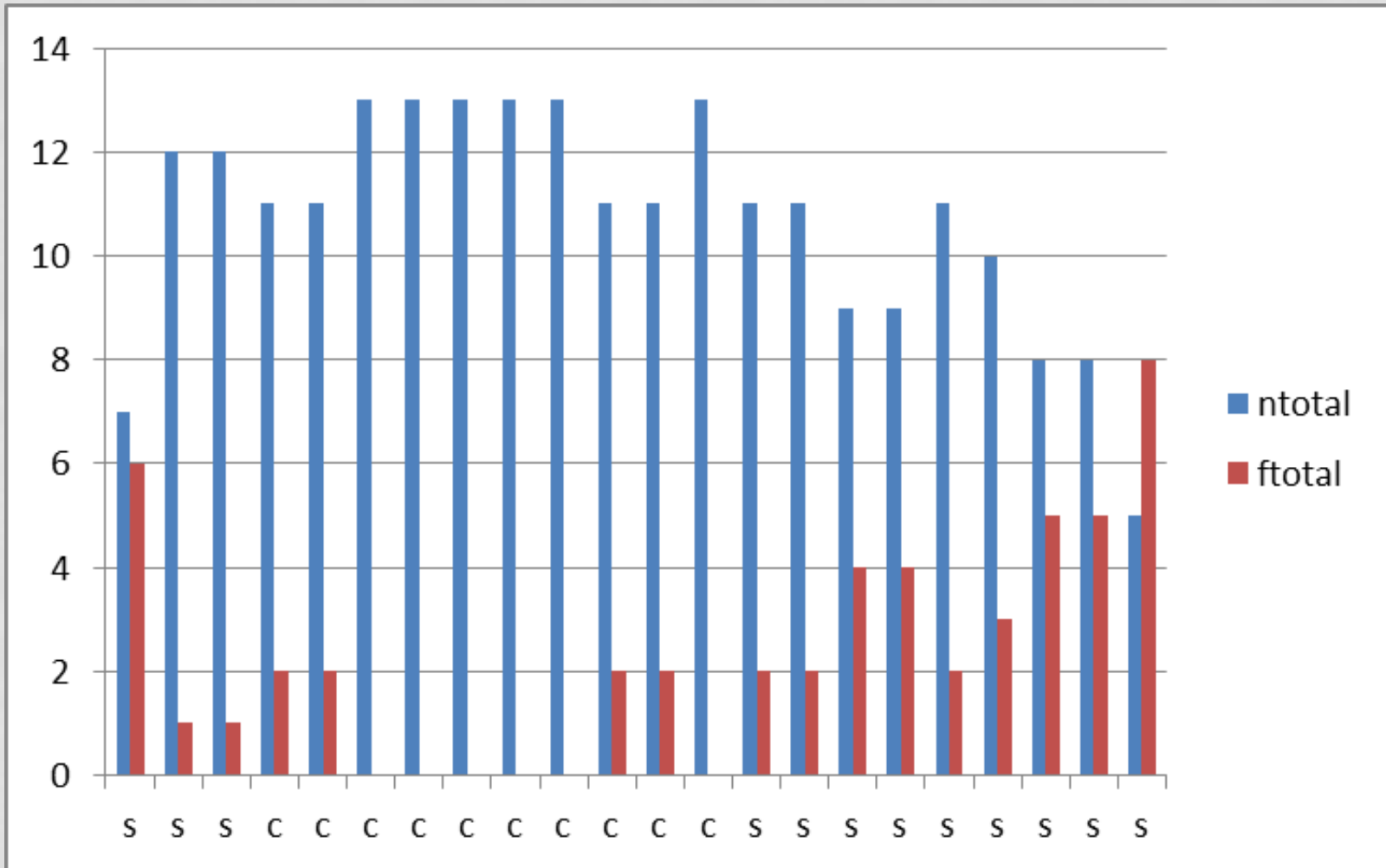


# RESULTS - GIFTED YOUTH

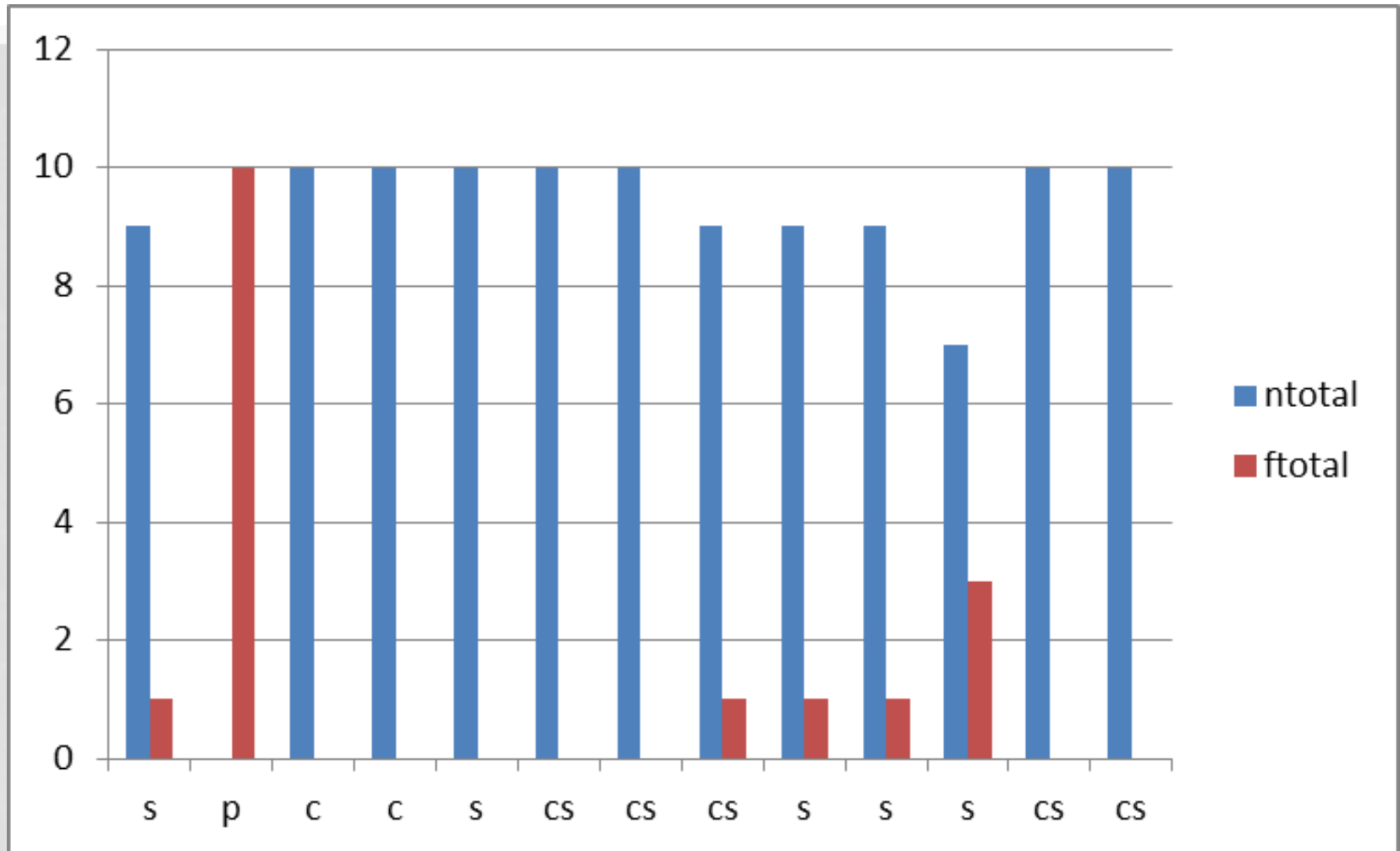




# RESULTS - GIFTED YOUTH



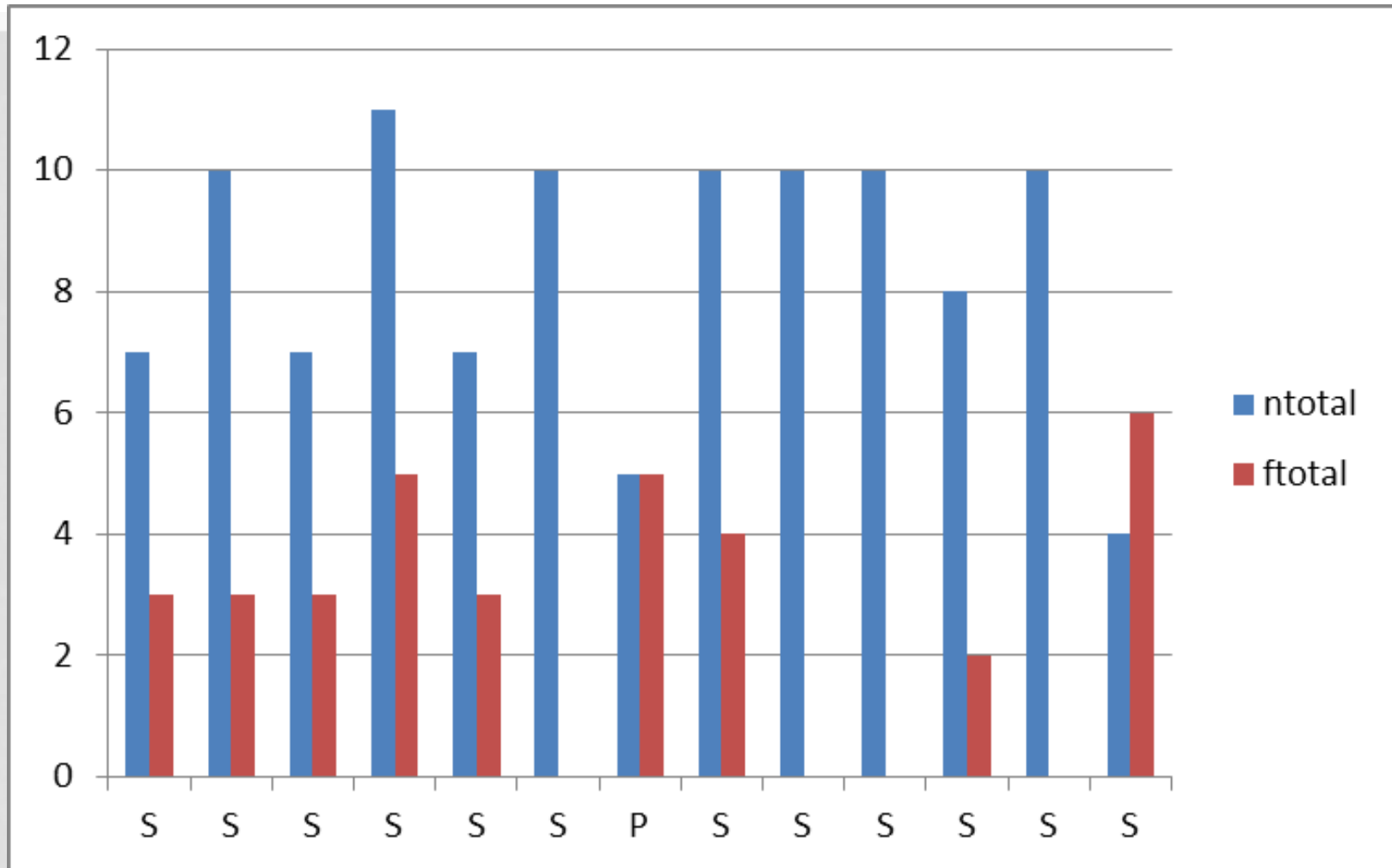
# RESULTS - NORTH DAKOTA







# RESULTS - NORTH DAKOTA



# SUMMARY OF FINDINGS

- For 88% of observations, at least half of the students were engaged in reading, listening, and performing lab activities.
- In 79% of observations, at least two-thirds of students were engaged in learning activities.



# CONCLUSIONS

- AN/AI can be engaged learners in science.
- STN incorporates best practices of learning.
- STN is a good method for teaching science concepts through:
  - Experiential learning
  - Learning transfer
  - Contextual learning





