

## **The Health of the Mississippi River in St. Paul**

Course: AP Statistics (Grade 12)

Adapted from Ryan Backman, St. Paul Public Schools

### **AP Statistics Topics (Standards) Addressed:**

**I.** Exploring Data: Describing patterns and departures from patterns

*Exploratory analysis of data makes use of graphical and numerical techniques to study patterns and departures from patterns. Emphasis should be placed on interpreting information from graphical and numerical displays and summaries.*

**A.** Constructing and interpreting graphical displays of distributions of univariate data

1. Center and spread
2. Clusters and gaps
3. Outliers and other unusual features
4. Shape

**B.** Summarizing distributions of univariate data

1. Measuring center: median, mean
2. Measuring spread: range, interquartile range, standard deviation

<https://secure-media.collegeboard.org/ap-student/course/ap-statistics-2010-course-exam-description.pdf> (page 7)

**Goals:** Students will participate in a canoe trip on the Mississippi River to collect water quality measurements. Students will make a graphical distribution and calculate summary statistics of their data. Students will interpret their distribution and statistics to judge the water quality of the river.

**Materials Needed:** Vernier interfaces (at least one per group of 3 or 4); Vernier sensors for the following water indicator: temperature, pH, conductivity, and dissolved O<sub>2</sub> (and possibly turbidity, nitrate levels, and chloride levels); Voyageur canoes and staff to access the river; data collection sheets and clipboards for use in the field; plastic ziplock bags; pencils

**Other Prep Necessary:** Organize Mississippi River Day Trip with Wilderness Inquiry, student permission slips should be distributed and collected

### **Procedure for Implementation:**

Student background knowledge needed: Introduction to making distributions (boxplot, dotplot, stemplot, histogram); calculating statistics (median, mean, range, IQR, standard deviation); and interpreting center, spread, shape, and unusual features of distributions.

This lesson should be implemented using one preparatory class period and a full (or most of a) school day in the field. Several days after the field day, students will submit a “mini-project” as a summative assessment. Work on this assessment can be done inside or outside of the classroom.

Preparatory Class Period

### Goal

- Students will work in groups to discuss the health of the Mississippi River.
- Students will learn about water quality indicators and how to measure them with a Vernier sensor.

### Access

- The teacher will present students with the question: How is healthy is the Mississippi River in St. Paul?
- The teacher asks students for their thoughts and perceptions of the health of the Mississippi.

### New Information

- Students should be in groups of 3 to 4 for this portion of the lesson. These will be the same groups they will be in for the field day.
- The teacher will show a short video on the Mississippi National River and Recreation Area (<https://www.youtube.com/watch?v=4zHNYRhZ1d8>).
- After showing the video, the teacher will ask students to work with their groups to come up with a written list of at least five reasons why a healthy Mississippi River is important to St. Paul.
- When students have completed their lists, the teacher will ask several groups to share their lists and lead a short discussion on the topic.
- The teacher will then direct the question, “How can we measure the health of the river?” to the students. A few students should be asked to share their thoughts.
- Students groups should then be asked to create a list of five “things” they could try to measure that would help indicate river health.
- The teacher will lead a student discussion on these brainstormed river health indicators.

### Apply

- After this discussion on brainstormed indicators, the teacher will tell students that the four indicators that will be used are temperature, pH, conductivity, and dissolved O<sub>2</sub> (and possibly turbidity, nitrate levels, and chloride levels). The teacher will give a brief introduction to these indicators and their association with the river.
- The teacher will then give a short demo on how to use the Vernier interface and sensors.
- Each student group will be assigned one of the four (or seven) indicators that they will study when they get into the field.
- The teacher should provide students with the logistical information needed for a successful field day. Students should also be provided with the “Mississippi River Data Assignment - Data Collection Sheet” document at this time.

### Generalize

- The teacher will ask each group to do a quick internet search on their assigned indicator to find out how it affects water quality.

- Students will be asked to write down five facts about the relationship between Mississippi River water quality and their assigned indicator.
- Time permitting, the teacher can ask groups to share their information.

### Field Day

- Before boarding the busses, each student group will be given a ziplock bag with a Vernier interface, their group's assigned indicator Vernier sensor, a clipboard, data sheets, and pencils.
- Students and teacher arrive at Hidden Falls in St. Paul by bus to meet Wilderness Inquiry (and possibly National Park Service) staff. The WI staff will introduce the day and give the paddle/safety talk.
- Students will be instructed to take two water quality measurements along the shore at Hidden Falls.
- Students will board the canoes and begin paddling.
- Students will collect data at all or some of the follow locations: Crosby Farm, Pike Island/Confluence, Harriet Island, and anywhere on the water.
- Interpretation or interpretive activities by WI staff or NPS rangers can be done at stops along the river. A talk on turbidity would be appropriate at the confluence.
- Lunch or a snack should be included in the day's logistics.
- Students will land at Harriet Island. The teacher, WI, and NPS will debrief students after landing.
- Students will bus back to school.

### **Evaluation Component:**

Each student group will produce a "mini-project" as a summative assessment. The assessment document is included and named "Mississippi River Data Assignment". Student groups should be given 3-5 days to complete the assignment outside of a class. The teacher may decide whether to dedicate a class period for students to work on this assignment/assessment.

### **Place-Based Education**

This lesson places students directly into the Mississippi River ecosystem within their own city of St. Paul. Students will participate in hands-on data collection that should result in increased levels of academic engagement both in the field and upon return to the classroom. This real-world statistics application will hopefully allow students to better appreciate their natural environment while gaining realization that math and science can help them become better stewards and citizens of their community.

**Mississippi River Data Assignment  
Data Collection Sheet**

Group Member Names

Your Group's Assigned Indicator

Data

| Sample Number | Measurement Reading from Sensor | Collection Location (Be Specific) |
|---------------|---------------------------------|-----------------------------------|
| 1             |                                 |                                   |
| 2             |                                 |                                   |
| 3             |                                 |                                   |
| 4             |                                 |                                   |
| 5             |                                 |                                   |
| 6             |                                 |                                   |
| 7             |                                 |                                   |
| 8             |                                 |                                   |
| 9             |                                 |                                   |
| 10            |                                 |                                   |
| 11            |                                 |                                   |
| 12            |                                 |                                   |
| 13            |                                 |                                   |
| 14            |                                 |                                   |
| 15            |                                 |                                   |
| 16            |                                 |                                   |
| 17            |                                 |                                   |
| 18            |                                 |                                   |
| 19            |                                 |                                   |
| 20            |                                 |                                   |

## **AP Statistics**

### **Mississippi River Data Assignment**

#### Instructions

Your group needs to submit a document with the following. Your document should be typed, and neatly organized. Graphs can be neatly hand drawn.

#### Introductory Information

- Provide a short informative description of your water quality indicator.
- Provide the common units of your measure. Discuss what levels of your indicator will indicate healthy or unhealthy water.
- Discuss the environmental impacts of unhealthy levels of your indicator.
- Please briefly cite your sources.

#### Data Collection Process

- Discuss how you collected your data.
- Provide your raw data.
- Describe any issues you encountered in your data collection process.
- Discuss 2-3 ways in which you could improve your data collection process. Be sure to explain your reasoning.

#### Graph and Statistics

- Make an appropriate graphical distribution (boxplot, dotplot, stemplot, histogram).
- Calculate appropriate measures of center and spread.
- Thoroughly describe your distribution (center, spread, shape, and unusual features). Use numerical measures (mean, median, standard deviation, etc) in your description. Make sure your description is in context.

#### Conclusions and Recommendations

- Decide whether there are healthy or unhealthy levels of your water quality indicator in the river. Provide a written analysis of your data, distribution, and statistical measures that supports your decision.
- Provide some recommendations for how St. Paul residents can help maintain healthy levels of your measure or can improve unhealthy levels.

**AP Statistics**  
**Mississippi River Data Assignment Rubric**

Names

|   |                  |
|---|------------------|
| <b>Introductory Information</b>   | <b>10 points</b> |
| Provide a short informative description of your water quality indicator.  | / 3 points       |
| Provide the common units of your measure. Discuss what levels of your indicator will indicate healthy or unhealthy water. | / 3 points       |
| Discuss the environmental impacts of unhealthy levels of your indicator.  | / 3 points       |
| Please briefly cite your sources.   | / 1 point        |

|  |                  |
|--|------------------|
| <b>Data Collection Process</b>   | <b>10 points</b> |
| Discuss how you collected your data.   | / 3 points       |
| Provide your raw data.   | / 1 point        |
| Describe any issues you encountered in your data collection process.   | / 3 points       |
| Discuss 2-3 ways in which you could improve your data collection process. Be sure to explain your reasoning. | / 3 points       |

|  |                  |
|--|------------------|
| <b>Graph and Statistics</b>  | <b>20 points</b> |
| Make an appropriate graphical distribution (boxplot, dotplot, stemplot, histogram).  | / 6 points       |
| Calculate appropriate measures of center and spread.   | / 6 points       |
| Thoroughly describe your distribution (center, spread, shape, and unusual features). Use numerical measures (mean, median, standard deviation, etc) in your description. Make sure your description is <u>in context</u> . | / 8 points       |

|   |                  |
|---|------------------|
| <b>Conclusions and Recommendations</b>  | <b>10 points</b> |
| Decide whether there are healthy or unhealthy levels of your water quality indicator in the river. Provide a written analysis of your data, distribution, and statistical measures that supports your decision. | / 5 points       |
| Provide some recommendations for how St. Paul residents can help maintain healthy levels of your measure or can improve unhealthy levels.   | / 5 points       |

**Final**    \_\_\_ / 50 points