Evaluating Derivatives Using Contour Lines – Teacher Notes

Forams as Storytellers

Ecomindedness Learning through sea surface temperature anomalies

Prepared by William Millard, Tillamook High School

In this activity, students use calculus to evaluate derivatives using contour lines that have been extracted from sea surface temperature anomalies.

Materials: Smartboard or Activboard Software, pencils, paper
Time: Standard 1 hour block
Space: Traditional classroom

EXPERIENCE BASED OBJECTIVE

Teacher Thinking…

How can I describe the students' experience? Who, What, When, Where, Why, and How? What standards or curriculum concepts do I need and want to address?

Student and Teacher Activities…

Students and Teacher explore multivariable calculus using a geometric approach that relates to their surroundings. Students have choices throughout their learning experiences. They get to choose what part of the graph that they wish to analyze. They will use their math skills to gain a deeper understanding of mathematics as well as an awareness of the change in ocean temperatures annually.

The primary reason for this lesson is to introduce multivariable calculus in a way that is much more friendly than its name implies.

LOCATE IT

Teacher Thinking…

How can I help students find the content in its "natural" context? Where does this skill, idea, concept, or element of content reside? What related examples can they find in their own lives, with their families, and their communities?

Key Concept: Interconnectedness

Acknowledge the eclectic and sometimes juxtaposed interconnected relationships among all things.

Students ask, “How am I connected to the concepts and ideas? How is the content I am studying related to other concepts?”

Student and Teacher Activities…
Students may go on scavenger hunts for ideas or skills (where do we find commas? What is the largest image of a bird you can find? Where was the Pythagorean theorem discovered?) by examining materials, various media sources, their own lives and families, etc.

Challenge students to analyze how sea surface temperature changes over time. You can also use this lesson to help students to analyze the world around them using a different lens. They can see that the ocean surface changes in temperature and that they can visualize this change in temperature as a slope or a derivative. The analysis and conclusion part of the lesson has them brush up on their averaging skills and provides them with an opportunity with an open-ended question that lets them unpack the data and draw their own conclusions.

LEARN IT
Teacher Thinking…
How can I design an experience to help students explore and experience the concept where it is found? In what ways can I help students care about themselves, others near and far, human and non-human? Care for self; care for animals, plants and the earth; care for strangers and distant others.

How can I help students understand the usefulness and meaning of this concept for their lives?

Key Concept: Care
Students ask: “What does it mean to care about myself? How does caring for myself allow me to care for others? In what ways might I care for others near and far, human and non-human?”

Student and Teacher Activities…
The experience may take many forms, but students will practice and examine ways that they can learn the content through and with caring about themselves and others.

Some students may take this lesson and draw connections to the state of the world at the time, or the impact of climate change.

Without pushing the students too far in one direction or another, the data can reveal some new-found insights. The ticket out the door allows them to dig deeper by comparing their data with other groups of students and contrasting how their analysis was similar and how it was different.

Ask students how the change in sea temperatures might affect the local sea life.

LIVE IT

Teacher Thinking…

How can I help students think about their learning as a part of their construction of beliefs and values, along with decision-making? What values and beliefs are embedded in the lesson? How can I help students develop and act upon those values and beliefs?

While some lessons may focus on immediate action, others may introduce a concept and generate many possibilities for living the ideas. For example, students might be introduced to thinking about habitat conservation, but the focus of the lesson is to help them connect their own habitat with animal habitats.

Key Concept: Integrity

To act in accordance with one's beliefs; wholeness.

Students ask: "How do I understand and develop my own beliefs and values related to content? What actions can I take, large and small, to act on my beliefs?"

Student and Teacher Activities…

Students try out ways of demonstrating their learning and the beliefs they have developed throughout the lesson. This may look different for different students, and idiosyncratic demonstrations and understandings are encouraged and fostered.

If students find that climate might be having an effect on the local sea life, then they may make meaningful changes in their lifestyles. Some lessons can really stick with you as a student.

If time permits and students are interested, we can have the conversation about climate change, ocean pollution, and other tough conversations about the health of our planet.

CHECKING FOR UNDERSTANDING

Teacher Thinking…

How will I monitor their progress? Will this be informal or formal? Individual or whole group?

Student and Teacher Activities…

The data collection can be done as a group, but each student has to respond to the prompts on their own. I'm sure that many groups may have a consensus on their answers.

GUIDED PRACTICE (WE DO)

Teacher Thinking…

What kinds of practice problems might I provide for the skills being taught? How can I organize them so they vary in complexity?

Student and Teacher Activities…

Do the first iteration for the whole class at a selected point, then have each group choose a different point to analyze.

INDEPENDENT PRACTICE (YOU DO)

Teacher Thinking…

What kinds of work should students practice independently toward mastery? Will this be done in class or for homework?

Student and Teacher Activities…

This is designed as an in-class assignment. Since this isn't a typical formula or equation lesson, you may prefer to be around while they are performing the work.