The Science of Surveys

I. UNIT OVERVIEW & PURPOSE:

Students will apply previous knowledge and newly acquired knowledge to develop, distribute, and analyze a meaningful survey about a topic of social interest (Drilling in Alaska). These skills will be applicable in a broad range of fields of interest.

II. UNIT AUTHOR:

Brittany Blair, Carroll County Public Schools

III. COURSE:

Mathematical Modeling: Capstone Course

IV. CONTENT STRAND:

Data Analysis and Statistics

V. OBJECTIVES:

The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

VI. MATHEMATICS PERFORMANCE EXPECTATION(s):

MPE 2 Collect and analyze data…

MPE 8 Compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features.

MPE 9 The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

MPE 22 Analyze graphical displays of univariate data, including dot plots, stem plots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays.

VII. CONTENT:

This unit will focus on the current interest (or disinterest) in accessing and using oil supplies in Alaska. Given the somewhat recent "green" movement, increasing imported oil prices, and ongoing changes in government (i.e. President Obama, mid-term elections, etc), this is an important topic being discussed. This unit will allow the students to learn more about the history, controversy, and proposed solutions to the debate about drilling in Alaska.

VIII. REFERENCE/RESOURCE MATERIALS:

Students will need access to a computer for research during class.

Students will need access to a surveying population (such as teachers at other schools in the county).

IX. PRIMARY ASSESSMENT STRATEGIES:

Assessment 1: Presentation of completed project

Assessment 2: Application of mathematical knowledge given an experiment with a similar theme of social interest. (Allowing students to both show understanding and learn about a topic of social interest.)

X. EVALUATION CRITERIA:

Project – Research (10%), Survey (15%), Attention to technique/control for bias/errors (10%), Data analysis (15%), Report of findings (10%), Final product/presentation (10%)

Assessment 2 – 30% (note: rubric supplied)

XI. INSTRUCTIONAL TIME:

Approximately 5, 90-minute class periods of work (due to the distribution of the survey, 5 additional days should be planned to cover MPE 8 while waiting for replies).

Where has all of the Oil gone???

Strand
Data Analysis: The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

Mathematical Objective(s)
Data Analysis: Sample Size, Sampling Techniques, Controlling sources of bias and experimental error, Create Survey and Design Experiment.

This lesson will act as an activation of prior knowledge and develop the students' knowledge about drilling in Alaska in order to give them the background to develop a meaningful survey regarding public opinion about the current state of oil in America.

Mathematics Performance Expectation(s)

MPE 2 Collect and analyze data … .

MPE 9 The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

Related SOL

AFDA 3 (Collect and represent data)

AFDA 8 (Design and conduct experiment/survey)

NCTM Standards

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data
- Develop and evaluate inferences and predication that are based on data.

Additional Objectives for Student Learning:
Students will develop an awareness of oil needs and the affects of these needs on society.

Materials/Resources

- Computers (with internet access for research)

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Assumption of Prior Knowledge

- Students should have completed Algebra I and Algebra II or Algebra Functions and Data Analysis (AFDA).
- Students should have a prior mathematics knowledge regarding basic experiment/survey set up and techniques (this will be accomplished in the form of class discussion.) Touching on: the purposes of surveys, sample size, and sampling techniques.
- Students should have an analytical understanding of experimental design.
- Students will develop language to better communicate their experimental design.
- Students may find it difficult to develop a meaningful survey independently.
- Students should have seen and read outcomes of surveys.
- Students should have experience using the Internet as a research tool.
- This lesson builds on the students' basic knowledge of experimental design and challenges students to develop their own background knowledge and critical thinking.
- The social/political concept of oil needs and drilling in Alaska.

Introduction: Setting Up the Mathematical Task

- In this lesson, the student will investigate the background, controversy, and potential solutions to the dilemma regarding drilling for oil in Alaska.
- Class Overview: Introduce prior knowledge (20 minutes), Research (30-45 minutes), Write 1-2 Page Paper (30 minutes), Use knowledge to develop meaningful survey questions for next class (20 minutes)
- Begin by discussing uses for surveys and places where surveys are used, such as: shopping/company surveys, political polls, personality type surveys, etc.
- References to political polls will be useful in generating student interest.
- Where have you seen surveys or polls in the past? Were they useful? Were they reliable? How do you know?
- The exploration and discovery will be done independently, but students will share findings with groups the following day.
- Student exploration of the social/political/environmental issue will help students build knowledge prior to developing a survey of their own.
- By discussing prior knowledge about experimental design, students will be able to begin planning their own design.
- Students will be given the outline of the project in order to give them more information about the direction of the task.
- Development of student survey questions will show their ability to begin developing an experimental design.

Student Exploration 1:

Students will begin the class by discussing experimental/survey design. Students should review the purposes of surveys, sample size, and sampling techniques. The teacher may facilitate this discussion by asking questions to guide students through the discussion, prompting for popular places surveys are seen, what is the population and the sample size (what would be adequate?), how students might choose the group of people to be surveyed, etc. This is also an opportunity to discuss "good questions" in a survey. (What wording should you avoid? How can you design a survey to accurately get the desired information?)

Students will the go on to explore and research drilling in Alaska independently. The information they find should be compiled in a paper (approx 1-2 pages typed) to share with their small group.

As students conclude the research and write-up, they will work in small groups. The group work will begin with students sharing what they learned about oil needs and the effects of drilling in Alaska and create a presentation or PowerPoint to share with the class. Students will go on to develop survey questions based on what they have learned.

Student/Teacher Actions:

- Students will use the first class period to develop their knowledge of drilling in Alaska and apply the information by creating meaningful and connected survey questions.
    - If students need some assistance getting started they can look at the following websites:
        - National Wildlife Refuge-The Debate http://arcticcircle.uconn.edu/ANWR/anwrdebateindex.html
        - Wikipedia (use with caution, may contain opinions) http://en.wikipedia.org/wiki/Arctic_Refuge_drilling_controversy
        - CBN News - The ANWR Debate http://www.cbn.com/cbnnews/us/2008/September/The-ANWR-Debate---To-Drill-or-Not-to-Drill-/
- Teacher should ask questions to guide exploration and encourage meaningful survey questions.
- Ask students: What traits of a person might influence a person's opinion about drilling in Alaska?
- Computers will be used to develop knowledge by accessing articles or creditable blogs.

Monitoring Student Responses

- Describe how you expect:
    - students will put their new knowledge in a short paper to share with the class;
    - students will use their new knowledge to create an effective survey in a small group;
    - teacher and/or students will discuss concepts influencing decisions to drill in Alaska;
    - teacher will guide students who struggle by asking questions and guiding them toward the answers; and
    - teacher will ask students to begin developing their own questions for a survey if they are finished with the background research.
- Summary
    - The last 10 minutes of the class will be spent as a whole group discussion to wrap up and prepare for the next day.
- Discussion participation and information in short reports will show student knowledge.

Assessment

- **Students should be able to:**
  - explain the social issue being examined (drilling in Alaska).
  - identify "good" and "bad" survey composition.
  - construct unique surveys.
  - determine useful and effective survey techniques.
- **Questions (to be posed during class discussion)**
  - What are some benefits of drilling in Alaska?
  - What makes drilling in Alaska controversial?
  - What effects does this battle have on the United States as a country?
  - Have you seen any evidence of the need to drill/not to drill for oil in the US?
  - Are there any possible solutions to this problem?
- **Journal/writing prompts**
  - Brainstorm ways to create a creditable survey based on the information you learned today.
- **Other**
  - Student understanding will be observed as students share in whole class discussion as well as during teacher observation throughout the class.

- See attached for grading criteria for Research.

Extensions and Connections (for all students)

- Students will brainstorm survey question ideas individually before working with a group.
- This lesson incorporates knowledge of experimental design.
- This lesson incorporates knowledge about politics and environment.
- This lesson can be linked to lessons in both science and history classes. By collaborating with those teachers, students would have the opportunity to learn even more about the aspects of oil needs, drilling, and the effects on people/the earth.

Strategies for Differentiation

- Kinesthetic (students may move to stations to develop prior knowledge), auditory (students may watch/listen to videos to develop prior knowledge), or visual learners;
- students with processing, memory, motor issues (computer use);
- English language learners (ELLs) (literature in the student's first language);
- high-ability students (expand research and learn about the ways other countries solve the problems of environment and power supply).

- Use an outline to guide students to self-exploration if necessary.
- Students may require assistance with directions or additional information in order to make the assignments meaningful to them.

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Should we be drilling? What do you think?

Strand
Data Analysis: The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

Mathematical Objective(s)
Data Analysis: Sample Size, Sampling Techniques, Controlling sources of bias and experimental error, Create Survey and Design Experiment.

Mathematics Performance Expectation(s)

MPE 2 Collect and analyze data … .

MPE 9 The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

Related SOL

AFDA 3 (Collect and represent data)

AFDA 8 (Design and conduct experiment/survey)

NCTM Standards
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Select and Use appropriate statistical methods to analyze data
- Develop and evaluate inferences and predication that are based on data.

Additional Objectives for Student Learning:
Students will gain a general understanding about the views of their geographical region.

Materials/Resources
- Population options from schools within the county
    - May be adapted by teacher. Because the classroom may be limited to a small sample space, let the teachers at different schools within the county be the "populations" for the groups. Given that one group is assigned a local elementary school as its "population," allow students to choose the most effective sampling technique to apply to the school.
        - This may be modified to apply to classrooms within the school for the sake of convenience.

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Assumption of Prior Knowledge

- It is assumed the students have had experience with population, sampling techniques, and bias and error in experimentation.
- Students should have an analytical understanding of experimental design.
- Students will develop language to better communicate development of surveys and survey techniques.
- Students may find it difficult to develop a meaningful survey independently.
- Students have already explored the concepts behind drilling in Alaska and have reviewed the key elements of survey design.
- This lesson builds on the students' basic knowledge of experimental design and challenges students to develop their own background knowledge and critical thinking.
- The social/political concept of oil needs and drilling in Alaska.

Introduction: Setting Up the Mathematical Task

- In this lesson, the student will develop a unique survey and distribute it to your target population.
- Activate Prior Knowledge (Population, sampling, bias/error) – 15 minutes, Create Survey in small groups - 30 minutes, Class critique – 20 minutes, Refine survey – 20 minutes, Trial survey in class – 20-30 minutes, Final survey – 10 minutes, Determine sample technique based on population – 20 minutes, Distribute surveys.
- Using the information gathered yesterday, the student will be developing a survey to determine how people feel about drilling in Alaska and other traits that may contribute to their opinion.
- Students will begin by looking at some reactions to other well-known polls and survey.
- What traits might affect a person's opinion about drilling in Alaska? What are the effects of drilling for the nation and for Alaska?
- Students will work both in small groups and use a jigsaw type critiquing method in order to allow students to collaborate within their own groups and hear the ideas of other students in the room.
- The development of the surveys will help students to understand the importance of experimental design.
- Students will be encouraged to use prior knowledge to develop their surveys.
- Students will share their surveys with a population of teachers of another school and report results in following lessons.

Student Exploration 1:

Students will begin by continuing the brainstorming exercise from the previous day.
A whole group discussion will follow. The class will be engaged in discussion to activate prior knowledge regarding population, sampling, and bias/error.
Students will spend the remainder of the class working in small groups to develop a meaningful survey. Students will then trade surveys among groups. The surveys will be filled out and critiqued within the class to create a less biased and more accurate outcome. The small groups will finalize their surveys and decide on the most effected sampling method.

Student/Teacher Actions:

- Students will work in small groups to develop their own survey based on their knowledge about drilling in Alaska. Students will continue to develop their surveys by working among groups to make the surveys more effective and have a test run within the classroom.
- Teachers will guide students by asking questions, such as: Would a person's stance on preserving the environment have an effect on their opinion about drilling in Alaska?
- Students may struggle to create questions. Sample surveys and more discussion about the survey topic may assist students in creating a meaningful survey.

Monitoring Student Responses

- students will communicate their thinking and their new knowledge by discussing with other groups (and the teacher) about the goal of their survey;
- students will highlight and clarify the ideas being examined with the survey questions;
- teacher will assist students who have difficulties by guiding and asking constructive questions; and
- teacher will extend the material for students that are ready to move forward by challenging students to choose a sample technique that is most effective. (All students will get to this step before sending out surveys.)
- At the conclusion of this lesson, all students will have filled out peer surveys and be ready to send out the final product.
- The survey questions including wording and question type will show student understanding of experimental design.

Assessment

- **Students should be able to:**
  - identify "good" and "bad" survey composition.
  - construct unique surveys.
  - determine useful and effective survey techniques.
  - control for bias and error.
- **Questions (to be asked during class)**
  - What traits and opinions might influence a person's point of view of drilling in Alaska?
  - What is the most effective way to gather a sample from your "population?"
  - How might you control for bias?
  - How might you control for errors?
- **Journal/writing prompts**
  - Make a prediction. What do you think the outcome of your survey will be?
- **Other**
  - The teacher will gather information about student understanding by interacting with the groups as they formulate, critique, and improve upon their original surveys.
  - See attachment for grading criteria of survey and technique/control of bias and error.

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Extensions and Connections (for all students)

- How might politicians use a survey like this to build their image?
- This lesson builds on previous statistics knowledge and students should be planning to analyze the outcome of their surveys.
- This lesson can be linked to lessons in both science and history classes. By collaborating with those teachers, students would have the opportunity to learn even more about the aspects of oil needs, drilling, and the effects on people/the earth.

Strategies for Differentiation

- Kinesthetic (group work), auditory (discussion leader), or visual learners (recorder);
- students with processing, memory, motor issues (heterogeneous groups with member responsibilities catered to student strengths);
- high-ability students (will lead the discussion in preventing bias and error from the beginning).

Students may require assistance with directions or further directions in order to make the assignment meaningful for them.

The Results are In!

Strand
Data Analysis: The student will design and conduct an experiment/survey. Key concepts include: a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting.

Mathematical Objective(s)
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Mathematics Performance Expectation(s)

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- Develop and evaluate inferences and predication that are based on data.

Additional Objectives for Student Learning:
Students will use technology to effectively analyze and represent collected data.

Materials/Resources
- Classroom set of graphing calculators
- Computers with program to organize data in tables and graphs.

Assumption of Prior Knowledge

- It is assumed that students have experience analyzing data and reporting findings.
- Students should possess an analytical understanding of experimental design.
- Students should develop vocabulary to express their findings from the unique surveys.
- Students my struggle to choose the most effect representation for their data.
- Students will have already developed and distributed their unique surveys after developing a sound experimental design.
- Students will build on knowledge about data, pictorial representations, and data reports.
- The social/political concept of oil needs and drilling in Alaska.

Introduction: Setting Up the Mathematical Task

- In this lesson, the student will investigate various methods to represent data and communicate findings with others verbally, mathematically, and pictorially.
- Review goals of the survey – 10 minutes, Evaluate survey responses and make general assumptions – 20 minutes, create statistical and pictorial representations of survey data – 30 minutes, Create a report including research, survey, findings, representations, and results – 20 minutes, Present project to classmates – 45 minutes, Class discussion of unit – 15 minutes, Formal Assessment – 30 minutes
    - Using the surveys you created as a group, choose the best way to represent and show your findings.
- Ask students: How can outcomes be represented? Circle graphs? Bar graphs? Box and whisker plots?...etc.
    - Using your questioning method, which representation best shows your results?
- Students will continue working in the groups they have been working with throughout the unit.
- By using their own data, students will have ownership of the material and be able to make a meaningful representation to analyze and communicate their findings.
- If students hesitate to complete the task, the teacher will ask students to remember the analytical tools they have used in the past.
- Students will have the opportunity to make their thinking and learning public through their final report and class presentation.

Student Exploration 1:

Students will work in their small groups to understand, analyze, and present data collected from the surveys they created.

Student/Teacher Actions:

- Students should study and analyze the data returned in the surveys and create a report (using technology such as PowerPoint) to share with classmates.
- Teachers should be encouraging students to effectively represent data.
- Students may question effective analysis approaches and require some guidance.
- Graphing calculators and computer programs that offer graphing and data analysis may be used.

Monitoring Student Responses

- Students will organize their understanding and articulate thoughts using appropriate vocabulary by organizing thoughts and presenting them in a report;
- teacher and/or students will highlight and clarify the ideas by engaging in the classroom discussion;
- teacher will assist students who have difficulties by offering suggestions for graphs and descriptions; and
- teacher will extend the material for students that are ready to move forward by challenging students to chose another representation or creating a presentations appropriate for print.

- Lesson closure will be with class discussion about projects and the unit will be wrapped up with a formal unit test.
- Students' explanations and presentations will exhibit knowledge.

Assessment

- **Students should be able to:**
  - analyze/examine survey data.
  - effectively represent survey findings.
  - determine useful and effective survey techniques.
  - present findings in a meaningful way.
- **Questions (to be asked during presentations-may also be written if the teacher chooses)**
  - Why do you think your sampling technique was the best choice?
  - Were you surprised by the outcome?
  - How could you apply what you have learned?
  - How did you control for bias?
  - How did you control for errors?
- **Journal/writing prompts**
  - How might you change your survey now that you have completed the project? Are there any parts you can improve on? Name at least one other topic that you would be interested in creating a survey for and outline your plan.

- Students may require assistance with directions or additional directions. Some students may require the assignments to be provided in a different language. Some students may require the formal assessment be given in a small group or read-aloud setting.
- See attached for formal assessment and grading criteria for report and presentation.

Extensions and Connections (for all students)

- Use journal entry/reflection to follow up lesson.
- This lesson will be connected to MPE 8, which may be taught during the time the surveys have been sent out.
- This lesson can be connected to government by combining mathematics with political points of view and planning.
- This lesson can be linked to lessons in both science and history classes. By collaborating with those teachers, students would have the opportunity to learn even more about the aspects of oil needs, drilling, and the effects on people/the earth.

Strategies for Differentiation

- Kinesthetic (actively presenting findings), auditory (describing and discussing results), or visual learners (organizing results in table, graph, etc);
- students with processing, memory, motor issues will be accommodated by presenting many options for learning representing understanding;
- English language learners (ELLs) – will be included in discussion by utilizing visualizations to bridge language gaps;
- high-ability students may be asked to predict why the outcomes make sense based on region, political points of view, etc.

Unit Rubric

Research	**Total Possible 10**	**Total Earned:**
Explanation of Background	Possible 3	
Explanation of Controversy	Possible 3	
Explanation of Solutions	Possible 3	
Clarity, punctuation, spelling	Possible 1	
Survey	**Total Possible 15**	**Total Earned:**
Meaningful Questions	Possible 5	
Effective Sampling Technique	Possible 5	
Original Question Addressed	Possible 5	
Control for Bias and Error	**Total Possible 10**	**Total Earned:**
Biased questioning addressed	Possible 5	
Errors controlled and reported	Possible 5	
Analysis	**Total Possible 15**	**Total Earned:**
Statistical Analysis	Possible 5	
Pictorial Representations	Possible 5	
Summary	Possible 5	
Final Report	**Total Possible 10**	**Total Earned:**
Clear explanation of assignment	Possible 5	
Professional and pleasing presentation	Possible 5	
Presentation	**Total Possible 10**	**Total Earned:**
Explanation of Survey	Possible 3	
Representation of Outcome	Possible 5	
Clarity, quality, creativity of presentation	Possible 2	
Assessment	**Total Possible 30**	**Total Earned:**
	Unit Total Possible 100	**Unit Total Earned:**

Assessment

1. What is an adequate sample size to yield dependable data?

2. What is the most effective sampling technique? Describe positive and negative aspects of the following techniques:
    a. Convenience
    b. Purposive
    c. Simple Random
    d. Random – Systematic
    e. Random – Stratified
    f. Random – Cluster

3. How can you control for Bias?

4. How can you control for Error?

Using the website http://www.thenationalcampaign.org/sextech/pdf/sextech_summary.pdf from CosmoGirl observe following data. (*Please note, this article should be printed and cut down due to material that may not be suitable for the public classroom. Pages 5-17 contain information about the survey itself and may be used for raw data. I have included suggested material.)*

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1. Are you male or female?

	Teens (13-19) %	Young Adults (20-26) %	TOTAL %
Male	49	51	50
Female	51	49	50

2. How old are you? _____

RANGE:	Teens (13-19) %	Young Adults (20-26) %	TOTAL %
13-16	49	0	25
17-19	51	0	26
20-22	0	51	25
23-26	0	49	24

3. Which of the following, if any, do you have and use? *Please mark all that apply.*

	Teens (13-19) %	Young Adults (20-26) %	TOTAL %
Computer (non-laptop)	79	71	75
Laptop computer	68	77	73
Cellphone	87	86	87
Smartphone (PDA, Blackberry, etc.)	13	23	18
Digital camera	80	82	81
Digital camcorder (video recorder)	29	26	27
MP3 Player (like iPod) without video	55	59	57
Video MP3 Player	50	33	42
Webcam	33	33	33
None of these	0	0	0

9. What do you think are the reasons that **girls** send/post sexy messages or pictures/video of themselves? *Please mark all that apply.*

(LIST RANDOMIZED)	Teens (13-19) %	Young Adults (20-26) %	TOTAL %
Get or keep a guy's attention	85	80	83
Guy pressured them to send it	47	38	42
As a "sexy" present for a boyfriend	74	73	73
To feel sexy	72	77	74
Get a guy to like them	76	66	71
Pressure from friends	23	16	20
To get positive feedback	57	56	57
To be fun/ flirtatious	78	76	77
To get noticed	80	79	79
In response to one she received	31	30	31
Other: _____	3	1	2

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4. Do you:

		YES	NO	"Yes" Teens (13-19) %	"Yes" Young Adults (20-26) %	"Yes" TOTAL %
A	Have a profile on a social-networking site (like MySpace, Facebook, etc.)	❑	❑	89	90	89
B	Have a profile on a dating or singles site (like match, cupid, or eHarmony)	❑	❑	3	16	9
C	View others' profiles/pictures on a social-networking site	❑	❑	85	85	85
D	View others' profiles/pictures on a dating/singles site	❑	❑	6	20	12
E	Write/update a personal blog	❑	❑	25	34	29
F	Regularly read others' personal blogs	❑	❑	33	50	41
G	Send/receive pictures or video on your cellphone	❑	❑	61	64	62
H	Send/receive pictures or video on a computer	❑	❑	80	83	81
I	Post photos online	❑	❑	78	79	79
J	Post videos online (like on YouTube)	❑	❑	38	31	35
K	Send/receive text messages	❑	❑	84	88	86
L	Watch TV shows online or on your MP3 Player	❑	❑	63	56	60

22. Which of the following best describes your current relationship status?

	Teens (13-19) %	Young Adults (20-26) %	TOTAL %
Not in a relationship	68	36	52
In a **casual/dating** relationship	15	13	14
In a **serious** relationship	17	34	25
Married	0	17	9

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5. Summarize the information provided in words.

6. If you were asked to present this as a magazine write up, how would you relate the data into an interesting and informative article? Be specific to include analysis techniques and pictorial representations.

7. How might an editor manipulate the data to show the outcomes in the publisher's best interest?

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