Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Scientific Methods (pp. 14–21)

WHAT ARE SCIENTIFIC METHODS?

scientific methods

1. What are the steps scientists use to answer questions and solve problems?

a. observations
b. formulations
c. flowcharts
d. scientific methods

2. List the steps that are included in the scientific methods.

1. make observations
2. ask a question
3. make a hypothesis
4. test a hypothesis
5. analyze the results
6. draw conclusions
7. communicate the results.

ASKING A QUESTION

b.

3. What does asking questions help scientists to do?

a. find answers with less investigation
b. focus the purpose of an investigation
c. ask questions and memorize answers
d. know where to look up the answers

4. Any use of the senses to gather information is called observation.

5. Observations made with tools are called measurements.

6. Efficiency compares energy output with energy input.

7. Why is the efficiency of a boat important?

Efficiency saves fuel resources.

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8. What question did the two engineers James Czarnowski and Michael Triantafyllou explore?

How can a ship's propulsion system be made more efficient.

FORMING A HYPOTHESIS

form a hypothesis

9. After a scientist has asked questions and made observations, he or she is ready to
- **a.** answer the questions.
- **b.** explain the answers.
- **c.** start a different investigation.
- **d.** form a hypothesis.

b. **10.** What is a hypothesis?
- **a.** an observation based on investigation
- **b.** a possible explanation based on observations
- **c.** a comparison of input and output
- **d.** a question based on conclusions

11. A good hypothesis should be testable.

12. What is wrong with a hypothesis that can't be tested?

A hypothesis that cannot be tested can never be proven or turned into a conclusion.

13. What was the hypothesis that Czarnowski formed?

A propulsion system that uses flippers like a penguin would be more efficient than a propeller.

14. What observations did Czarnowski make before forming his hypothesis?

He noticed the way that penguins move with their flippers

15. A good way to make a prediction about a hypothesis is by stating it in a(n) "If - then" statement.

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16. How might the MIT scientists have stated their prediction in an if-then statement?

If flippers are attached to a boat, then the boat will be more efficient than propellers.

TESTING THE HYPOTHESIS

A. **17.** Testing a hypothesis helps you determine if the hypothesis is
- **a.** a reasonable answer to your question.
- **b.** a controlled experiment.
- **c.** efficient.
- **d.** an adaptation.

d. **18.** If your tests show that your hypothesis is way off the mark, you may have to
- **a.** change the topic you are studying.
- **b.** buy new measurement tools.
- **c.** repeat the tests until you get the results you want.
- **d.** change the hypothesis.

c. **19.** A controlled experiment compares results from experimental groups with
- **a.** results from other experimental groups.
- **b.** results from other investigations.
- **c.** results from a control group.
- **d.** results from past experiments.

20. The purpose of a controlled experiment is to test a hypothesis.

21. In a controlled experiment, the control group and the experimental groups are the same except for a factor in the experimental groups called a(n) variable parameter.

22. In a controlled experiment, the factors that are kept the same between groups are called controlled parameter, aka constants

23. How did Czarnowski and Triantafyllou decide to test their hypothesis?

They built an experimental boat called Proteus.

24. Pieces of information gathered through observation or experimentation are called data.

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25. What was the only parameter the scientists changed in the *Proteus* experiment?

They took off the flippers and changed it to an electric propeller motor.

26. What could the scientists tell from changing this parameter?

By changing the method of propulsion, they could measure different amounts of electrical energy input to the two different types of motors. They could tell if the flipper motor pushed the boat further.

ANALYZING THE RESULTS

27. After you run an experiment and collect data, you must analyze the data to see if the results support your hypothesis.

28. Organizing data into tables and graphs can make information easier to use.

DRAWING CONCLUSIONS

draw a conclusion

29. What must you do at the end of an experiment?

- **a.** Draw a conclusion.
- **b.** Analyze a graph.
- **c.** Draw a picture.
- **d.** Analyze a chart.

30. Give examples of general conclusions you might draw after an investigation.

You might conclude that your data (results) support your hypothesis (HA)
You might conclude that your data (results) do not support your hypothesis (H0)

31. What did the two scientists conclude after the trials of the *Proteus*?

They concluded that the flipper propulsion system was more efficient than the propeller propulsion system.

32. Why were the scientists able to reach this conclusion?

They repeated their controlled tests enough times to validate their conclusion, Usually a scientific test must be repeated about 40 times to convince other scientists.

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COMMUNICATING RESULTS

33. What are some ways to communicate the results of a scientific investigation?

Write a scientific paper, make a presentation or post it to a web site.

34. Why is it important to communicate the results of a scientific investigation?

So that other scientist will learn from your research experiment

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