TECEP® Test Description for EAS-1311-TE

INTRODUCTION TO METEOROLOGY

This exam assesses students on a wide variety of basic atmospheric concepts and, in the process, measures their understanding of "how the weather works." The exam is best suited for students with a fundamental understanding of Earth's atmospheric systems and an appreciation for the atmosphere. The prime objective of this science exam is to assess students' familiarity with the physical processes associated with weather and climate, including jet streams, cyclones/hurricanes/typhoons, cloud types, air masses and fronts, global warming impacts, ozone hole, El Niño/La Niña, Fujita Scale, and anthropogenic climate change. (3 credits)

- **Test format:**
  - 60 multiple-choice questions (1 point each)
  - 4 short essays (5 points each)
  - 2 long essays (10 points each)
- **Passing score:** 70% (70/100 points).Your grade will be reported as CR (credit) or NC (no credit).
- **Time limit:** 3 hours

OUTCOMES ASSESSED ON THE TEST

- Interpret meteorology terminology.
- Describe the origin, composition, and structure of Earth's atmosphere.
- Describe how temperature, pressure, and density affect the atmospheric circulation patterns.
- Explain how different physical forces (Coriolis, Ekman, centripetal, etc.) affect the atmosphere.
- Articulate the effects that different types of thermal energy transfer (conduction, convection, and radiation) have on atmospheric circulation.
- Characterize the benefits of using remote sensing, IR, and visible imagery in meteorology.
- Elaborate on weather computer models and the errors and accuracy in forecasting.
- Describe the influence of human activities on the atmosphere as it relates to global warming/climate change.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

TOPICS ON THE TEST AND THEIR APPROXIMATE DISTRIBUTION

The table below indicates the main topics covered by this exam and the approximate percentage of the exam devoted to each main topic. Under the main topic heading is a list of related but more specific topics. It is important to review these topics to determine how much prior knowledge you have and/or how much additional study is necessary.

Topic	Percentage
The Meteorologist's Toolbox ● Definition of meteorology ● Function and application of meteorology ● Composition of atmosphere ● Influence of temperature, pressure, and density of atmosphere	**10%**
Modes of Transfer of Thermal Energy ● The EM spectrum ● Modes of thermal energy transfer: conduction, convection, and radiation ● Four laws of radiation: ○ Planck's law ○ Wien's law ○ Stefan-Boltzmann law ○ Kirchhoff's law ● The "greenhouse effect," global warming, and climate change	**15%**
Global and Local Controllers of Temperature ● Seasonal fluctuations of temperature on Earth ● Air masses and types of fronts ● Clouds, dew points, precipitation, and snow cover ● Urbanization and urban heat-island effect ● Temperature measurements: ○ Liquid-in-glass ○ Bimetallic ○ Thermistors	**10%**
Water Cycle and Cloud Types ● Hydrologic cycle (water cycle) ● Components of the hydrologic cycle ● Formation and types of clouds ● Fog, dew point, and precipitation ● Humidity and its types	**10%**



TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Atmospheric Disturbances • Effects of low and high pressure on weather events • Fronts and pressure-gradient forces • Effects of Coriolis, friction, geostrophic, and centripetal forces	**10%**
Severe Weather • Hurricanes and the scale used to measure them • Tornadoes and the scale used to measure them • Derechos • Downbursts, hail, squall lines, and bow echoes	**15%**
Remote Sensing of Atmosphere • In-situ observations versus remote sensing • Active versus passive remote sensors • Visible versus infrared satellite imagery • Doppler radar and dual polarization radar • MODIS measurements to investigate volcanic eruptions	**15%**
Human Influence on Atmosphere • Carbon cycle • Global warming • Climate agreements (1997 Kyoto, 2015 Paris, 2019 Chilli) • Anthropogenic causes of ozone depletion in atmosphere • Natural causes of climate change	**15%**

STUDY MATERIALS

This is a comprehensive list of the materials used in this test description. We encourage you to explore these resources to make sure that you are familiar with multiple perspectives on the topics above. All of these resources are openly licensed, which means that they are free to be revised, remixed, reused, redistributed, and retained, so long as their unique terms are followed. You can learn more about open licensing at Creative Commons.

Resource Licensing Guide
Title
Penn State College of Earth and Mineral Sciences, Department of Meteorology and Atmospheric Science. (2018). *METEO 3: Introductory meteorology*. Licensed under CC BY-NC-SA 4.0
Penn State College of Earth and Mineral Sciences, Department of Meteorology and Atmospheric Science. (2019). Learning weather [weather simulations]. Licensed under CC BY-NC-SA 4.0
Menzel, W. P. (2006). *Remote sensing applications with meteorological satellites*. Madison, WI: NOAA Satellite and Information Service, University of Wisconsin.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

SAMPLE QUESTIONS

The questions below are designed to help you study for your TECEP. Answering these questions does not guarantee a passing score on your exam.

Please note that the questions below **will not** appear on your exam.

Multiple-Choice Questions

1. Meteorology is the study of

    a. landforms.
    b. the oceans.
    c. the atmosphere.
    d. outer space.

2. Ozone is found primarily in the _____ and is important because _____.

    a. stratosphere; of its interaction with ultraviolet radiation
    b. troposphere; it enhances thunderstorm development
    c. mesosphere; it makes the mid-levels of the atmosphere cold
    d. thermosphere; it makes the upper levels of the atmosphere very warm

3. Which of the following are used to identify places of equal atmospheric pressure?

    a. Isobars
    b. Isotherms
    c. Isohyets
    d. Isotachs

4. On a weather map, sharp changes in temperature, humidity, and wind direction are marked by

    a. a front.
    b. an anticyclone.
    c. a ridge.
    d. blowing dust.

5. The largest energy transfer in the solar spectrum occurs in the

    a. x-ray part of the spectrum.
    b. ultraviolet part of the spectrum.
    c. visible part of the spectrum.
    d. infrared part of the spectrum.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

6. The largest source of electromagnetic radiation on Earth is

    a. our sun.
    b. nuclear power plants in Connecticut.
    c. the evaporation of water.
    d. Mars.

7. Convection is the process that

    a. does not involve an actual transfer of energy.
    b. involves potential energy only.
    c. involves mixing in a fluid.
    d. is another term for conduction.

8. The area near the equator where the three-cell model of the northern hemisphere interfaces with the three-cell model of the southern hemisphere is called the

    a. ITCZ (intertropical convergence zone).
    b. heat equator.
    c. doldrums.
    d. equatorial convergence.

9. Orographic uplift is usually associated with rising air

    a. over the Great Plains.
    b. along the Gulf of Mexico coast.
    c. over oceans.
    d. along the windward side of mountains.

10. The difference between fog and a cloud is

    a. they form via a different process.
    b. fog never forms in mountains.
    c. clouds can have ice crystals in them, but fog cannot.
    d. nothing; clouds and fog are a matter of observational perspective.

11. $? = \frac{\text{mass of water vapor (grams)}}{\text{mass of dry air (kilograms)}}$

    The formula shown above defines the humidity measure known as

    a. the mixing ratio.
    b. absolute humidity.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

c. vapor pressure.
d. relative humidity.

12. Relative humidity indicates the

    a. probability of precipitation.
    b. chance of cloud formation.
    c. chance for evaporation of water.
    d. nearness to saturation for the air.

13. Who first created the cloud classification system on which our modern system is based?

    a. Benjamin Franklin
    b. Luke Howard
    c. Tor Bergeron
    d. Andrew Ellis

14. Meteorologist's refer to a "low pressure system" or a "lightweight" that brings

    a. fair weather conditions.
    b. inclement weather (clouds and precipitation).
    c. a mixture of fair weather and inclement weather.
    d. tornado-like activities.

15. Hurricanes form in the Atlantic Ocean. When these weather events/severe weather events occur in the western Pacific Ocean, what are they known as?

    a. Typhoons
    b. Tropical breezes
    c. Tsunamis
    d. Cyclones

16. A geostrophic wind

    a. follows the pressure gradient force.
    b. curves around to flow toward its original source.
    c. flows perpendicular to the pressure gradient force.
    d. is usually not affected by the Coriolis force.

17. The Coriolis effect occurs because of

    a. Earth's magnetic field.
    b. Earth's atmosphere.
    c. Earth's rotation.
    d. Earth's dense core.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

18. The reason almost all hurricanes form in the equatorial regions of Earth is because

    a. they are the largest source of warm ocean water.
    b. the Coriolis force is the strongest.
    c. vertical wind shear is the greatest.
    d. there is stronger vorticity near the equator.

19. The _____ scale is used to establish categories of hurricane intensity.

    a. Storm fury
    b. Fujita
    c. Saffir-Simpson
    d. Johnson-Hildebrandt

20. In 1969, the Saffir-Simpson scale included the wind-based damage data along with the storm surge potential. However, because of two storms in 2005 and 2008, the scale was revised to depend on the maximum sustained wind speed in a hurricane. What are the names of these two hurricanes from 2005 and 2008?

    a. Katrina and Ike
    b. Dalal and Patel
    c. Henry and Potter
    d. Julia and Roberts

21. A cup anemometer and wind vane measure which of the following?

    a. Wind speed and wind direction
    b. Pressure and wind speed
    c. Humidity and pressure
    d. Precipitation and humidity

22. Visible satellite imagery is only useful during the local daytime because

    a. it measures the amount of sunlight being reflected from clouds and the surface.
    b. it measures the magnetic reflection from the clouds and the surface.
    c. it measures the electrical impulses from the clouds and the surface.
    d. the combination of the day and night radiation makes it difficult to measure.

23. Radar imagery usually displays the variable _____, which is the measure of the amount of signal returned to the radar from the original transmitted pulse.

    a. reflection
    b. refraction
    c. reflectivity

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

d. resonance

24. The most important source of carbon monoxide emissions in the United States is

    a. natural emissions.
    b. automobile engines.
    c. coal-fired energy plants.
    d. industrial processes.

25. The Environmental Protection Agency considers this city to have the worst ozone pollution.

    a. Los Angeles
    b. Chicago
    c. New York
    d. Phoenix

26. The gradual warming of Earth caused by an unnatural increase of the greenhouse effect is known as

    a. the green thumb effect.
    b. global warming.
    c. the Ice Age.
    d. global cooling.

Short-Essay Question

Explain the similarities and differences between climate and weather. Can these two terminologies be used interchangeably? Why or why not?

Long-Essay Question

Describe the two methods of taking meteorological measurements—in-situ and remote. Remote sensing measurements use several different methods and techniques. Provide two different methods of remote sensing that are commonly used in meteorological analysis. What are some of the advantages of using one over the other?

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

ANSWERS TO SAMPLE QUESTIONS

Multiple-Choice Questions

1. (**c**)
2. (**a**)
3. (**a**)
4. (**a**)
5. (**c**)
6. (**a**)
7. (**c**)
8. (**a**)
9. (**d**)
10. (**d**)
11. (**a**)
12. (**d**)
13. (**b**)
14. (**b**)
15. (**a**)
16. (**c**)
17. (**c**)
18. (**a**)
19. (**c**)
20. (**a**)
21. (**a**)
22. (**a**)
23. (**c**)
24. (**b**)
25. (**a**)
26. (**b**)

Short-Essay Questions

The following rubric will be used to evaluate short-essay questions.

Criterion	Exemplary	Proficient	Needs Improvement	Not Evident
Comprehension of Technical Information	An authoritative understanding of the concepts, principles, and laws with exhaustive explanation, description, and examples of the topic.	Adequate understanding of the concepts, principles, and laws with relevant explanation, description, and examples of the topic.	Incomplete and inconsistent response with minimal explanation, description, and examples of the topic.	Incomprehensible information without any explanation or description with no examples of the topic.
Scientific Inquiry and Analysis	Concisely provides scientific discussions and elaboration of scientific concepts and principles (e.g., application of data, use of scientific method, application of theory). Examples provided are adequately	Logically provides understanding of the scientific inquiry and analysis of the topic by providing some examples and description. Certain application of data and use of scientific method	Minimal understanding of the scientific inquiry and analysis is seen as it relates to the understanding of the scientific method and the application of the data available on the topic.	Incorrect or incomplete analysis and discussions without any examples or discussion of the topic. Application of theory or data on the topic is not seen.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

	explained and elaborated in the response.	is seen in the response.		
Integration and Application	Outstanding application of scientific laws, principles, and concepts to explain the processes asked here by providing an insightful example along with an authoritative short description of what it represents.	General application of scientific laws, principles, and concepts to explain the processes asked here by providing very few examples along with a short description of what it represents.	Narrow understanding of the integration and application of scientific laws, principles, and concepts without providing any examples or short descriptions.	Irrelevant or little understanding and application of scientific laws, principles, and concepts with no examples or descriptions.
Critical Thinking and Research	Insightful critical thought process and research application of the issues.	Viable thought process and application of research with discussion of some issues.	Vague thought process and research application without much discussion or debate of the issues at hand.	Unsound critical thought process and research without any discussion of the issues.
Writing Mechanics	Persuasive writing, easily understood, clear, concise response. The structure and organization of the ideas in the response are excellent.	Reasonable response with clear and concise information. The structure and organization of the ideas in the response are acceptable.	Limited response with mostly unclear information. Ideas were not clearly conveyed and were unorganized in the response.	Incoherent response with unclear information. No structure or organization of the ideas are seen in the response.

Long-Essay Questions

The following rubric will be used to evaluate long-essay questions.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Criterion	Exemplary	Proficient	Needs Improvement	Not Evident
Comprehension of Technical Information	An advanced understanding of the concepts, principles, and laws with compelling explanation, description, and examples that clarify the detail.	Intelligible understanding of the concepts, principles, and laws with relevant explanation, description, and examples that sufficiently clarify the detail.	Confusing response with minimal explanation, description, and examples that leaves room for misinterpretation of the concepts and principles.	Indiscernible information without any explanation or description that does not address the question appropriately.
Scientific Inquiry and Analysis	Erudite scientific discussions and analytical data provided eloquently that addresses the question comprehensively.	Methodically provides understanding of the scientific inquiry and analyzes.	Ill-defined understanding of both the items.	Inferior analysis and discussions.
Integration and Application	Outstanding application of scientific laws, principles, and concepts that comprehensively addresses the question.	Sensible application of scientific laws, principles, and concepts that explains the question in fair amount of detail.	Imprecise understanding of the integration and application of scientific laws, principles, and concepts that does not address the question completely.	Inept understanding and application of scientific laws, principles, and concepts that does not address the question even remotely.
Critical Thinking and Research	Commendable critical thought process and research application of the issues at hand. Provides great examples and description that analyzes the problem well.	Valid thought process and application of research but without providing many examples or description of the issues.	Nebulous thought process and research application of the issues that were not thoroughly explained by examples or description.	Unfocused critical thought process and research of the issues without providing examples or description.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Writing Mechanics	Discerning writing with easily understood, clear, concise response. The structure and organization of the ideas in the response are excellent.	Workable response with clear and concise information. The structure and organization of the ideas in the response are acceptable.	Subpar response with mostly unclear information. Ideas were not clearly conveyed and were unorganized in the response.	Inappropriate response with unclear information. No structure or organization of the ideas are seen in the response.

TECEP Test Description for EAS-131-TE by Thomas Edison State University is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.