

# AMS Introductory College-Level Courses: A hands-on exploration of the dynamic Earth system

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The American Meteorological Society (AMS) views introductory college-level courses as important avenues for promoting scientific literacy among the public. As such, the AMS Education Program considers the development of high-caliber, scientifically-authentic educational materials to be one of its top priorities. In striving to reach that goal, the AMS has produced a suite of introductory college-level courses that engage students by investigating current topics in Earth science and making use of the most up-to-date, real-world environmental data.

Developed by the AMS with support from the National Science Foundation (NSF), National Oceanographic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA), *AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies*, are introductory college-level courses available for implementation at undergraduate institutions nationwide. These high-caliber, scientifically-authentic courses place students in a dynamic learning environment where they investigate current topics in Earth science through the use of real-world and real-time environmental data. More than 600 colleges and universities throughout the United States have already offered these unique courses.

*AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies* each consist of a fully-integrated set of printed and online learning materials. All three course packages include a hardcover 15-chapter textbook, an Investigations Manual with 30 lab-style activities, and access to a course website providing weekly Current Weather Studies, Current Ocean Studies, and Current Climate Studies activities and environmental data streams.

The *AMS Ocean Studies* Student Package offers a unique way to study marine science through the use of an inflatable globe. Oceanography comes alive in three-dimensions, helping the student understand complex oceanographic principles.

The Daily Weather Summary provided Monday through Friday during the fall and spring semesters provides a comprehensive analysis of the synoptic weather in the United States for the previous 24 hours, as well as historical weather events. The Weekly Weather and Ocean News along with Climate News provide important breaking information from these sciences.

Instructor support materials for each course are available and include a faculty CD with a faculty manual, chapter test banks, textbook images, PowerPoint® presentations and other innovative resources. Faculty websites contain answer keys for Investigations Manual and Current Investigation questions. The Investigations Manual, Current Investigations, and test banks are provided in Respondus® format, which can be ported into a college's course management system for automated scoring and

immediate student feedback. This feature allows for full integration to a college's e-learning environment.

The course can be offered by experienced science faculty or those new to teaching the subject matter. Collegial assistance from AMS staff and other course users is available to all new instructors. A simple licensing procedure allows for full institutional access to the Current Investigations, course websites, and course management system-compatible files via a secure password-protected entry portal.

*AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies* aim to interest all students in the Earth sciences and to increase general scientific literacy through the use of real-world and current information. For more information, please visit <http://www.ametsoc.org/amsedu>.

## I. INTRODUCTION

Developed by the American Meteorological Society with support from NSF, NOAA, and NASA, *AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies*, are introductory college-level courses available for implementation at undergraduate institutions nationwide. These high-caliber, scientifically-authentic courses place students in dynamic learning environments where they investigate current topics in Earth science through the use of real-world and real-time environmental data. The courses place emphasis on hands-on investigations and improving critical thinking skills. More than 600 colleges and universities throughout the United States have already offered these unique courses.

## II. COURSE STRUCTURE

*AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies* are fully-integrated course packages containing both printed and online learning materials. Each course includes a comprehensive 15-chapter textbook, Investigations Manual with 30 laboratory-style activities, course website, faculty website, and a faculty resource CD. Instructors can use these materials in any combination that best suits their needs.

A. Textbook

The *Weather Studies: Introduction to Atmospheric Science*, 4<sup>th</sup> edition textbook, written by Joseph M. Moran, covers the foundations of atmospheric science, including radiation, stability, circulation patterns, mid-latitude weather systems, severe weather, and climate change. *Climate Studies: Introduction to Climate Science*, 1<sup>st</sup> edition, also written by Moran, focuses on the climate science while addressing the societal impacts that draw the attention of today’s students. *Ocean Studies: Introduction to Oceanography*, 2<sup>nd</sup> edition, edited by Moran with major contributions to the 1<sup>st</sup> edition from M. Grant Gross and Elizabeth Gross, explores the world ocean from an Earth system perspective. A brand new edition of *Ocean Studies* will be released and available for implementation in Fall 2011.

All of the books are full-color and include 15 chapters. Each chapter opens with a Case-in-Point, an authentic, relevant, and real-life issue that highlights some of the main concepts covered in the chapter. Immediately following is a Driving Question, a broad-based query that links chapter concepts and provides a central focus for that week’s study, which then leads students into the chapter narrative. Each chapter concludes with Basic Understandings along with Review and Critical Thinking Questions.

The textbook is typically used in conjunction with the rest of the course package but can also be used alone in a traditional lecture-style course.



Figure 1. AMS Weather, Ocean, and Climate Studies textbooks.

B. Investigations Manual

Each course package also includes an Investigations Manual with 30 lab-type investigations, two per textbook chapter. The Investigations Manuals are updated annually to stay current on the latest research and technological advances within the geosciences. For example, in the *AMS Climate Studies* Investigations Manual, Investigation 9B explores methane hydrates climate implications, and how they thwarted the initial attempt to contain oil during the Gulf Oil Spill.

The *AMS Ocean Studies* Investigations Manual also incorporates current data by providing links to relevant reports from other scientific and government organizations, including NOAA and the Navy. The *AMS Ocean Studies* Investigations Manual table of contents is listed in Table 1. An inflatable globe (to represent the ocean in true three-dimensional spatial

relationships) is included to guide visualization of ocean phenomena, including tides, El Niño/La Niña, currents, and tsunamis.

TABLE I  
AMS OCEAN STUDIES INVESTIGATIONS MANUAL ACTIVITIES

1A	Ocean in the Earth System
1B	Ocean in the Global Water Cycle
2A	“Seeing” the Bottom of the Ocean
2B	Ocean Bottom Bathymetry
3A	Seawater Temperature, Salinity and Density
3B	Fresh Water, Ocean Water and Sea Ice
4A	What Goes Down
4B	Sediment from Land to Sea
5A	Ocean-Atmosphere Connections
5B	Incoming Solar Radiation and Sea Surface Temperature
6A	Wind-driven Ocean Circulation and Ocean Gyres
6B	Density-driven Circulation and Water Masses
7A	Deep- and Shallow-Water Waves
7B	Tides
8A	Coastal Processes
8B	Open Ocean and Coastal Impacts of Tropical Cyclones
9A	Upwelling and Ocean Productivity
9B	Chesapeake Bay Estuary
10A	Marine Food Webs
10B	Ocean Life
11A	Seawater Temperature, Pressure and Surface Ocean Currents
11B	El Nino/La Nina: The Ocean-Atmosphere Connection
12A	Change in Earth’s Climate System
12B	The Ocean and Climate Change
13A	The Sea and the Shore
13B	Sensing the Top 2km of the Ocean in Near Real-time
14A	Fisheries and Overfishing
14B	Fisheries and Bycatch
15A	Oil Spills and the Marine Environment
15B	Ocean Policy – Determining the Boundaries

C. Course Website

The secure course website brings near real-time data into the classroom through *Current Weather*, *Ocean*, and *Climate Studies* investigations and tying it with the Weekly Weather, Ocean, and Climate News. This dynamic learning strategy motivates students by connecting key concepts with recent news. One such example was the fierce fall storm of 2010, now deemed the North American Extratropical Cyclone (October 25-26, 2010). As the storm was setting records for lowest pressure in Minnesota and Wisconsin, students had the opportunity to analyze actual data by completing that week’s *Current Weather Studies*. *Current Weather*, *Ocean*, and *Climate Studies* are posted on Mondays (and Wednesdays for *Current Weather Studies*) during the fall and spring semesters. With links to timely news items and a chronology of related historical events, the Weekly News, is freshly prepared on Monday and updated as the week progresses.

Additionally, the course website also provides chapter self-test questions and geoscience career information. Weekly “In Greater Depth ...” supplemental information files provide a detailed examination of various topics.

#### IV. ACKNOWLEDGEMENTS

*AMS Weather Studies* and the *AMS Weather Studies* Diversity Project were funded by NSF grants GEO-0119740 (OEDG) and DUE-0126032 (CCLI\_ND). The *AMS Ocean Studies* Diversity Project is supported by NSF grant DUE-0442497 (CCLI-ND). *AMS Climate Studies* is supported by NASA grants NNX-09AP58G and NNX-08AN53G.

#### D. Faculty Resource Material

Course instructors receive a Faculty CD containing a faculty manual, Investigations Manual answers, test bank questions, textbook images, and PowerPoint® presentations for each chapter. The faculty manual describes the course and its components and contains suggestions for course implementation in a variety of classroom settings. Included for each text chapter is an outline, summary, and learning objectives. The CD Investigations Manual answer forms are compiled in Respondus®, which works with institutional management systems.

A secure faculty website delivers answers to chapter Review and Critical Thinking, Investigations Manual, and *Current Weather, Ocean, and Climate Studies* questions. The website also includes Respondus®-formatted answer forms for *Current Weather, Ocean, and Climate Studies*.

#### E. Course Implementation

*AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies* can be offered completely online, in blended or hybrid classrooms, and face-to-face lecture or lecture/laboratory learning environments. The material can be used by experienced science faculty and those new to teaching the subject matter. For all new instructors, mentoring from instructors experienced with the course, and AMS staff, is available.

#### F. Course License Procedure

A license is required for institutions using the course package, which includes the textbook, Investigations Manual, and course and faculty websites, or only the Investigations Manual and/or course website. Students enrolled in the course receive local institutional credit and purchase course materials through their college bookstore.

#### III. CONCLUSIONS

*AMS Weather Studies*, *AMS Ocean Studies*, and *AMS Climate Studies* have together introduced real-world geoscience education to more than 600 institutions, including many minority serving institutions. Many had not previously offered a course in these disciplines. The courses deliver highly motivational learning experiences that encourage additional student exploration of the geosciences, possibly leading to careers in science or science education.

The AMS will continue to encourage even more institutions to offer *AMS Weather Studies*, *AMS Ocean Studies*, or *AMS Climate Studies* and continually update them to fit the changing needs of colleges and incorporate the very latest in research and applications.

AMS is also in the process of seeking developmental funding for *AMS Water Studies*, to build upon its suite of courses.