Get the Picture: Severe Weather
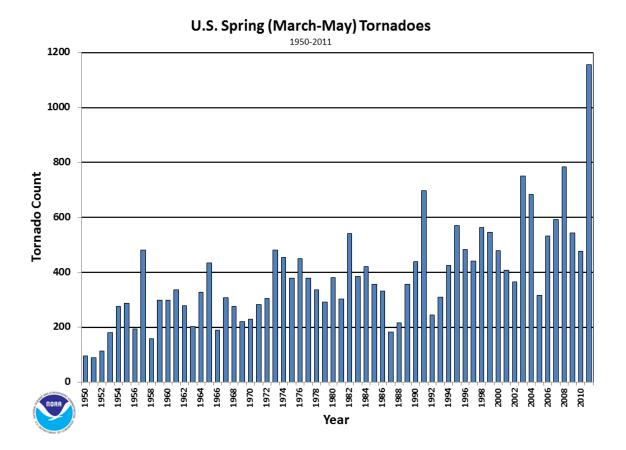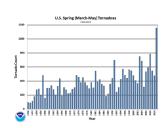## U.S. Spring (March-May) Tornadoes

U.S. Spring (March-May) Tornadoes
1950-2011

DIRECTIONS ▸ Place a T for True or an F for False in the box to the left of the statement to be judged.

☐ The graph shows significant increases in the number of tornadoes from March to May since the 1950s.

☐ The data from the 1950s is likely more inaccurate than the data from the 2000s.

☐ 2011 was an extremely prolific spring in terms of the number of tornadoes produced.

☐ The graph shows that approximately 790 tornadoes occurred in 2008.

☐ If the average annual number of tornadoes in the US in recent decades is 1235, then all of these years are under the average.

☐ On average, someone alive in the 1950s would be less likely to experience a tornado in the spring than someone alive in the 1970s.

Activity by Teresa Eastburn.

Get the Picture: Severe Weather

U.S. Spring (March-May) Tornadoes

Rational for True or False answer for "US Spring (March-May) Tornadoes" graph
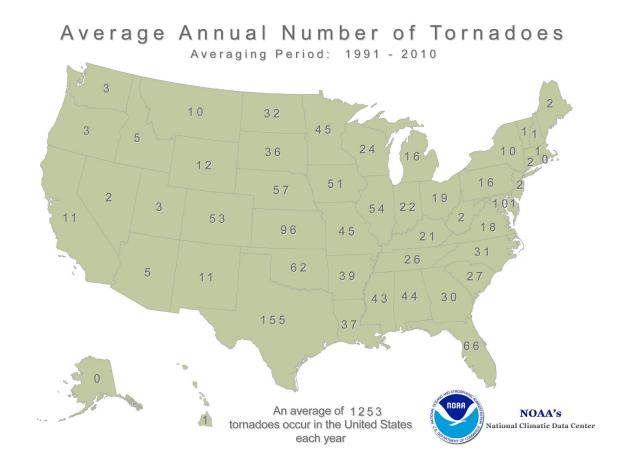
TRUE	RATIONAL
The graph shows significant increases in the number of tornadoes from March to May since the 1950s.	The graph clearly shows an increase in the tornado count during this period. During the 30-year period from 1950 to 1979, five years exceeded 400 tornadoes during March to May. From the 30-year period from 1980-2009, tornado counts exceeded 400 out of 18 of the 30 years between March and May. The graph clearly shows this increase, however, why it exists requires additional interpretation.
* The data from the 1950s is likely more inaccurate than the data from the 2000s.	To answer this question correctly, students need to understand that technology has greatly improved weather detection and forecasting capabilities today as compared to prior decades. It is very likely that many tornadoes went undetected due to lower populations and thus fewer sighting reports, as well as less effective technology due to significant improvements in radar and computer capabilities in addition to other advances.
2011 was an extremely prolific spring in terms of the number of tornadoes produced.	With close to 1200 tornadoes between March and May in 2011, the total exceeds the prior maximum since 1950 by over 300 tornadoes. Because the total far exceeds tornado counts from recent years, the extreme rise confirms that 2011 was indeed extremely prolific.

FALSE	RATIONAL
The graph shows that approximately 90 tornadoes occurred in 2008.	The graph only shows the period from March to May 2008. The count would no doubt rise for 2008 if all months were included in the graph's total.
If the average annual number of tornadoes in the US in recent decades is 1253, then all of these years are under the average.	Because the graph does not convey annual tornado totals between the years 1950 and 2011, there is no way to know if all of these years are under the average given. A student could also agree that there is not enough information to accurately answer this question.
* On average, someone alive in the 1950s would be less likely to experience a tornado in the spring than someone alive in the 1970s.	On the data alone, this appears true with the average March to May count for the 1950s in the US averaging approximately 280 tornadoes and the average tornado count for March to May through the 1970s in the US averaging approximately 280. Meteorologists, however, would argue that the larger numbers for the 1970s during March – May were greater than the numbers reported in the 1950s because of subsequent and significant improvements in weather detection technology. Also, the data from the first three weeks of June are not included in the totals (but would be considered spring data), while the data from the first three weeks of March (winter) is included. Thus, the totals for what constitute spring are not fully reported in this particular graph. Where a person lives also would impact the accuracy of this answer.

Note: Where an asterisk precedes a TRUE or FALSE statement, Students should be allowed to defend their answer to the statement, and teachers should evaluate the "correctness" of the answer based on the soundness of a student's scientific reasoning. Some answers are intentionally NOT black-and-white as data requires analysis and interpretation. The thoughtful and systematic collection, analysis, and interpretation of data allow it to be developed into evidence that supports scientific ideas, arguments, hypotheses, and the need often for additional research.

Activity by Teresa Eastburn.

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Get the Picture: Severe Weather

Average Annual Number of Tornadoes

Average Annual Number of Tornadoes
Averaging Period: 1991 - 2010

An average of 1253 tornadoes occur in the United States each year

NOAA's National Climatic Data Center

DIRECTIONS ▶ Place a T for True or an F for False in the box to the left of the statement to be judged.

☐ The graph shows that the most prolific state for producing tornadoes between 1991 and 2010 has been Texas.

☐ *If the data represented 1950 - 2010 averages, state averages would mostly decline.

☐ The states furthest north and/or west in the US on average had less tornadoes during the period represented.

☐ It is highly unlikely that Wyoming will have more than 12 tornadoes in any given year.

☐ Alaska never has any tornadoes.

☐ On average, between 1991 and 2010, the region hardest hit by the shear number of tornadoes each year was the South (LA, MS, GA, AR, FL, AL, TN).

Activity by Teresa Eastburn.

Get the Picture: Severe Weather

Average Annual Number of Tornadoes

Average Annual Number of Tornadoes
Averaging Period: 1991 - 2010

An average of 1253 tornadoes occur in the United States each year

NOAA's National Climatic Data Center

Rational for True or False answer for "Average Annual Number of Tornadoes, 1991 to 2010"
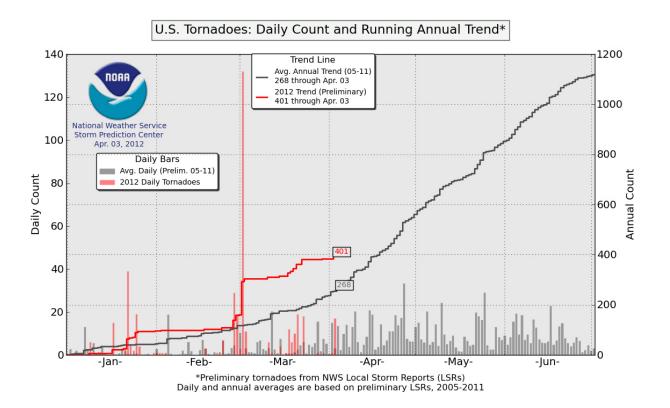
TRUE	RATIONAL
The graph shows that the most prolific state for producing tornadoes between 1991 and 2010 has been Texas.	The graph shows that the average number of tornadoes produced in Texas each year from 1991 to 2010 is 155. No other state comes close to exceeding this average annual number of tornadoes. Kansas is the closest with 96.
*If the data represented 1950 – 2010 averages, state averages would mostly decline.	While the graph does not provide evidence of this, knowledge about scientific progress and population growth since the 1950s could help some to state that this statement is very likely true. Radar's used for weather forecasting began during WWII and advanced significantly within each subsequent decade to advance the detection of severe weather. Computers also have greatly advanced society's ability to forecast and detect areas where severe weather events like tornadoes are probable. The US population in 1950 was also significantly less than the population in 1991 (approximately 152 million compared to 252 million in 1991). Greater population increases of this magnitude increase the odds that a tornado will be sighted.
The states further north and/or west in the US on average have less tornadoes.	Northern states and states in the West do experience less tornadoes than other regions within the United States. Plain states in the Midwest and Southern states experience the most tornadoes on average, but tornadoes can appear anywhere.

FALSE	RATIONAL
It is highly unlikely that Wyoming will have more than 12 tornadoes in any given year.	Since Wyoming's average annual number of tornadoes between 1991 and 2010 was 12, it is highly probable that 12 tornadoes didn't occur each year and that during this period the annual total exceeded 12 tornadoes a year.
Alaska never has any tornadoes.	While tornadoes are relatively rare in Alaska, they can and do occur. Just because the average annual number of tornadoes between 1991 and 2010 is zero for Alaska, that is no guarantee that a tornado will NEVER occur. Beware of the word "never."
On average, between 1991 and 2010, the region hardest hit by the shear number of tornadoes each year was the South (LA, MS, GA, AR, FL, AL, TN).	While these Southern states did experience a large number of tornadoes on average during the years 1991 to 2010, the states with the highest number of tornadoes annually during this period were actually located in the plain states east of the Rockies (Texas, Oklahoma, Kansas, Missouri, Nebraska, Iowa, Illinois). It should be noted, however, that this graph says nothing about tornado intensity. Colorado, for example, experienced on average 53 tornadoes annually during 1991-2010, but few if any may have reached above EF2 strength. Oklahoma reached 62 tornadoes on average each year, and most of them may have exceeded EF2 or EF3 intensity. From the data presented, we have no way of knowing where the strongest and most damaging tornadoes occurred.

Note: Where an asterisk precedes a TRUE or FALSE statement, Students should be allowed to defend their answer to the statement, and teachers should evaluate the "correctness" of the answer based on the soundness of a student's scientific reasoning. Some answers are intentionally NOT black-and-white as data requires analysis and interpretation. The thoughtful and systematic collection, analysis, and interpretation of data allow it to be developed into evidence that supports scientific ideas, arguments, hypotheses, and the need often for additional research.

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Get the Picture: Severe Weather

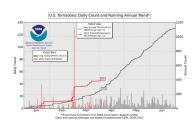## U.S. Tornadoes: Daily Count and Running Annual Trend

DIRECTIONS ▶ Place a T for True or an F for False in the box to the left of the statement to be judged.

[ ] The graph shows that on many days there are a multiple number of tornadoes that form.

[ ] The number of tornadoes thus far reported for 2012 exceeds the 2005-2011 average number of tornadoes for the same time period.

[ ] *Between 2005 - 2011, there were less than 10 days that averaged more than 20 tornadoes.

[ ] The graph clearly shows that there was a day in February that averaged over 120 tornadoes between 2005 – 2011.

[ ] June's average number of tornadoes between 2005 - 2011 was greater than all the other months combined.

[ ] No tornadoes occurred after June in the US between 2005 - 2011.

Activity by Teresa Eastburn.

Get the Picture: Severe Weather

U.S. Tornadoes: Daily Count and Running Annual Trend

Rational for True or False answer for "US Tornadoes: Daily Count and Running Annual Trend, 2005–2011"

TRUE	RATIONAL
The graph shows that on many days there are a multiple number of tornadoes that form in the US.	The data in the graph clearly shows this for many days between 2005 - 2011 and also in 2012 through April 3rd.
The number of tornadoes thus far reported for 2012 exceeds the 2005 - 2011 average number of tornadoes for the same time period.	The 2012 preliminary daily average trend through April 3rd totals 401 tornadoes, while the 2005 - 2011 average annual trend through the same period totals 268 tornadoes. This clearly illustrates that tornadoes were more plentiful up to April 3rd in 2012 as compared to the 2005 - 2011 average.
*Between 2005 - 2011, there were less than 10 days that averaged more than 20 tornadoes.	According to the data illustrated in the graph, 20 or more tornadoes were the average on only three days between January and June 2005 - 2011. While data from July to December is not included in the graph, these months historically produce far fewer tornadoes than the January through June period, so this statement is most likely true. A student may argue that without July through December numbers, however, he or she is unable to answer this question with complete confidence.

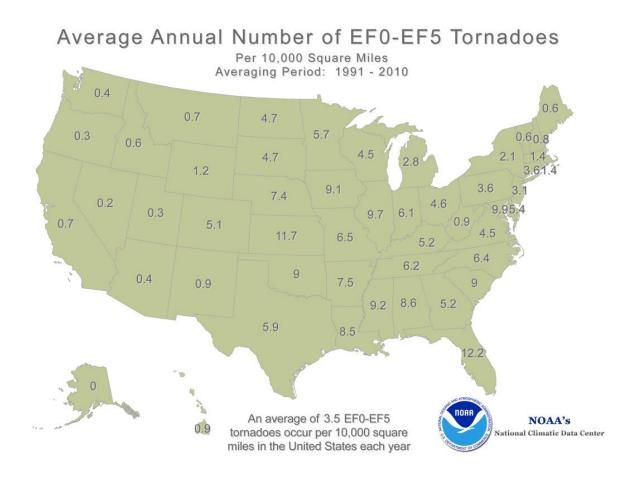| FALSE	RATIONAL
The graph clearly shows that there was a day in February that averaged over 120 tornadoes between 2005 – 2011.	The graph clearly shows this for 2012 but not for the average between 2005 - 2011.
June's average number of tornadoes between 2005 - 2011 was greater than all the other months combined.	It appears that the combination of April and May's '05-'11 total tornado daily count would exceed the total daily averages tallied for June 2005 - 2011. The annual trend line from January to July 1st exceeds 1100 tornadoes, but this is the annual average accumulation and does not represent June 2005 - 2011 averages.
No tornadoes occurred after June in the US between 2005 - 2011.	Tornadoes can happen anywhere and historically occur throughout each month of the year within the United States. While tornadoes typically are less frequent during the months of July through December as compared to January through June, tornadoes nonetheless occur. It would be statistically improbable to have none. In fact, 103 tornadoes were recorded for July 2011, 57 in August 2011, 51 in September 2011, 23 in October 2011, 44 in November, 2011 and 15 in December 2011 according to NOAA's Storm Prediction Center statistics.

Note: Where an asterisk precedes a TRUE or FALSE statement, Students should be allowed to defend their answer to the statement, and teachers should evaluate the "correctness" of the answer based on the soundness of a student's scientific reasoning. Some answers are intentionally NOT black-and-white as data requires analysis and interpretation. The thoughtful and systematic collection, analysis, and interpretation of data allow it to be developed into evidence that supports scientific ideas, arguments, hypotheses, and the need often for additional research.

Activity by Teresa Eastburn.

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UPDATED: AUG 2021

Get the Picture: Severe Weather
Average Annual Number of EF0–EF5 Tornadoes

Average Annual Number of EF0-EF5 Tornadoes
Per 10,000 Square Miles
Averaging Period: 1991 - 2010

An average of 3.5 EF0-EF5 tornadoes occur per 10,000 square miles in the United States each year

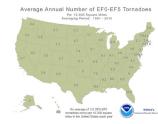**NOAA's** National Climatic Data Center

DIRECTIONS ▶ Place a T for True or an F for False in the box to the left of the statement to be judged.

[ ] Tornado averages by a given area (10,000 sq. miles) makes it easier to determine areas within a state consistently above or below the state average.

[ ] Although CO has on average 53 tornadoes and GA has 30 on average each year, when looked at by number of tornadoes per 10,000 square miles, they have approximately the same number.

[ ] The top two states that experienced the most tornadoes by area between 1991 - 2010 are Florida and Kansas.

[ ] The state that had the most tornadoes between 1991 and 2010 was Florida.

[ ] Rounding up to the nearest tenth, 4 tornadoes occur per 10,000 square miles in the US on average each year.

[ ] Florida had the most tornado devastation between 1991 and 2010.

Activity by Teresa Eastburn.

Get the Picture: Severe Weather

Average Annual Number of EF0-EF5 Tornadoes

Average Annual Number of EF0-EF5 Tornadoes
Per 10,000 Square Miles
Averaging Period: 1991 - 2010

Rational for True or False answer for
"Average Annual Number of EF0-EF5 Tornadoes Per 10,000 Sq. Miles, 1991–2010"

TRUE	RATIONAL
*Tornado averages per a given area (10,000 sq. miles) make it easier to determine areas within a state consistently above and/or below the state average.	Yes, it would help pinpoint a region within a state that experiences more or less tornadoes. It would also allow states of various sizes to compare equally sized areas within their states and identify those states that experience the most tornadoes relevant to their size. This graph does just that.
Although Colorado has on average 53 tornadoes and Georgia has 30 on average each year, when looked at by number of tornadoes per 10,000 square miles, they have approximately the same number.	By area (per 10,000 square miles), Colorado experienced on average 5.1 tornadoes between 1991 and 2010, while Georgia experienced close to the same, 5.2 tornadoes. Colorado experienced more than 20 more tornadoes as a state on average annually, but when you compare the two states by area (per 10,000 square miles), they experienced approximately the same number of tornadoes.
The top two states that experienced the most tornadoes by area between 1991-2010 are Florida and Kansas.	This is true. Florida experienced 12.2 tornadoes on average annually per 10,000 square miles during 1991- 2010, while Kansas came in a close second with 11.7 tornadoes on average each year during this period. The information only conveys tornado numbers and not tornado intensity data.

FALSE	RATIONAL
The state that had the most tornadoes between 1991 and 2010 was Florida.	Florida experienced the most tornadoes per 10,000 square mile area, however, it did not experience the most tornadoes by state count. Texas experienced 155 tornadoes between 1991 and 2010 and holds that record. When analyzed by 10,000 sq. mile area, however, Texas does not even fall in the top 10 states for average annual number of tornadoes.
If you round to the nearest tenth, four tornadoes occur per each 10,000 square mile in the US each year on average.	According to the graph, an average of 3.5 EF0- EF5 tornadoes occur per 10,000 square miles in the US each year. Rounding to the nearest tenth would result in the same figure since ".5" is a tenth and no numbers follow in subsequent decimal places.
Florida had the most tornado devastation between 1991 and 2010.	While Florida had the most tornadoes per 10,000 square miles between 1991 and 2010, the data gives us no indication as to the devastation that Florida experienced. Nor does it give us any indication of the rankings of strength on the Enhanced Fujita scale for the various tornadoes that hit the state, which helps to quantify the devastation.

Note: Where an asterisk precedes a TRUE or FALSE statement, Students should be allowed to defend their answer to the statement, and teachers should evaluate the "correctness" of the answer based on the soundness of a student's scientific reasoning. Some answers are intentionally NOT black-and-white as data requires analysis and interpretation. The thoughtful and systematic collection, analysis, and interpretation of data allow it to be developed into evidence that supports scientific ideas, arguments, hypotheses, and the need often for additional research.

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Get the Picture: Severe Weather
The Ten Deadlist Documented US Tornado Events

The Ten Deadliest Documented US Tornado Events as of 12/2011

Rank	Date	Estimated Intensity*	State	Injuries (Deaths)
1	March 18, 1925	F5	MO, IL, IN	2027 (695)
2	May 6, 1840	unknown	LA, MS	109 (317)
3	May 27, 1896	F4	MO, IL	1000 (255)
4	April 5, 1936	F5	MS	700 (216)
5	April 6, 1936	F4	GA	1600 (203)
6	April 9, 1947	F5	TX, KS, OK	970 (181)
7	May 22, 2011	EF5	MO	1,000 (158)
8	April 24, 1908	F4	LA, MS	770 (143)
9	June 12, 1899	F5	WI	200 (117)
10	June 8, 1953	F5	MI	844 (116)

Source: NOAA NCDC

https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology/deadliest

DIRECTIONS ❯ **Place a T for True or an F for False in the box to the left of the statement to be judged.**

☐ It's very likely that injuries and fatalities reported on the list would be lower if these tornadoes occurred in recent years.

☐ It's possible that the US tornado that injured the most people in the past century is not on the list.

☐ The tornado that caused the most fatalities also caused the most injuries.

☐ According to the table, the only deadly tornado since 2000 occurred in 2011 in Joplin, MO.

☐ The "EF5" in the Estimated Intensity column for #7 is an obvious typo that should instead be listed as "F5".

☐ All of the tornadoes on the list occurred within Tornado Alley.

Activity by Teresa Eastburn.

UCAR CENTER FOR **SCIENCE EDUCATION**

Get the Picture: Severe Weather
The Ten Deadlist Documented Tornado Events

Rational for True or False answer for "The Ten Deadliest Documented US Tornado Events as of 2011"

TRUE	RATIONAL
*It's very likely that injuries and fatalities reported on the list would be lower if these tornadoes occurred in recent years.	It is likely that many of the tornadoes that resulted in injuries and deaths decades ago would produce fewer injuries and fatalities today because of the great advances in forecasting capabilities and warning times. However, there is no guarantee that the same storm today would be injury and/or death free. Even with the great advances in forecasting severe weather, injuries and deaths still occur, as evident from the 2011 Joplin, MO tornado.
*It's possible that the US tornado that injured the most people in the past century is not on the list.	It is possible that a tornado that resulted in large numbers of injuries and even fatalities was not accurately documented during the past century, but no one knows this definitely. Improvements in transportation, communication, technology, and documentation procedures have no doubt improved the accuracy of such figures over time. These figures are based on the best information available.
The tornado that caused the most fatalities also caused the most injuries.	According to the data in the table, this is true. In March 1925 the Tri-State tornado injured 2027 people and resulted in 695 deaths. It has the dubious honor of being our nation's deadliest documented tornado event.

FALSE	RATIONAL
According to the table, the only deadly tornado since 2000 occurred in 2011 in Joplin, MO.	The table lists the ten deadliest documented tornadoes, not the tornadoes that produced fatalities (deaths). While the 2011 Joplin, MO tornado resulted in significant numbers of lost lives, it does not mean that no other tornadoes between 2000 and 2011 resulted in fatalities, unfortunately. Regretfully, there are definitely other tornadoes that resulted in deaths during this period of time.
The "EF5" in the Estimated Intensity column for #7 is an obvious typo that should instead be listed as "F5".	As of February 2007, the Fujita scale was replaced by the Enhanced Fujita scale (EF scale), which rates the strength of tornadoes in the US based on the damage they cause. The tornadoes on the list before Feb. 2007 were ranked according to the Fujita scale, (F0 – F5) which was introduced in 1971. The new Enhanced Fujita scale ranks storms similarly from EF0 to EF5, but improvements have been made in wind and structural damage descriptions.
All of the tornadoes on the list occurred within Tornado Alley.	Tornado Alley is comprised of the area of plains east of the Rocky Mountains that includes areas of Texas, Oklahoma, Kansas, Missouri, Nebraska, South Dakota, and the eastern plains of Colorado. The tornados on the list occurred in these states within Tornado Alley, but they also occurred in states outside of it: Mississippi, Georgia, Michigan, Wisconsin, Illinois, and the Tri-State region of New York, Pennsylvania, and New Jersey. A severe tornado is capable of occurring anywhere. The odds are simply higher for certain regions of the country.

Note: Where an asterisk precedes a TRUE or FALSE statement, Students should be allowed to defend their answer to the statement, and teachers should evaluate the "correctness" of the answer based on the soundness of a student's scientific reasoning. Some answers are intentionally NOT black-and-white as data requires analysis and interpretation. The thoughtful and systematic collection, analysis, and interpretation of data allow it to be developed into evidence that supports scientific ideas, arguments, hypotheses, and the need often for additional research.

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Get the Picture: Severe Weather

March 2012 Statewide Precipitation Ranks

March 2012 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA

Precipitation

1 = Driest
118 = Wettest

Record Driest | Much Below Normal | Below Normal | Near Normal | Above Normal | Much Above Normal | Record Wettest

DIRECTIONS ▶ Place a T for True or an F for False in the box to the left of the statement to be judged.

☐ The precipitation information conveyed in the image would be considered climate data.

☐ According to the rankings, nearly a third of the country was at above normal conditions for precipitation in March 2012.

☐ Drier-than-average conditions prevailed in much of the interior West and Northeast in March 2012.

☐ The precipitation information shows that the majority of states received near normal precipitation for 2012.

☐ The numbers on each state refer to the number of inches of water each received in March 2012.

☐ The amount of precipitation in states of the same color is approximately the same.

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Get the Picture: Severe Weather
March 2012 Statewide Precipitation Ranks

March 2012 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA

Precipitation
1 = Driest
118 = Wettest

Record Driest | Much Below Normal | Below Normal | Near Normal | Above Normal | Much Above Normal | Record Wettest

Rational for True or False answer for "March 2012 Statewide Precipitation Ranks"

TRUE	RATIONAL
*The precipitation information conveyed in the image would be considered climate data.	The data used to determine the color of each state is based on climate precipitation data for a period of 118 years as compared to March 2012 precipitation. Because the graph conveys current conditions in comparison to long-term averages, it definitely conveys climate data. Climate is the long-term pattern of weather conditions and their extremes for a specific area and time period, usually at least 30 years.
According to the rankings, nearly a third of the country was at above normal conditions for precipitation in March 2012.	Approximately 15 states are colored light to dark green conveying that they had above normal conditions for precipitation for March 2012. This is nearly a third of the 48 states shown on the graph for the continental US.
Drier-than-average conditions prevailed in much of the interior West and Northeast in March 2012.	Much of the Northeast is below or much below normal precipitation levels with the exception of Pennsylvania, while half of the interior west was drier than average, with Colorado experiencing record dryness, Wyoming experiencing levels much below normal, and New Mexico and Utah having below normal precipitation.

FALSE	RATIONAL
The precipitation information shows that the majority of states received near normal precipitation for 2012.	The data only shows precipitation rankings for March 2012 based on historical climate precipitation data for each state. It does not provide precipitation information for the year as a whole.
The numbers on each state refer to the number of inches of water they received in March 2012.	The number refers to the state ranking from the driest March ever recorded for the state (#1), to the wettest March ever recorded for the state (#118) during the past 118 years as of 2012. Colorado, therefore, experienced their driest March on record for the past 118 years, while Oregon had one of its wettest years, ranking 117 out of 118 (its second wettest) between the years 1895 and 2012.
The amount of precipitation in states of the same color is approximately the same.	The color for each state is solely based on March 2012 precipitation compared to the state's March long-term average precipitation from 1895 to 2012. The March long-term average precipitation for Florida may be 4 inches with current 2012 levels below normal at 3 inches, while the state of New Mexico 's long term average may be less than a half inch, with 2012 precipitation levels also reaching below normal levels at .27 inches. Both states are colored yellow because they have below normal precipitation for March 2012, but this is the only similarity the graphic conveys and that all yellow-colored states share.

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