**Comparisons**

We know many comparison operators from maths.

In JavaScript they are written like this:

* Greater/less than: a > b, a < b.
* Greater/less than or equals: a >= b, a <= b.
* Equals: a == b, please note the double equality sign == means the equality test, while a single one a = b means an assignment.
* Not equals: In maths the notation is ≠, but in JavaScript it’s written as a != b.

In this article we’ll learn more about different types of comparisons, how JavaScript makes them, including important peculiarities.

At the end you’ll find a good recipe to avoid “JavaScript quirks”-related issues.

**[Boolean is the result](https://javascript.info/comparison" \l "boolean-is-the-result)**

All comparison operators return a boolean value:

* true – means “yes”, “correct” or “the truth”.
* false – means “no”, “wrong” or “not the truth”.

For example:

alert( 2 > 1 ); // true (correct)

alert( 2 == 1 ); // false (wrong)

alert( 2 != 1 ); // true (correct)

A comparison result can be assigned to a variable, just like any value:

let result = 5 > 4; // assign the result of the comparison

alert( result ); // true

**[String comparison](https://javascript.info/comparison" \l "string-comparison)**

To see whether a string is greater than another, JavaScript uses the so-called “dictionary” or “lexicographical” order.

In other words, strings are compared letter-by-letter.

For example:

alert( 'Z' > 'A' ); // true

alert( 'Glow' > 'Glee' ); // true

alert( 'Bee' > 'Be' ); // true

The algorithm to compare two strings is simple:

1. Compare the first character of both strings.
2. If the first character from the first string is greater (or less) than the other string’s, then the first string is greater (or less) than the second. We’re done.
3. Otherwise, if both strings’ first characters are the same, compare the second characters the same way.
4. Repeat until the end of either string.
5. If both strings end at the same length, then they are equal. Otherwise, the longer string is greater.

In the first example above, the comparison 'Z' > 'A' gets to a result at the first step.

The second comparison 'Glow' and 'Glee' needs more steps as strings are compared character-by-character:

1. G is the same as G.
2. l is the same as l.
3. o is greater than e. Stop here. The first string is greater.

**Not a real dictionary, but Unicode order**

The comparison algorithm given above is roughly equivalent to the one used in dictionaries or phone books, but it’s not exactly the same.

For instance, case matters. A capital letter "A" is not equal to the lowercase "a". Which one is greater? The lowercase "a". Why? Because the lowercase character has a greater index in the internal encoding table JavaScript uses (Unicode). We’ll get back to specific details and consequences of this in the chapter [Strings](https://javascript.info/string).

**[Comparison of different types](https://javascript.info/comparison" \l "comparison-of-different-types)**

When comparing values of different types, JavaScript converts the values to numbers.

For example:

alert( '2' > 1 ); // true, string '2' becomes a number 2

alert( '01' == 1 ); // true, string '01' becomes a number 1

For boolean values, true becomes 1 and false becomes 0.

For example:

alert( true == 1 ); // true

alert( false == 0 ); // true

**A funny consequence**

It is possible that at the same time:

* Two values are equal.
* One of them is true as a boolean and the other one is false as a boolean.

For example:

let a = 0;

alert( Boolean(a) ); // false

let b = "0";

alert( Boolean(b) ); // true

alert(a == b); // true!

From JavaScript’s standpoint, this result is quite normal. An equality check converts values using the numeric conversion (hence "0" becomes 0), while the explicit Boolean conversion uses another set of rules.

**[Strict equality](https://javascript.info/comparison" \l "strict-equality)**

A regular equality check == has a problem. It cannot differentiate 0 from false:

alert( 0 == false ); // true

The same thing happens with an empty string:

alert( '' == false ); // true

This happens because operands of different types are converted to numbers by the equality operator ==. An empty string, just like false, becomes a zero.

What to do if we’d like to differentiate 0 from false?

**A strict equality operator === checks the equality without type conversion.**

In other words, if a and b are of different types, then a === b immediately returns false without an attempt to convert them.

Let’s try it:

alert( 0 === false ); // false, because the types are different

There is also a “strict non-equality” operator !== analogous to !=.

The strict equality operator is a bit longer to write, but makes it obvious what’s going on and leaves less room for errors.

**[Comparison with null and undefined](https://javascript.info/comparison" \l "comparison-with-null-and-undefined)**

There’s a non-intuitive behavior when null or undefined are compared to other values.

**For a strict equality check ===**

These values are different, because each of them is a different type.

alert( null === undefined ); // false

**For a non-strict check ==**

There’s a special rule. These two are a “sweet couple”: they equal each other (in the sense of ==), but not any other value.

alert( null == undefined ); // true

**For maths and other comparisons < > <= >=**

null/undefined are converted to numbers: null becomes 0, while undefined becomes NaN.

Now let’s see some funny things that happen when we apply these rules. And, what’s more important, how to not fall into a trap with them.

**[Strange result: null vs 0](https://javascript.info/comparison" \l "strange-result-null-vs-0)**

Let’s compare null with a zero:

alert( null > 0 ); // (1) false

alert( null == 0 ); // (2) false

alert( null >= 0 ); // (3) true

Mathematically, that’s strange. The last result states that "null is greater than or equal to zero", so in one of the comparisons above it must be true, but they are both false.

The reason is that an equality check == and comparisons > < >= <= work differently. Comparisons convert null to a number, treating it as 0. That’s why (3) null >= 0 is true and (1) null > 0 is false.

On the other hand, the equality check == for undefined and null is defined such that, without any conversions, they equal each other and don’t equal anything else. That’s why (2) null == 0 is false.

**[An incomparable undefined](https://javascript.info/comparison" \l "an-incomparable-undefined)**

The value undefined shouldn’t be compared to other values:

alert( undefined > 0 ); // false (1)

alert( undefined < 0 ); // false (2)

alert( undefined == 0 ); // false (3)

Why does it dislike zero so much? Always false!

We get these results because:

* Comparisons (1) and (2) return false because undefined gets converted to NaN and NaN is a special numeric value which returns false for all comparisons.
* The equality check (3) returns false because undefined only equals null, undefined, and no other value.

**[Avoid problems](https://javascript.info/comparison" \l "avoid-problems)**

Why did we go over these examples? Should we remember these peculiarities all the time? Well, not really. Actually, these tricky things will gradually become familiar over time, but there’s a solid way to avoid problems with them:

* Treat any comparison with undefined/null except the strict equality === with exceptional care.
* Don’t use comparisons >= > < <= with a variable which may be null/undefined, unless you’re really sure of what you’re doing. If a variable can have these values, check for them separately.

**[Summary](https://javascript.info/comparison" \l "summary)**

* Comparison operators return a boolean value.
* Strings are compared letter-by-letter in the “dictionary” order.
* When values of different types are compared, they get converted to numbers (with the exclusion of a strict equality check).
* The values null and undefined equal == each other and do not equal any other value.
* Be careful when using comparisons like > or < with variables that can occasionally be null/undefined. Checking for null/undefined separately is a good idea.

[**Tasks**](https://javascript.info/comparison#tasks)

**[Comparisons](https://javascript.info/comparison" \l "comparisons)**

**importance: 5**

What will be the result for these expressions?

5 > 4

"apple" > "pineapple"

"2" > "12"

undefined == null

undefined === null

null == "\n0\n"

null === +"\n0\n"

**solution**

5 > 4 → true

"apple" > "pineapple" → false

"2" > "12" → true

undefined == null → true

undefined === null → false

null == "\n0\n" → false

null === +"\n0\n" → false

Some of the reasons:

1. Obviously, true.
2. Dictionary comparison, hence false. "a" is smaller than "p".
3. Again, dictionary comparison, first char "2" is greater than the first char "1".
4. Values null and undefined equal each other only.
5. Strict equality is strict. Different types from both sides lead to false.
6. Similar to (4), null only equals undefined.
7. Strict equality of different types.

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