Organic boron compounds play increasing role in various areas of science and technology. Recently, they are widely used in modern synthesis as convenient and easily accessible tarting materials for the preparation of complex organic molecules featuring special properties. In 2010, the Nobel Prize in chemistry was awarded to Prof. Akira Suzuki from Japan for the discovery of the so-called Suzuki-Miyaura cross-coupling reaction, which is very popular method enabling relatively simple synthesis of many useful substances, *e.g.*, pharmaceuticals or conductive polymers. In addition, there are also great hopes surrounding studies on biological applications and direct application of boron compounds in medicine. A good example is *Boron-Neutron Capture Therapy* (BNCT) used for the treatment of brain cancer. Boron-based compounds have a unique physicochemical properties that allows them to have two distinct shapes, giving them the ability to interact with biological targets in specific ways and to address targets not amenable to intervention by traditional, carbon-based compounds. In last years, a strong interest of researchers is focused on benzoxaboroles – a group of boracyclic compounds composed of two fused rings. They consist of the benzene and the five-membered oxaborole rings; the latter possessing boron and oxygen atoms. It was found, that some benzoxaboroles exhibit high antifungal, antibacterial, antiparasitic, and anti-inflammatory activity, while simultaneously retaining low toxicity. Potential applications of these compounds include the treatment of important diseases such as sleeping sickness, malaria and fungal infections. One of these compounds, *Tavaborole* (*AN2690*, trade name *Kerydin*) was approved in 2014 as a topical antifungal drug for the treatment of *Onychomycosis* – a fungal infection of the nail and nail bed. Later on, another derivative *Crisaborole* (trade name *Eucrisa*) was approved as a nonsteroidal topical medicines for the treatment of mild-tomoderate atopic dermatitis (eczema). Another boraheterocyclic compound with high antibacterial activity is *Vaborbactam* - an inhibitor of enzymes decomposing carbapenems - "the last-chance antibiotics". *Vaborbactam* was approved for the treatment of severe, complicated urinary tract infections caused by *Enterobacteriaceae*. In the clinical trials there are further compounds with a similar chemical structure presenting activity against Gram-negative bacilli. This is another argument for the advisability of further testing of this type of substances. Despite the high potential application of boron-based compounds, their evaluation as product candidates has been hampered by an insufficient understanding of their physical properties and limited methods for their synthesis. This project deals with the synthesis and studies on the physicochemical and biological properties of selected groups of heterocyclic compounds containing the boron atom in one of rings (this ring is fused with an aromatic ring). The project is focused on evaluation of their antimicrobial activity. Research aimed at the development of novel classes of biologically active substances featuring antibacterial and antifungal properties is of high priority and significance. This is due to an increasing resistance of bacterial strains against currently used antibiotics. It is also planned to examine the properties of the compounds obtained as inhibitors of enzymes responsible for the resistance of bacteria to drugs and as inhibitors of membrane pumps removing from the cell the harmful substances for bacteria, including antibiotics. Recently, we have obtained preliminary and promising results concerning biological properties of compounds bearing silicon and oxygen atoms in the boracyclic ring. It is therefore worth not only to continue but also to extend this research, especially in the areas related to medical and bioanalytical chemistry. These studies would also include compounds of similar structure containing, among others, phosphorus atom in the boric cyclic ring.